Effects of Yara Fertilizer Formulations on Sugarcane Yield in Outgrowers' Fields of Kilombero, Tanzania

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ABSTRACT

The on farm trials were set in outgrowers' (OGs) fields of Kilombero sugar mill area in Morogoro Region, Tanzania in 2014-15 seasons. The objective was to compare the fertilizer recommendation rates established by Sugarcane Research Institute (SRI) with rates and products of Yara Fertilizer Company. The new fertilizer products to OGs initiated the needs of information on performance of these fertilizer rates and nutrient combinations and their net return to farmers' investment capacities. The trials were laid in three outgrowers' fields in different micro-climate. Four treatments were applied in the following rates per hectare: standard (SRI Recommendation), Basic, Medium and Advanced. The standard treatment used single nutrient fertilizer formulation including Urea, TSP and Muriate of Potash. Other treatments used YARA fertilizer formulations including YaraMila tobacco, YaraVera Amidas and Muriate of Potash. The results showed that tillers count and height, three months after second fertilizer application were recorded higher in advanced treatment, followed by standard treatment. While number of millable stalks were higher in advanced, medium and basic treatments than standard treatment. Results showed that advanced treatment had highest tones cane per hectare led to highest tones of sugar per hectare (TSH) ranging from 11.28 to 17.82 TSH, but not significant different ($P < 0.05$). Therefore preliminary results showed that advanced treatment is more effective in increasing cane and sugar yield compared to standard .

Key words: cane yield, fertilizer application rates, nutrients, sugar yield

INTRODUCTION

Sugarcane in Tanzania is the main cash crop for production of sugar and ethanol as byproduct. It is produced mainly for domestic consumption and industrial purpose (SBT, 2016). The area under rainfed sugarcane production is about 60% of the total area under sugarcane production at Kilombero. In most cases rainfed sugarcane production is practiced by out-growers (OG). Sugarcane productivity in out-growers' fields has remained low, below the attainable yield potential of 70-100 tons per hectare (SBT, 2016). Among the reasons for low yields is low adoption of good agronomic practices, particularly the use of fertilizers at recommended rates (Mtunda *et al* 1998). The under fertilization is attributed to high cost of existing fertilizer products and unavailability of different fertilizer products. Consequently, the YARA Fertilizer Company has introduced new products of fertilizers that could probably suit to sugarcane production to smallholder farmers. These products have been tested in Brazil and being used by Brazilian smallholder farmers for sugarcane production. The products have combination of macro- and micro-nutrients. These products are proposed to be used in three categories including basic (low), medium (mid) and advanced (high) nutrient levels of fertilizer. The introduction of these new products to smallholder farmers initiated the needs of information on these crop nutrient rate combinations that can give the highest return from farmers' investments. Therefore, the study was carried out to compare the fertilizer recommendation rate (standard) established by Sugarcane Research Institute (SRI) of Tanzania with YARA Fertilizer Company products and rates.

MATERIALS AND METHOLDS

Location of Experiments

The experiments were conducted at Kilombero in out-growers' fields in Kungurumwoga, Msolwa Ujamaa and Mang'ula villages which have different micro-climate. The rainfall in the area is bimodal with pronounced wet and dry seasons. Mean annual rainfall at Kilombero is ranging from 1000 - 1500 mm with mean monthly temperature of 29.9 ^{0}C.

Field Experiments and Layout

Composite soil sample were collected before laying out experiment and analysis was done by use of standard soil analytical methods (Yara Lancrop Methods Soil of Analysis) at Lancrop Laboratory. Each experiment was laid out in a randomized complete block design (RCBD) with three replications. Individual experimental plots were 9.6 m x 10 m comprising 8 sugarcane rows of 10 m long spaced at 1.2 m apart. Adjacent plots and replications were separated by 1 m path. Four treatments were applied in both plant cane (PC) and adjacent ratoon (R) where it was possible to get the field with ratoon crop in the following rates per hectare (ha): Standard ($N_{100}P_{25}K_{100}$), Basic ($N_{78}P_3K_{12}Ca_{2.5}Mg_{1.25}S_{3.75}B_{0.25}$), Medium ($N_{105}P_7K_{25}Ca_5Mg_{2.5}S_{7.5}B_{0.5}$) and Advanced ($N_{125}P_{20}K_{50}Ca_{7.5}Mg_{1.25}S_{17.5}B_{0.03}$) for plant cane. The treatments for ratoon crop for the Standard was the same, Basic ($N_{39}P_2K_{6.2}Ca_{1.9}Mg_{1.25}S_{0.63}B_{0.13}$), Medium ($N_{105}P_7K_{25}Ca_{7.5}Mg_5S_{2.5}B_{0.5}$) and Advanced ($N_{120}P_{16}K_{40}Ca_{14}Mg_6S_1B_{0.02}$).

