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Contribution of Rice Mill Ash and Pressmud with Inorganic Fertilizers on the Productivity of Sugarcane

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ABSTRACT

The experiment was conducted during 2002-03 cropping season at Bangladesh Sugarcane Research Institute, Ishurdi farm under the High Ganges River Floodplain soils (AEZ-11). It comprised of eight treatments. Results indicated that growth parameters viz; number of tiller, millable canes and yield of cane responded significantly over control, while unit stalk weight, girth, height and all the quality parameters showed non significant effect for different treatment combination. Highest yield of cane (106.3 t ha^{-1}) was obtained from the treatment T_4 where recommended dose of fertilizer (N_{130}, P_{33}, K_{60}, S_{20}, Zn_3 kg ha^{-1}) with pressmud @ 5.0 t ha^{-1} was applied. Again the treatment T_2 having that recommended dose of fertilizers with rice mill ash @ 8 t ha^{-1} also showed better performance in yield (102.2 t ha^{-1}) and yield attributing parameters of sugarcane. Highest gross margin of Tk 112593 and BCR of 2.92 were obtained from the treatment T_4. Treatment T_2 also performed better regarding gross margin (Tk.107680.0) and BCR (2.80). It was further observed that organic matter, total N, available P, K and S were built up a little in treatments where pressmud or rice mill ash were applied with inorganic fertilizers.

Key word: Rice Mill Ash, pressmud, plant nutrients and sugarcane

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.), is a long duration crop with high requirements of nutrients. It removes considerable amount of nutrients from soil. Proper soil fertility management is of prime importance in an endeavor to increase sugar productivity. Balanced use of organic and inorganic fertilizer is very essential for the stable soil fertility where nutrient turn over in the soil plant system is faster and larger. Yield of sugarcane increases in the soils with sufficient level of organic matter and available nutrients (Islam *et al.*, 1995). Kumar and Mishra (1992) reported that application with suitable combinations of organic and inorganic nutrients increased fertilizer use efficiency and sugar yield.

In Bangladesh generally ash has no use as manure in agriculture. However, it is used as insect repellent. Due to this property a little amount of ash is used in vegetable cultivation and seed bed preparation. In rural areas of Bangladesh cooking of foods mostly depends on woods, fallen leaves, herbs, rice bran and on cake of cow dung. As such a huge amount of ash is produced annually. It was found that ash is enriched in plant nutrients. It was found that in house hold ash 0.5-1.9% N, 1.6-4.2% P and 2.3-12%

K is present and in wood ash 0.1-0.2% N, 0.8-5.9%P and 1.5-36.0% K is present (Gupta 1999). So ash may be used as good manure in agriculture. Paul et al (2005a) reported highest yield of sugarcane and net economic benefit with the application of 75% recommended inorganic fertilizers along with both rice mill ash and pres mud @ 10 t ha^{-1}. Paul *et al* (2005b) also reported highest yield of cane, economic benefit and better apparent nutrient balance in soil with the combined application of inorganic fertilizers along with pressmud and rice mill ash in sugarcane ratoon production.

Pressmud is an organic by-product of sugar mills and a rich source of organic carbon (35-37%) and supplies 1.0-1.5% N, 1.09-1.53% P and 0.25-0.66% K as reported by Kale (1981). Bangladesh is producing about 0.85 million tons of sulphitation press mud every year from sulphitation process. For sustainability in sugarcane and sugar production, neither inorganic fertilizers nor organic manures alone but their integrated use has been observed to be highly beneficial (Yadav and Sharma 1981 and Bangar *et al.*, 1994). Therefore, this investigation was undertaken to develop an economically suitable combination of organic (ricemill ash and pressmud) and inorganic fertilizers in supplementing potassium and on the productivity of sugarcane.

