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PRE AND POST-HARVEST SOIL NUTRIENT STATUS AT RANGPUR SADAR SUGARCANE FIELD

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ABSTRACT

An experiment was conducted at the farmer's field at the Rangpur, during January-December 2018 to evaluate the nutrient status of pre and post-harvest soil of the sugarcane field. The experiments consisted of seven treatments viz., T_0 = Control (No fertilizer), $T_1 = N_{165}P_{55}K_{120}S_{30}Zn_{2.5}Mg_{20}$ (as per soil analysis), T_2 = T_1 + Dolomite (1 t ha^{-1}),T_3 = 50% of T_1 + Poultry manure (10 t ha^{-1}), T_4 = 50% of T_1 + Poultry manure (10 t ha^{-1}) + Dolomite (1 t ha^{-1}), T_5 = 50% of T_1 + Cowdung (12.5 t ha^{-1}) and T_6 = 50% of T_1 + Cowdung (12.5 t ha^{-1}) + Dolomite (1 t ha^{-1}). Results revealed that all the treatments showed statistically more or less similar to each other in respect to pH (5.51-5.71), OM (1.70-1.88),Ca (3.00-3.82 me 100 g^{-1}) and Zn (0.93 to 1.07 µg g^{-1}) contents of the post-harvest soil. Total N contents were the highest in T_5 (0.124%) followed by T_4 (0.105%) while it was the lowest (0.085%) in T_6.However, the highest available P, S, and Ca were found in those post harvest soil at Rangpur which treatment T_5.

Key words: Sugarcane, initial soil, post-harvest soil.

Introduction

Sugarcane (*Saccharum officinarum* L.) ranks second among the cash crops and third among the major field crops in Bangladesh and occupies 2.05% of the country's total cultivable land (BBS, 2017). Around 1,07,287 ha of land is under sugarcane cultivation in the country and the production of sugarcane is 45,08,344 metric tons per annum with an average yield of 6.89 t ha^{-1} in 2014–15 which was higher than the year of 2015-16 (BBS, 2017). In many developing countries, imbalanced and inadequate use of nutrients results in poor cane yield, deterioration of soil health and multiple nutrient deficiencies (Singh *et al*., 2014). Cowdung increases the efficiency of mineral fertilizer by improving the physical properties of the soil. Soil incorporated with cowdung contains enough suitable phosphoric acid, potash and lime which will increase the production of plant and ratoon crop of sugarcane (Gana, 2011). Dropping of poultry can also be used as essential organic manure and it has more capability to reduce the use of chemical fertilizer in sole or intercrops of sugarcane. Like other organic manures, pressmud has great potential to supply nutrients in addition to its favorable effects on physicochemical and biological properties of soil. Bokhtiar *et al*. (2015) observed 25% reduction of fertilizer application was possible with the use of FYM. An excellent nutrient source adds organic matter; pressmud addition leads to better nitrogen nutrition and promotes cation exchange capacity. Manure can play a vital role in sustaining soil fertility and crop production than the use of chemical fertilizers. Organic sources are the major components of sustainable agriculture. By using the organic manure soil fertility is increased and quality crops can be produced. There is a verse scope of research on sugarcane with integrated nutrient management for the sustainable production. Hence, an attempt was taken to explore the effect of fertilizers and manures on the nutrient status of sugarcane cultivated soil in Bangladesh.

Materials and Methods

The present study was conducted in the farmer's field at Rangpur. Sugarcane grows in Rangpur farmers Farm. The climatic condition such as air temperature, rainfall, humidity and bright sunshine during the study period has been shown in Table 1.

Table 1. Weather data of Rangpur District during the period from January to December, 2018

Month	Air temperature (^{0}C)			Total rainfall (mm)	Mean humidity (%)	Mean Bright sunshine (hrs)
	Max.	Min.	Mean			
January, 2018	23.71	11.53	17.62	38.41	83.90	5.04
February, 2018	25.87	12.76	19.32	3.18	80.61	7.08
March, 2018	32.42	20.94	26.68	8.90	77.22	7.10
April, 2018	35.50	23.87	29.69	58.19	78.10	8.15
May, 2018	34.55	24.39	29.47	155.51	82.61	7.26
June, 2018	32.95	25.67	29.31	271.58	86.64	4.32
July, 2018	31.52	25.84	28.68	297.95	89.47	2.65
August, 2018	32.55	26.58	29.57	204.79	87.15	4.82
September, 2018	32.75	26.02	29.39	225.14	86.70	5.33
October, 2018	30.79	22.82	26.81	81.41	85.90	6.71
November, 2018	28.60	17.39	23.00	Nil	82.36	8.91
December, 2018	24.77	14.84	19.81	Nil	87.52	3.76

