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Efficacy of Northern Organic Fertiliser on Sustainable Sugarcane Production in Bangladesh

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A field study was conducted to evaluate the efficacy of northern organic fertiliser on sugarcane yield and economic return at Ishurdi (High Ganges River Flood Plain) and Thakurgaon (Old Himalayan Piedmont Plain) sites in Bangladesh. Results revealed that the combined use of northern organic fertiliser @ 750 kg per hectare and 75 per cent recommended inorganic fertilisers gave higher average sugarcane yield of 72.33 tonnes and the highest net economic benefit of Taka 27653 per hectare with benefit cost ratio of 1.52 from the sites under study. The average yield increase from that was 142.4 per cent over control and 4.7 per cent over recommended inorganic fertiliser alone.

Keywords: *Efficacy, northern organic fertiliser, sustainable, sugarcane, production*

Sugarcane (*Saccharum officinarum*) is one of the most important agro-industrial crops in Bangladesh. It is the only source of white sugar in Bangladesh, cultivated over an area of about 0.41 million hectares annually with an average low yield of 41.2 tonnes per hectare (BBS, 2004). Such yield is considered low as compared to 60 tonnes per hectare (national target). Being a long duration and heavy feeder of nutrients it uptakes considerable amount of nutrients from the soil. As a result, the nutrient supplying capacity of soil in sugarcane growing areas of Bangladesh is gradually declining each day that creating problems to achieve higher productivity of sugarcane till recently. It is generally agreed that the combined use of organic and inorganic fertilisers can improve cane production and maintain soil health. Many important soil properties are dependent to some degree on the quantity of organic matter (OM) (Black, 1965). Parthasarathy (1972) reported that a field having adequate or optimum quantities of organic matter, such fields rarely deteriorate in productivity of any crop. Rabindra *et al.* (1990) reported that continuous application of farmyard manure along with NPK fertiliser improves the physical and chemical properties of soil, as well as cane yield and juice quality. Paul *et al.* (1999) also reported that the use of cake-o-meal, a blended organic and inorganic fertiliser, produced higher sugarcane yield in Old Himalayan Piedmont Plain soils of Bangladesh. It revealed that the application of northern organic fertiliser with recommended inorganic fertiliser significantly increased sugarcane yield (Paul *et al.*, 2005a). Sustainable crop production can never be achieved by using either chemical fertiliser alone or by applying only organic manure (Bair, 1990). Thus, considering the above facts a study was conducted with the following objectives:

a) To evaluate the efficacy of northern organic fertiliser on sugarcane yield.

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b) To study the productivity and profitability of northern organic fertiliser for sustainable sugarcane production.

MATERIALS AND METHODS

A field study was conducted in two sites at Ishurdi under High Ganges River Flood Plain and Thakurgaon under Old Himalayan Piedmont Plain soils of Bangladesh. It was laid out in randomised complete block design with four replications. The treatment wise different rates of organic and inorganic fertiliser at two sites are presented in *Table 1*. The unit plot size was 8 m x 6 m. Five treatments were included in the study. They were as follows: T_1: Control (no fertiliser), T_2: Recommended fertiliser dose (RFD) as per Bangladesh Sugarcane Research Institute Guide'98, T_3: Northern organic fertiliser @ 750 kg /ha + 50% RFD, T_4: Northern organic fertiliser @ 750 kg /ha + 75% RFD and T_5: Northern organic fertiliser @ 750 kg/ha + 100% RFD. It was planted in early December 2005 and was harvested after full maturity of the crop in January 2007. Three budded setts of Isd 34 were used as test material. N as urea and K as muriate of potash were applied in three equal splits, first at 20-30 days after transplanting, second at peak tillering stage and finally after one month of second top dressing. Full amount of triple super phosphate, gypsum, zinc sulphate, magnesium oxide and northern organic fertiliser were applied in the trenches and mixed thoroughly with soil by spade. All the recommended cultural management practices were followed as and when required. The major nutrient contents of northern organic fertiliser are given in *Table 2*. Initial and post harvest soils at the depth of 0-15 cm were collected and analysed following standard procedure. Necessary data were recorded and analysed using the Least Significant Difference Test (LSD) at P=0.05. Cost and return analysis of

TABLE 1
AMOUNT OF INORGANIC AND NORTHERN ORGANIC FERTILISERS USED IN DIFFERENT TREATMENTS

Location	*Treatment*	*Nutrient (kg/ha)*						*NOF (kg/ha)*
		N	*P*	*K*	*S*	*Zn*	*Mg*	
Ishurdi	T_1: Control	-	-	-	-	-	-	-
	T_2: Recommended fertiliser rate (as per BSRI'98)	150	52	90	34	3	-	750
	T_3:	75	26	45	17	1.5	-	750
	T_4:	112	39	68	26	2	-	750
	T_5:	150	52	90	34	3	-	750
Thakurgaon	T_1: Control	-	-	-	-	-	-	-
	T_2: Recommended fertiliser rate (as per BSRI'98)	120	38	100	25	2	20	750
	T_3:	60	19	50	13	1	10	750
	T_4:	90	28	75	18	1.5	15	750
	T_5:	120	38	100	25	2	20	750

BSRI= Bangladesh Sugarcane Research Institute, NOF =Northern Organic Fertiliser

TABLE 2
MAJOR NUTRIENT CONTENTS OF NORTHERN ORGANIC FERTILISER USED IN THE STUDY

Name of fertiliser	*Nutrient content (%)*						
	OM	*N*	*P*	*K*	*S*	*Ca*	*Mg*
Northern organic fertiliser	15.0	4.0	1.15	1.5	1.0	2.5	0.75

different treatments were calculated on the basis of prevailing market prices during the study period.