MATERIALS AND METHODS

The experiment was conducted during 2002-03 cropping season at BSRI farm under the High Ganges River Floodplain soils (AEZ-11). The experiment comprised the following treatment laid out in a randomized complete block design having unit plot size of (8m x 6m) with four replications. Sugarcane variety 'Isd-31' was used as test crop. Treatment of the experiment was as follows:

Table1. Treatments details of the experiments

Treatments code	Details
T_0	Control (No fertilizer and manure)
T_1	RFD based on FRG' 97 ($N_{130}P_{33}K_{60}S_{20}Zn_3$)
T_2	RFD + Rice mill ash @ 8 t ha^{-1}
T_3	RFD-K + Rice mill ash @ 8 t ha^{-1}
T_4	RFD + Pressmud @ 5 t ha^{-1}
T_5	RFD-K + Pressmud @ 5 t ha^{-1}
T_6	RFD + Rice mill ash @ 4 t ha^{-1} + Pressmud @ 2.5 t ha^{-1}
T_7	RFD -K + Rice mill ash @ 4 t ha^{-1} + Pressmud @ 2.5 t ha^{-1}

Pressmud and rice mill ash of relevant treatment were applied and mixed properly in soils before planting. Forty five days old 2 budded soil bed settling of variety Isd 31 were transplanted in November, 2002. Soil samples were collected from the experimental plots before transplanting of sugarcane seedlings and later analyzed for nutrient status. Soil pH was measured in soil: water suspension at 1: 2.5 by glass electrode. Total N by Kjeldahl method (Jackson, 1973); organic carbon by Wakly and Black wet oxidation method; available P ($NaHCO_3$ extractable) by standard ammonium molybdate method of Olsen; exchangeable K (NH_4OAc extractable) by flame photometer; and available S (NH_4OAc

extractable) by terbidimetric method of Bardsley and Lancaster (Black, 1965). Press mud and rice mill ash were also analysed to know their nutrient status (Table 2).

Table 2. Mean composition of organic materials used in the experiment (on oven dry basis)

Characteristics	Organic material	
	Pressmud	Ricemill ash
Moisture (%)	55.95	39.17
pH	5.8	8.19
OC (%)	19.5	1.10
Total N (%)	2.35	-
Available P (%)	0.13	0.12
Exchangeable K (%)	0.54	1.02
Available S (%)	0.56	0.09

Abbreviation: OC = Organic carbon

Phosphorus (P) as triple super phosphate (TSP), S as gypsum and Zn as zinc sulphate were applied at a time in trenches; N as urea and K as muriate of potash (MP) were applied in two splits, first after establishment of setts and second at tillering completion stage. After the final land preparation, 45 days old two eyed soil bed settlings were transplanted in late November at 1.0 m between row spacing. After transplanting of settling a live irrigation was given. Further two irrigations were given at 7 days and 15 days after transplanting for the establishment of settlings. Necessary intercultural operations and both chemical and mechanical control of insect pests and diseases were done as recommended practice. Data on number of tillers, millable canes, height of cane, girth of cane and brix per cent were recorded and their interpretations were given on the basis of statistical analysis.

RESULTS AND DISCUSSION

Yield and yield attributes:

Data on yield attributing parameters of sugarcane viz; tillers, millable cane, unit stalk weight, girth of cane, height of cane and cane yield are presented in Table 3. Significant effect of imposed treatments on number of tiller, millable canes and cane yield whereas, non significant effect on height, stalk weight and girth of cane were recorded. Highest number of tillers (184.6 x10^3 ha^{-1}) was found in T_2 treatment where recommended dose of NPKS & Zn fertilizer plus rice mill ash @ 8.0 t ha^{-1} were applied this was followed by T_4 (183.1 x 10^3 ha^{-1}) treatment (RFD + press mud @ 5 t ha^{-1}). These findings were in accordance with Paul *et. al* (2005a) and Paul *et al* (2005b) where maximum tillers was observed with the application of rice mill ash and pressmud in combination of 75% recommended dose of fertilizer. Treatment T_1 (RFD based on FRG'97), T_3 (RFD-K + Rice mill ash @ 8 t ha^{-1}), T_5 (RFD-K + Pressmud @ 5 t ha^{-1}) and T_6 (RFD-K + Rice mill ash @ 4 t ha^{-1}+ Pressmud @ 2.5 t ha^{-1}) showed statistically similar results with T_4. Again, the treatment T_7 was statistically similar to T_1, T_3, T_5 and T_6 regarding tiller production. The lowest number of tiller was obtained from the treatment T_0 (control). Significant increase in number of millable canes over control was found due to different treatment