Source: Metrological Department of Rangpur weather station

Treatments of the experiment: The experiments consisted seven treatments viz., T_0=Control (no fertilizers and manures), $T_1 = N_{165}P_{55}K_{120}S_{30}Zn_{2.5}Mg_{20}$ (as per soil analysis), $T_2 = T_1$ + Dolomite (1 t ha^{-1}), T_3 = 50% of T_1 + Poultry manure (10 t ha^{-1}), T_4 = 50% of T_1 + Poultry manure (10 t ha^{-1}) + Dolomite (1 t ha^{-1}), T_5 = 50% of T_1 + Cowdung (12.5 t ha^{-1}), T_6 = 50% of T_1 + Cowdung (12.5 t ha^{-1}) + Dolomite (1 t ha^{-1}). Urea, triple superphosphate (TSP), muriate of potash (MOP), gypsum and zinc sulphate was used as the source of N, P, K, S and Zn, respectively. Poultry manure (PM) and cowdung (CW) were used as organic manure while dolomite was used as liming material.

Experimental design: The experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications. Each of the experimental areas was divided into three blocks representing three replications to reduce soil heterogenic effects and each block was divided into seven unit plots with raised bunds as per treatments. Thus the total number of unit plots was 7×3 = 21. The size of each unit plot was 8 m × 6 m= 48 m^2. The plots were separated from one another by 1 m. Line to line distance and plant to plant distances were 1 and 0.45 m, respectively.

Soil analysis: The soil samples were air dried, ground, sieved through 2 mm sieve and stored in plastic containers before analysis. Soil water suspension at 1: 2.5 was prepared for the determination of soil reaction (Soil pH) using a pH meter fitted with a combined electrode (Jackson, 1973). Finely ground (0.2 mm sieve) soil was used for estimation of organic carbon by wet oxidation method using potassium dichromate and sulphuric acid for oxidation of organic matter (Walkley, 1947). The Organic carbon of soil was determined by wet oxidation method of Walkley and Black (1934). The organic matter content was calculated by multiplying the percent organic carbon by 1.73 (van Bemmelen factor). Total N content of the soil was determined following the micro–Kjeldahl method. The soil was digested with H_2O_2 and concentrated H_2SO_4 in presence of a catalyst mixture (K_2SO_4:$CuSO_4.5H_2O$: Se in the ratio of 10:1:0.1) and the nitrogen in the digest was determined by distillation with 40% NaOH followed by titration of distillate trapped in H_3BO_3 with 0.01N H_2SO_4 (Bremner and Mulvaney, 1982). Available P was extracted from the soil with 0.5 M NaHCO3 solutions, pH 8.5 (Olsen *et al.*, 1954). Phosphorus in the extract was then determined by developing blue color with reduction of phophomolybdate complex and the color intensity was measured colorimetrically at 660 nm wavelengths. The phosphorus concentration of the extract was calculated by fitting the absorbance reading to the standard curve (Olsen and Sommers, 1982). Exchangeable potassium was determined on 1M NH_4OAc (pH 7.0) extract of the soil by using a flame photometer (Knudsen *et al.*, 1982). Available S content of the soil was determined by extracting the soil with $CaCl_2$ (0.15%) solution as described by Tabatabai (1982). The extractable S was estimated by developing turbidity by adding acid seed solution (20 ppm S as K_2SO_4 in 6N HCl) and $BaCl_2$ crystals. The intensity of the turbid was measured by a spectrophotometer at 420 nm wavelength. Available Zn in the soil was extracted with DTPA and the concentrations of Zn in the extract were measured directly by atomic absorption spectrophotometer (AAS) at 214 nm wavelength (Lindsay and Norvell, 1978). Calcium was extracted from the soil with 1 M CH_3COONH_4, pH 7.0 (Cahoon, 1974). The volumetric soil: extractant ratio was 1:10 and shaking (end over end) time 1 h (27 rpm). The Concentration of L-arginine-HCl and La were added to the extract to make the extract 0.2 M with 0.25% HCl. The cations were determined with an AAS (Techtron AA-4 or Varian Techtron 1200) using an air–acetylene flame for Ca. The observed values were analyzed in terms of average as well as SD. The analyzed data were analyzed statistically following the analysis of variance (ANOVA) technique and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) using the statistical computer package program, MSTAT-C (Gomez and Gomez, 1984).