RESULTS AND DISCUSSION

Ishurdi site

Sugarcane yield

Evaluating the results reported in *Table 3*, it is evident that the combined application of northern organic fertiliser with 75 per cent recommended inorganic fertilisers significantly increased yield over control. The treatment T_4 having integrated application of 75 per cent recommended inorganic fertilisers along with northern organic fertiliser at 750 kg per hectare produced higher sugarcane yield of 82.12 tonnes per hectare among all other treatments but the effect was identical except control. The second highest sugarcane yield of 76.50 tonnes per hectare was obtained from T_5 that with 100 per cent recommended inorganic fertilisers and the effect was identical for all. Integrated application of northern organic fertiliser along with 75-100 per cent recommended inorganic fertilisers gave 4.4 per cent and 76.2 per cent higher cane yields over

TABLE 3
YIELD AND YIELD CONTRIBUTING PARAMETERS OF SUGARCANE AS INFLUENCED BY DIFFERENT FERTILISER TREATMENTS

Locations	*Treatments*	*Tillers ($\times 10^3$/ha)*	*Millable cane ($\times 10^3$/ha)*	*Yield (t/ha)*	*Pol (%)*
Ishurdi	T_1	165.80b	126.02b	60.64b	11.62
	T_2	235.40a	181.30a	77.03ab	10.82
	T_3	212.70a	176.85a	74.17ab	11.08
	T_4	226.70a	189.63a	82.12a	10.70
	T_5	228.20a	187.13a	76.50ab	10.77
	$LSD_{(0.05)}$	28.62	16.19	20.06	ns
Thakurgaon	*Treatments*	*Tillers ($\times 10^3$/ha)*	*Millable cane ($\times 10^3$/ha)*	*Yield (t/ha)*	*Brix(%)*
	T_1	89.11b	23.24b	21.24b	17.52
	T_2	186.40a	64.32a	62.51a	18.35
	T_3	194.40a	57.51a	57.51a	17.85
	T_4	205.10a	64.54a	62.54a	17.53
	T_5	203.80a	68.12a	68.20a	17.74
	$LSD_{(0.05)}$	22.79	13.79	14.06	ns

recommended inorganic fertilisers alone and control, respectively. Nutrient management option following integrated application with northern organic fertiliser and 75-100 per cent recommended inorganic fertiliser was found more effective in respect of increasing cane yield. Similarly, Paul *et al.* (2004a) reported that OM amended soils increased microbial biomass C and N contents in soil resulted in higher cane yield. Singh *et al.* (1995) reported that application of press mud alone or in combination with inorganic N fertiliser improved cane yield and quality of plant and ratoon crops. The present findings are supported with the results found by many investigators (Bokhtiar *et al.*, 2001; Paul *et al.*, 2004b). Paul *et al.* (2005b) demonstrated that the integrated application with 50-75 per cent recommended inorganic fertiliser and organic manure at 10-20 tonnes per hectare gave the highest net economic benefit per hectare. Paul *et al.* (2005a) further supported our findings where they confirmed that the integrated application with 75-100 per cent recommended inorganic fertiliser and northern organic fertiliser gave higher economic benefit and benefit cost ratio (BCR) from a unit land of sugarcane cultivation in Bangladesh.

Soil fertility status

The status of soil pH, organic carbon, total N, available P, K and S in initial and post harvest soil as influenced by different fertiliser management options are presented in *Table 4*. No perceptible changes were observed in soil characteristics due to the use of varying fertiliser options. However, a little positive change in organic C, total N, available P and S balance in soil was remarked for the combined use of northern organic and inorganic fertilisers but it was not conspicuous. Similar results were obtained by many investigators (Bokhtiar *et al.*, 2001; Islam *et al.*, 1998; Paul *et al.*, 2005a).

