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Combined Application of Organic and Inorganic Fertilizer for Sustainable Sugarcane Production

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ABSTRACT

A field study was conducted over two consecutive years to determine the appropriate combination of organic and inorganic fertilizer dose for achieving higher sugarcane yield and proper soil fertility status at the High Ganges River Floodplain soils in Bangladesh. Results revealed that the combined application of 2/3rd of recommended fertilizer dose plus pressmud @ 10 t ha^{-1} gave the highest sugarcane yield of 68.45 t ha^{-1} and 64.11 t ha^{-1} followed by 68.38 t ha^{-1} and 63.59 t ha^{-1} where 2/3rd of recommended fertilizer dose plus farmyard manure @ 10 t ha^{-1} was applied in 2007-08 and 2008-09 cropping seasons, respectively. Thus, the combined application of 2/3rd of recommended fertilizer dose either with pressmud @ 10 t ha^{-1} or farmyard manures @ 10 t ha^{-1} would be beneficial for sustainable production sugarcane.

Key words: Combined, organic, inorganic, fertilizer, sugarcane

INTRODUCTION

Sugarcane is a long duration exhaustive crop having a high demand of nutrients for its high dry matter production per unit area. It produces heavy tonnages and removes large amounts of nutrients from soil. Sugarcane soil is loosing its inherent nutrients supply capacity for intensive cropping with high yielding varieties, little use of organic materials and improper soil management. As a result, crops suffer from inadequate of nutrients, which is reflected in poor yield and quality of the cane. Thus, there is a need to add nutrients to the soil through organic and inorganic fertilizers in order to get desired yields. Sugarcane is grown in the soils having sufficient level of organic matter and available nutrients (Islam *et al.*,1995). But the organic matter content in Bangladesh soils is far below (~ 1-2%) than crop requirement and it is depleting day by day (Mia *et al.*,1993). Some organic and factory wastes viz., poultry manure, cattle manure and press mud are easily available in Sugar Mills Zones of Bangladesh. They could play role in satisfying the high demand of nutrients for sustained production of sugarcane in our poor soils maintaining a good nutrient balance. Bokhtiar *et al.* (2004) reported that continuous application of farmyard manure along with NPK fertilizer improved physio-chemical properties of soil, cane yield and juice quality. In Africa, soil structure and fertility is maintained or enhanced by the use of animal manure, compost, farm wastes and green manure (Vanlauwe *et al.*, 2001). Moreover, organic farming is becoming more popular in the country because of its balanced supply of macro and micro nutrients essential for healthy growth and development of crop plant. Hence, an attempt has been undertaken to bring out the possibility of using these organic manures with inorganic fertilizers for sustaining sugarcane productivity in Bangladesh.

MATERIALS AND METHODS

A field trial was conducted in High Ganges River Floodplain of AEZ 11 at farmer's field of Mirpur under Kushtia districts during 2007-08 and 2008-09 cropping season to find out the efficacy of combined application of organic and inorganic fertilizer for sustainable sugarcane production. It was laid out in RCBD with four replications. The experiments comprised of five treatments viz., T_1 –Control (No fertilizer and manure), T_2- Full Recommended Fertilizer Dose (RFD) as per FRG'2005, T_3 –2/3rd RFD + Poultry litter @5 t/ha, T_4 - 2/3rd RFD + Farm yard manure @10 t/ha , T_5 –2/3rd RFD + Press mud @10 t/ha. The small plot size was 6m x 8 m. Variety Isd 37 was taken as test crop. Forty five day old two-budded soil bed settling was planted. Poultry litter, Farm yard manure and Press mud were applied in the trenches and thoroughly mixed with soil by spade before seven days of plantation. Full amount of triple super phosphate, gypsum, zinc sulphate and one-third of urea and muriate of potash were applied as basal in the trenches and thoroughly mixed with soil by spade. Rest amount of urea and muriate of potash were top-dressed in two equal splits at 120 and 180 days after plantation. Soil pH was measured in a 1:2.5 soil water suspension by glass electrode pH meter. Total N was determined by macro Kjeldahl procedure and organic carbon by Walkley and Black method. Available soil P was extracted with 0.5M $NaHCO_3$ and the amount was determined by Spectrophotometry. Exchangeable K (1N NH_4OAc extractable) was determined by flame photometry and available S by turbidimetric method (Black 1965) for soil. All the recommended cultural management practices were done as and when required. Crop was harvested after 14 months of transplantation at full maturity of the crop. Data on number of tillers, millable canes, yield and brix per cent were recorded. Interpretations of data were given on the basis of statistical analysis and were presented in Table 2. Initial and post harvest soil nutrient status was given in Table 1.