Results and Discussion

The effect of different treatments containing organic manure and inorganic fertilizer was not significant on pH, OM, Ca and Zn contents of post-harvest soil obtained from the experimental field of plant sugarcane. Besides these, the N, P, K and S contents in post harvest soil showed statistically significant effects among different treatments of integrated nutrient management practices. These results revealed that all the treatments showed statistically more or less similar to each other in respect to pH (5.51-5.71), OM (1.70-1.88),Ca (3.00-3.82 me 100 g^{-1}) and Zn (0.93 to 1.07 µg g^{-1}) contents of the post-harvest soil. Total N contents was the highest in T_5 (0.124%) followed by T_4 (0.105%) while it was the lowest (0.085%) in T_6. However, the available P was the highest with T_5 (13.14 µg g^{-1}) but it was statistically close to other treatments of the study except T_1 (10.52 µg g^{-1}), T_2 (11.92 µg g^{-1}) where T_1 showed much lower P content than T_2. However, the highest S and Zn was found in those post harvest soil at Rangpur which were treated by 50% fertilizer doses as per soil analysis along with 10 t ha^{-1} PM and 1 t ha^{-1} dolomite or treatment T_5 (18.48 µg g^{-1} and 1.070 µg g^{-1} respectively) but K content had the highest in treatment T_4 and T_5 (0.22 me 100g^{-1}) containing 50% fertilizer doses as per soil analysis along with Dhaincha as green manure in situ. Similarly, treatment T_1 treated soil of Rangpur showed same the lowest content of K (0.183 me 100g^{-1}) while available S content had lowest (14.0 µg g^{-1}) in control treated post harvest soil. the highest available ca was found in those post harvest soil at Rangpur. The highest available Ca was found in treatment T_5.

Table 2. Effect of integrated nutrient management on chemical properties of experimental surface soil after plant sugarcane harvest at Rangpur Sadar farmer's field 2018

Treatments	Nutrients concentration							
	pH	OM (%)	N (%)	P (µg g^{-1})	K (me 100 g^{-1})	S (µg g^{-1})	Ca (me 100 g^{-1})	Zn (µg g^{-1})
Initial values	5.65	1.70	0.095	10.50	0.183	14.0	3.00	0.93
T_1	5.51	1.71	0.096cd	10.52d	0.183 bc	14.33 f	3.41	0.95
T_2	5.70	1.74	0.096cd	11.92c	0.18 c	15.41def	3.35	0.98
T_3	5.71	1.75	0.097cd	12.81ab	0.19 bc	16.37 cde	3.44	0.96
T_4	5.63	1.88	0.105bc	12.47 ab	0.22 ab	16.82bc	3.45	0.93
T_5	5.69	1.82	0.124a	13.14 ab	0.22 ab	18.48a	3.82	1.07
T_6	5.66	1.83	0.085d	12.79 ab	0.20 abc	16.67 bcd	3.54	0.99
Sig.	NS	NS	**	**	**	**	NS	NS
CV (%)	3.10	4.08	2.02	7.22	3.30	6.06	2.20	3.56

In a column figures with same letter or without letter do not differ significantly Sig.= Level of significance
*= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Not significant

Similar observation was also obtained in available P content with the ranges of 15.25 ppm (T_1) to 17.22 ppm (T_5). N, S and Ca content also varied significantly from 0.095 to 0.112%, 13.25 to 17.15 µg g^{-1} and 3.46 to 4.25 me 100 g^{-1} respectively where the lowest values were recorded in treatment T_1 and the highest values were obtained in treatment T_5. Babu *et al.* (2007) reported that there was a slight reduction in soil pH and increase in electrical conductivity with the application of organic manures. At the end of ratoon crop, the increase in available N and Ca was maximum (38.2% and 24.4%) with the application of FYM whereas the application of PM resulted in the highest increase in available P (122.2%), K (23.6%) and magnesium (47.4%) over the initial soil values. Application of PM along with inorganic fertilizers resulted in higher cane yield in plant crop whereas, FYM along with inorganic fertilizers resulted in the highest cane yield in ratoon crop. The results showed that sole application of inorganic or organic nutrient sources exhibited no prominent increase in all sugarcane. It is concluded that integrated nutrient management showed 25% saving of inorganic fertilizers with the application of FYM and or press mud applied at 20 t ha^{-1}.

Conclusion

From the results of the experiments, it may be concluded that the performance of 50% of recommended fertilizer dose along with 10 t ha^{-1} poultry manure and 1 t ha^{-1} dolomite was the best for better soil fertility in Rangpur regions. Fifty percent of recommended fertilizer dose as per soil analysis and 10 t ha^{-1} poultry manure and 1 t ha^{-1} dolomite treated sugarcane produced higher post-harvest soil fertility.

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