Thakurgaon site

Sugarcane yield

From the results presented in *Table 3*, it is evident that the combined application of northern organic fertiliser with 75-100 per cent recommended inorganic fertilisers significantly increased yield over control. The treatment T_5 having integrated application of 100 per cent recommended inorganic fertilisers along with northern organic fertiliser at 750 kg per hectare produced higher sugarcane yield of 68.20 tonnes per hectare among all other treatments but the effect was identical except control. The second highest sugarcane yield of 62.50 tonnes per hectare was obtained from T_4 that with 75 per cent recommended inorganic fertilisers. Integrated application of northern organic fertiliser along with 75-100 per cent recommended inorganic fertilisers gave 5.0 per cent and 208.0 per cent higher cane yields over recommended inorganic fertilisers alone and control, respectively. Nutrient management option following integrated application with northern organic fertiliser and 75-100 per cent recommended inorganic fertiliser was found more effective in respect of increasing cane yield. Similarly, Paul *et al.* (2005c) reported that OM amended soils increased microbial biomass C and N contents in soil resulted in higher cane yield. Singh *et al.* (1995) reported that application of press mud alone or in combination with inorganic N fertiliser improved cane yield and quality of plant and ratoon crops. Many investigators corroborated the results of our present study (Bokhtiar *et al.*, 2001; Paul *et al.*, 2005b, d). Paul *et al.* (2005a) further supported our findings where they confirmed that the

integrated application with 75-100 per cent recommended inorganic fertiliser and northern organic fertiliser gave higher sugarcane yield from a unit land of sugarcane cultivation.

Soil fertility status

The status of soil pH, organic carbon, total N, available P, K and S in initial and post harvest soil as affected by different fertiliser treatments are reported in *Table 4*. No perceptible changes were observed in soil characteristics due to the use of varying fertiliser treatments. However, a remarkable positive change in organic C and a little positive change in total N, available P and S balance in soil were noted for the combined use of northern organic and inorganic fertilisers. Similar results were obtained by many investigators (Bokhtiar *et al.*, 2001; Islam, *et al.*, 1998; Paul *et al.*, 2005d).

Cost and return analysis of the study

From the results reported in *Table 5*, it is evident that gross return increased with increase in cane yield at both the sites under study. It further demonstrated that the highest average net benefit of Taka 27653 per hectare with benefit cost ratio 1.52 was obtained from T_4 that received northern organic fertiliser and 75 per cent recommended inorganic fertiliser. The second highest average net benefit of Taka 26627 per hectare with benefit cost ratio 1.52 was found from T_2, where 100 per cent recommended inorganic fertilisers was applied alone. Similarly many researchers supported our results where they found higher economic return from the integrated application of organic and inorganic fertilisers in sugarcane production (Bokhtiar *et al.*, 2001; Iskam *et al.*, 1998; Paul *et al.*, 2005a, b, d).

CONCLUSIONS

It may be concluded that the integrated application with 75 per cent recommended inorganic fertilisers and northern organic fertiliser at 750 kg per hectare confirmed higher average sugarcane yield of 72.33 tonnes with the highest net economic benefit of Taka 27653 per hectare with benefit cost ratio of 1.52 at the sites under study. The average yield increase from that was 142.4 per cent over control and 4.7 per cent over recommended inorganic fertiliser alone. Thus, the combined application with northern organic fertiliser and 75 per cent recommended inorganic fertiliser would be cost effective for sustainable sugarcane yield and soil fertility in the study locations.

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TABLE 4
STATUS OF INITIAL AND POST HARVEST SOIL OF EXPERIMENTAL SITES AFFECTED BY DIFFERENT FERTILISER TREATMENTS FOR SUGARCANE PRODUCTION

Sites	*Treatment*	*Analytical value*					
		pH	*Organic carbon (%)*	*Total N (%)*	*Available P (ppm)*	*Exchangeable K (meq /100 g soil)*	*Available S (ppm)*
Ishurdi	Initial soil	7.75	0.60	0.065	9.00	0.14	18.00
	Post harvest						
	T_1	7.65	0.59	0.050	6.50	0.11	15.00
	T_2	7.65	0.61	0.065	6.50	0.12	17.00
	T_3	7.60	0.64	0.067	7.00	0.12	17.00
	T_4	7.65	0.64	0.067	7.30	0.12	17.20
	T_5	7.71	0.58	0.070	7.30	0.11	20.00
Thakurgaon	Initial soil	5.40	1.42	0.070	15.00	0.15	16.00
	Post harvest						
	T_1	5.33	1.37	0.053	11.67	0.10	10.50
	T_2	5.34	1.45	0.060	13.67	0.15	14.00
	T_3	5.30	1.40	0.070	14.00	0.14	14.00
	T_4	5.37	1.46	0.067	14.00	0.13	14.50
	T_5	5.32	1.39	0.070	14.33	0.14	14.00

TABLE 5
ECONOMIC ANALYSIS OF DIFFERENT FERTILISER TREATMENTS FOR SUGARCANE PRODUCTION (AVERAGE OF TWO SITES)

Treatments	*Yield (t/ha)*	*Fertiliser cost(Tk./ha)*	*Total cost (Tk./ha)*	*Return (Tk./ha)*	*Net benefit (Tk./ha)*	*BCR*
T_1	40.94	-	42965	46058	3093	1.07
T_2	69.27	8337	51302	77929	26627	1.52
T_3	65.84	8669	51634	74070	22436	1.43
T_4	72.33	10753	53718	81371	27653	1.52
T_5	72.35	12837	55802	81383	25581	1.46

Price (Taka /kg):
Input: Urea-6.50, TSP-14.00, MP-9.50, Gypsum-4.00, Zinc sulphate-60.00, MgO-40.00, Northern organic fertiliser-6.00
Output: Sugarcane-1.125
USD~ Taka 68.00

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