combination. This supports the findings of Paul *et.al.* (2005a). All the treatment combinations except control showed statistically similar effect among them regarding millable cane production. Highest cane yield (106.3 t ha^{-1}) was found in T_4 treatment where recommended dose of fertilizer along with pressmud @ 5 t ha^{-1} were applied being followed by T_2 (102.2 t ha^{-1}), T_1 (100.8 t ha^{-1}) and T_6 (100.2 t ha^{-1}) The lowest yield of cane (38.7 t ha^{-1}) was obtained from the control. This supports the findings of Paul *et al* (2005a) and Paul *et al* (2005b) where higher yield of sugarcane was obtained with the application of pressmud and rice mill ash in combination of recommended dose of inorganic fertilizers.

Juice quality parameters:

From Table 4 it reveals that Juice quality parameters like percent of brix, pol in juice, purity and recovery percent of sugar increased slightly over control due to different treatment combination but the difference was not significant. This corroborates the findings of Paul et al (2005a) and Paul et al (2005b).

Economic aspects:

The results presented in the Table 5 reveals that all the fertilizer manure combination treatment increased the gross margin progressively over control (no fertilizer). The highest gross margin was obtained from the treatment T_4 (Tk. 112593.0) where recommended dose of NPKS & Zn fertilizer plus pressmud @ 5.0 t ha^{-1} were applied. The second highest gross margin was recorded from T_2 (Tk. 107680.0) where recommended dose of NPKS & Zn fertilizer plus rice mill ash @ 8.0 t ha^{-1} were applied. The third highest gross margin was recorded in treatment T_1 (Tk. 106905.0) where recommended dose of NPKS & Zn fertilizer were applied. Highest BCR of 2.92 was noted in treatment T_4 while the second highest of 2.81 was obtained form T_1. The treatment T_2 produced the 3rd highest BCR of 2.80.

Soil fertility changes:

The changes in chemical properties of soil ie, the soil properties before and after the execution of the treatments are presented in Table 6. Use of pressmud and rice mill ash in combination with inorganic fertilizer increased soil N, P, K and S. It maintained and renewed organic matter and improved physico-chemical properties of soil, cane yield and juice quality as reported by several workers (Bokhtiar, S M. 2004; Alam *et al.*, 1997; Jiao 1983). The results in the present study revealed that organic matter, total N, available P, K and S were built up in treatments where pressmud and rice mill ash were applied with inorganic fertilizers.

From the above discussion it may be concluded that considering yield, yield attributing parameters and economic benefit, application of recomended dose of fertilizers (N_{130}, P_{33}, K_{60}, S_{20}, Zn_3 kg ha^{-1}) plus pressmud @ 5 t ha^{-1} was found superior among the treatments. Again application of recomended dose of fertilizers (N_{130},P_{33},K_{60},S_{20},Zn_3) with rice mill ash @ 8 t ha^{-1} showed better performance considering yield, yield attributing parameters and economic benefit. It was further found that organic matter, total N, available P, K and S were built up in treatments where pressmud or rice mill ash were applied with inorganic fertilizers over control. Thus the combined dose of recommended

fertilizer ($N_{130}P_{33}K_{60}S_{20}Zn_3$ kg ha^{-1}) with pressmud @ 5.0 t ha^{-1} or rice mill ash @ 8.0 t ha^{-1} may be recommended for sustainable production of sugarcane in High Ganges River Floodplain Soil of BSRI farm.