RESULTS AND DISCUSSION

Cane yield and other parameters

Results on yield and its components like tiller number, millable cane stalk, yield and Brix of cane are presented in Table 2. Application of organic and inorganic fertilizer showed significantly better response in terms of increased number of tiller, millable cane, and cane yield but there was no significant effect on brix per cent in both the cropping seasons. During 2008-09, significantly higher (177.3 $\times 10^3$ ha^{-1}) number of tiller was obtained from T_3 treatment having 2/3rd RFD with poultry litter @5 t/ha except, T_4 . These results are in agreement with those of Paul *et al.(*2008),Soumare *et al.* (2003) and Jadoon *et al.* (2003) who found beneficial effect of combined application of organic and inorganic fertilizer in sustaining soil fertility and crop productivity. Significantly higher number of millable cane (79.20 $\times 10^3$ ha^{-1}) was recorded from T_4 treatment having 2/3rd RFD with farm yard manure @10 t/ha, but that was statistically similar with T_5 and T_2 treatments. The lowest number of millable cane (55.72 $\times 10^3$ ha^{-1}) was recorded from control. However the treatment T_5 produced significantly higher cane yield (68.45 TCH) over all other treatments, but it was identical with T_4 and T_2. This results are at par with Agboola (1975) and Daliparthy *et al.* (1994) who reported the ability of cow dung in improving the soil structure and aeration thereby reducing leaching of inorganic fertilizer applied consequently leading to the increase in crop yield. The results are also in close conformity with the findings of many researchers who reported that integrated use of inorganic fertilizer and organic manure resulted in higher sugarcane yield (Singh and Singh, 2002; Paul *et al.*, 2005a,b)

On the other hand during 2007-08 significantly higher (133.9 $\times 10^3$ ha^{-1}) number of tiller was obtained from T_4 treatment having 2/3rd RFD with farm yard manure @10 t/ha. Significantly higher number of millable cane (79.68 $\times 10^3$ ha^{-1}) was recorded from T_5 treatment having 2/3rd RFD with press mud @10 t/ha, but that was statistically similar with T_4 and T_3 treatments, which also corroborated with the findings of Bokhtiar *et al.* (2004, 2008). The lowest number of millable cane (61.35×10^3 ha^{-1}) was recorded from control. Treatment T_5 produced the highest cane yield (64.11 TCH), but it was identical with all other treatments except control. The findings supported the results found by many investigators (Paul *et el.*, 2008; Bhalerao *et el.*, 2006). Gana (2008) further confirmed our findings who reported that organic and inorganic fertilizers had positive influence on cane yield.

Soil nutrient status after sugarcane harvest

The soils under study were very low in total N, available P and exchangeable K but high in available S. Application of different treatments with organic and inorganic fertilizers slightly improved soil nutrient status except N contents of soils after harvesting of sugarcane(Table 1).

It may be concluded that the combined use of either pressmud or farmyard manure @10 t ha^{-1} with 2/3rd recommended dose of inorganic fertilizer may be suggested for higher sugarcane yield and maintenance of soil fertility in High Ganges River Floodplain (AEZ 11).

Table 1. Status of initial and post harvest soils of the experiment.

Crop year	Treatments	Nutrient status					
		pH	OC (%)	N (%)	P (µg/g)	K (meq %)	S (µg/g)
2008 -2009	Initial soil	7.50	0.71	0.06	12.0	0.16	21.0
	Post harvest soil						
	T_1	7.50	0.60	0.05	8.0	0.14	20.5
	T_2	7.55	0.64	0.05	12.0	0.17	24.5
	T_3	7.57	0.70	0.05	12.5	0.18	22.0
	T_4	7.54	0.71	0.06	19.0	0.15	23.5
	T_5	7.53	0.68	0.06	16.5	0.17	21.0
	T_6	7.55	0.60	0.05	18.0	0.18	20.5
2007-2008	Initial soil	7.60	0.74	0.07	13.0	0.18	22.5
	Post harvest soil						
	T_1	7.55	0.60	0.05	8.0	0.14	20.5
	T_2	7.60	0.63	0.05	13.0	0.18	21.5
	T_3	7.57	0.65	0.06	12.5	0.16	22.0
	T_4	7.54	0.70	0.06	18.0	0.15	23.5
	T_5	7.53	0.67	0.05	16.5	0.17	22.0
	T_6	7.55	0.61	0.05	18.0	0.14	21.5

Table-2. Cane yield and other parameters as affected by organic and inorganic fertilizer

Cropping year	Treatment	Tiller (x $10^3 ha^{-1}$)	Millable cane ($\times 10^3$) ha^{-1}	Brix (%)	Yield (TCH)
2008-2009	T_1 –Control	135.7 c	55.72 c	18.75	37.10 c
	T_2- RFD as per FRG' 2005	158.8 b	74.47 ab	18.59	65.99 ab
	T_3 –2/3rd RFD + Poultry litter @5 t/ha	177.3 a	71.76 b	18.63	63.90 b
	T_4 - 2/3rd RFD + Farm yard manure @10 t/ha	173.6 a	79.20 a	18.20	68.38 a
	T_5 –2/3rd RFD + Press mud @10 t/ha	162.7 b	77.23 ab	18.50	68.45 a
	LSD (0.05)	10.01	5.242	ns	3.676
2007-2008	T_1 –Control	78.75 d	61.35 c	20.85	46.40 b
	T_2- RFD as per FRG' 2005	97.50 b	67.28 bc	20.63	60.10 a
	T_3 –2/3rd RFD + Poultry litter @5 t/ha	85.10 cd	73.27 ab	20.75	61.72 a
	T_4 - 2/3rd RFD + Farm yard manure @10 t/ha	133.9 a	78.85 a	20.75	63.59 a
	T_5 –2/3rd RFD + Press mud @10 t/ha	91.14 bc	79.68 a	20.63	64.11 a
	LSD (0.05)	10.88	10.16	ns	9.801

In a column, the figures having same letter do not differ significantly as per DMRT at 5% level.

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