Materials Used

Materials used were YaraMila tobacco (10% N, 18 % P_2O_5, 24 % K_2O, 3 % CaO, 0.5 %MgO, 7 % S and 0.012% B), YaraVera Amidas: - (40 % N and 5.5 % S), Urea 46 % N, TSP 46 % P_2O_5 and Muriate of Potash (MOP) 61 % K_2O. Phosphate containing fertilizers were applied at planting other fertilizer were applied in two splits, one month and three months after planting. The test sugarcane variety used was NCo376.

Data Collected

Data were collected from four center test rows in each plot, including number of millable stalks, cane yield and quality parameters (Brix % cane, Pol % cane and Purity % cane at maturity) and thereafter sucrose content was calculated. The Analysis of variance (ANOVA) and Multiple Range Test were done to determine the variations among treatments.

RESULTS

Soil

The results on chemical characteristics are presented in Table 1. The soils were predominant alluvial with low to medium level of soil fertility. This could probably be due to soils being under cultivation for long time.

Table 1: Selected Soil Chemical Characteristics

Analysis	Guideline	Result		
		MSOLWA ITEFA	MANGULA	KUNGURU MWOGA
pH	7.0	5.4	5.5	5.7
Phosphorus (ppm)	26	24	20	26
Potassium (ppm)	200	104	121	199
Calcium (ppm)	1600	1215	1884	2009
Magnesium (ppm)	120	451	441	336
Manganese (ppm)	5	57	58	108
Boron (ppm)	2.10	0.51	0.53	0.72
Copper (ppm)	2.1	8.5	6.9	4.3
Molybdenum (ppm)	0.10	< 0.01	< 0.01	< 0.01
Iron (ppm)	50	550	1267	565
Zinc (ppm)	4.1	3.1	7.2	6.3
Sulphur (ppm)	10	5	1	1
Nitrogen Total (mg/kg)	2000	2445	1165	1026

Legend

Very Low	Low	Slightly Low	Normal	High

Sugarcane

Number of Millable Stalks

Results presented in figures 1 show that plots which were treated with advanced treatment applied with Yara fertilizers performed better compared to all other treatments. However, there were no significant differences between treatments ($p < 0.05$).

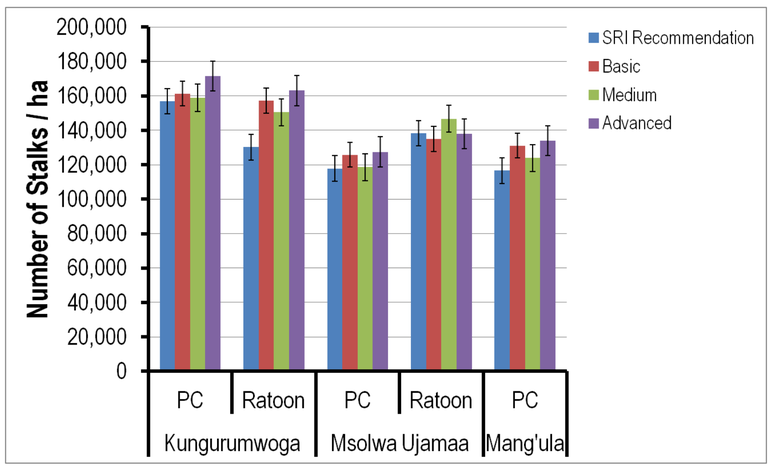

Figure 1: Showing number of stalks of sugarcane per hectare

Sugarcane Yield (tones per hectare: TCH)

Results presented in figure 2, show that Advanced treatment applied with Yara fertilizers had the highest TCH in all experimental sites as compared to the other treatments including standard except Msolwa Ujamaa in PC crop. As in other parameters there was no significant different between treatments ($p < 0.05$).