Table 3. Effect of rice mill ash and pressmud on the growth and yield of sugarcane.

Treatments	Tiller (x $10^3 ha^{-1}$)	Millable cane (x $10^3 ha^{-1}$)	Unit stalk weight (kg)	Girth (cm)	Height of cane (m)	Yield of cane (t ha^{-1})
T_0	153.1 c	64.4 b	0.91	1.58	2.86	38.7 c
T_1	180.0 ab	111.9 a	1.02	1.67	3.06	100.8 ab
T_2	184.6 a	115.7 a	1.01	1.70	3.01	102.2 ab
T_3	172.1 ab	115.3 a	1.06	1.72	3.04	96.2 b
T_4	183.1 a	114.4 a	1.02	1.70	3.05	106.3 a
T_5	180.7 ab	112.0 a	0.94	1.65	2.83	98.2 b
T_6	178.9 ab	112.4 a	0.96	1.65	3.00	100.2 ab
T_7	168.9 b	111.7 a	1.08	1.70	3.15	94.8 b
LSD (0.05)	13.45	7.94	ns	ns	ns	7.94

Table 4. Effect of rice mill ash and pressmud on the quality parameters of sugarcane.

Treatments	Brix (%)	Pol in juice	Purity	Recovery
T_0	18.05	15.50	85.86	9.25
T_1	18.08	15.51	85.78	9.25
T_2	19.03	16.38	86.06	9.79
T_3	18.93	16.22	85.67	9.66
T_4	18.60	16.16	86.48	9.69
T_5	18.63	16.09	86.31	9.63
T_6	18.00	15.51	86.11	9.28
T_7	18.10	15.71	86.77	9.43
LSD (0.05)	ns	ns	ns	ns

Table 5. Economics of fertilizer management practices

Treatment	Yield of cane (tha^{-1})	Gross Return (Tk. ha^{-1})	Fertilizer cost (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	Benifit Cost Ratio (BCR)
T_0	38.7	43538.0	-	33898.0	43538.0	1.28
T_1	100.8	113400.0	6495.0	40393.0	106905.0	2.81
T_2	102.2	114975.0	7295.0	41193.0	107680.0	2.80
T_3	96.2	108225.0	5975.0	39873.0	102250.0	2.71
T_4	106.3	119588.0	6995.0	40893.0	112593.0	2.92
T_5	98.2	110475.0	5675.0	39573.0	104800.0	2.80
T_6	100.2	112725.0	7145.0	41043.0	105580.0	2.75
T_7	94.8	106650.0	5825.0	39723.0	100825.0	2.68

Price Tk/ kg:
Input: Urea= 6.50, TSP = 14.00, MP= 11.00, Gypsum = 4.00, Zinc Sulphate = 60.00 ,
Labour = 70.00
Out put: Sugarcane = 1.125

Table 6. Nutrient status of initial and post harvest soil as influenced by fertilizer management (composite samples of each replicated plot were analyzed)

Treatment	Texture	pH	OC %	Available N %	Available P ($\mu g\ g^{-1}$)	Exchange able K Cmol (k^+) kg^{-1}	Available S ($\mu g\ g^{-1}$)
Initial soil							
-	Loamy	7.8	0.77	0.07	10.5	0.195	29.5
Post harvest soil							
T_0	Loamy	7.56	0.76	0.068	8.0	0.13	29.0
T_1	Loamy	7.60	1.11	0.075	20.0	0.22	30.0
T_2	Loamy	7.67	1.19	0.080	22.5	0.27	31.0
T_3	Loamy	7.72	1.11	0.075	21.0	0.24	30.0
T_4	Loamy	7.52	1.21	0.081	23.0	0.28	32.5
T_5	Loamy	7.45	1.12	0.078	18.0	0.26	30.0
T_6	Loamy	7.50	1.13	0.079	21.0	0.23	31.0
T_7	Loamy	7.52	1.15	0.80	20.5	0.21	30.2

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