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RESULTS

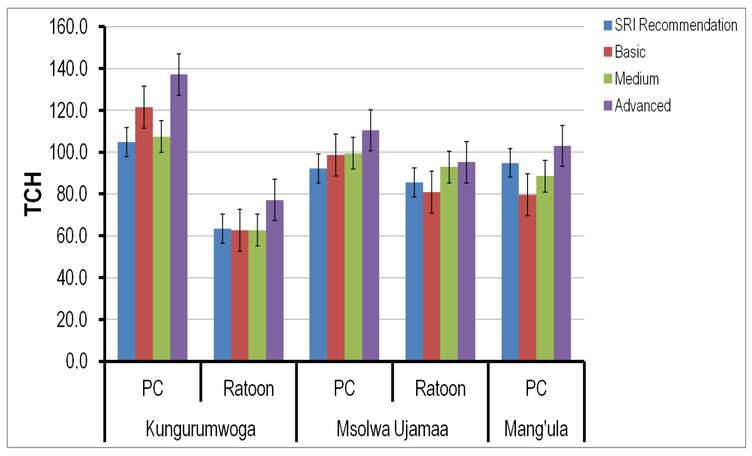
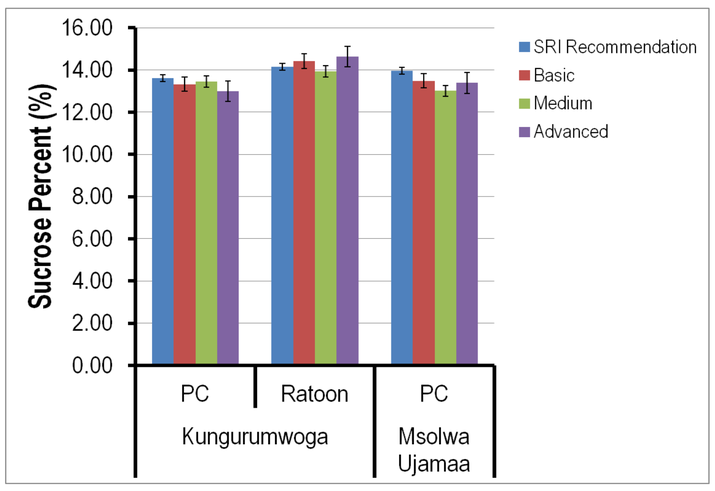


Figure 2: Sugarcane Yield in tones of sugar per hectare

Percentage Sucrose and Sugar Yield

Results presented in figure 3a shows that there was no significant difference in sucrose percent between all treatments ($p < 0.05$). Kungurumwoga and Msolwa Ujamaa for PC crops, standard had slightly higher sucrose. While figure 3b shows that Kungurumwoga ratoon crop, advanced treatment recorded slightly higher TSH.

3a



3b

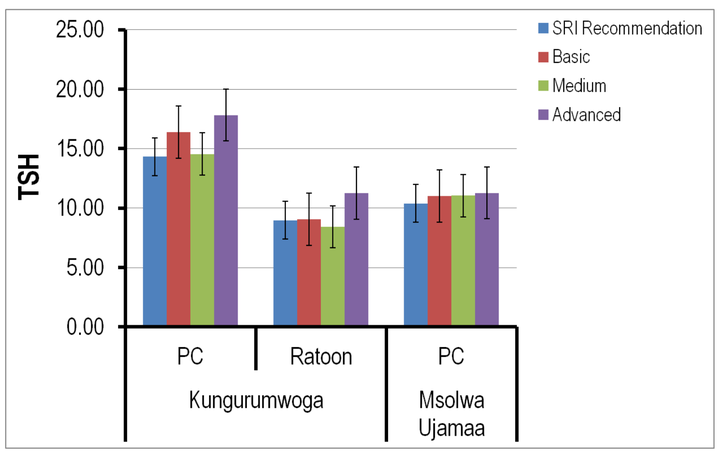


Figure 3a) Sucrose content in percent and 3b) Sugar yield tones per hectare

SUMMARY

Results presented in this study shows that there was no significant difference in all parameters among treatments ($p < 0.05$). Kungurumwoga and Msolwa Ujamaa for PC crops, standard had slightly higher sucrose. Kungurumwoga ratoon crop, advanced treatment recorded slightly higher sucrose. Applied Yara fertilizers at advanced treatment increased TCH and subsequent TSH as compared to the standard that used normal fertilizers.
The experiment is continuing until the results of four plant circles obtained in order to determine cost-benefit of different treatments.

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