



Original Research Article

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## Effects of Organic and Inorganic Fertilizers on the Growth and Yield of Selected Varieties of Sugarcane (*Saccharum officinarum*)

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### Abstract

A field experiment was conducted at the Teaching and Research Farm (Crop section) of the Federal University of Technology Akure, Ondo State, Nigeria to examine the effects of organic, inorganic and organomineral fertilizer on the growth and yield of sugarcane (*Saccharum officinarum* L.). The experiment was a 3 x 6 factorial scheme laid out in a randomized complete block design (RCBD) with three replications per treatment. Three varieties of sugar cane (F141, Ibon007 and Hausani), five fertilizer sources (250kg/ha organomineral fertilizer, 5 tons/ha organic fertilizer, 5 tons/ha poultry manure, 200kg/ha organomineral fertilizer, and 200kg/ha NPK20:10:10) and control (no fertilizer/manure application) were used. The growth parameters assessed include: plant height (cm), stem girth (cm), number of leaves, and number of tillers; cane yield (kg/ha) and proximate and chemical composition of the cane was determined. Results from the study showed that the varieties differed in most of the growth and yield attributes measured. The improved sugarcane varieties (F141 and Ibon 007) produced significantly higher numbers of leaves and tillers compared to the local (Hausani) variety. The Hausani variety gave higher (but not significant ( $p=0.05$ )) cane yield compared with the improved varieties. Application of 250kg/ha sunshine organomineral fertilizer also resulted in significantly ( $p =0.05$ ) higher cane yields. The analysis of the proximate composition of the sugarcane varieties showed that the percentage ash, crude protein, carbohydrates, crude fibre, fats and moisture contents differed significantly across treatments. The highest percentages of crude protein and fibre were recorded in plots treated with 5t/ha poultry manure. Plots treated with 5 tons/ha organic fertilizer recorded the highest percentage of fat, while 200kg/ha organomineral fertilizer produced highest carbohydrate contents. Application of 250kg/ha of organomineral fertilizer produced overall highest growth and yield compared with other treatments. This result suggests that the use of organomineral and organic fertilizers should be encouraged in sugarcane production to obtain increase in the productivity of sugarcane.

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### Introduction

Sugarcane (*Saccharum officinarum* L.) is one of the most important commercial crops grown by farmers in countries of the tropics (Sivanesan and Waller, 1986; Alvaris, 2008) and it improves the socio-economic

conditions in various aspects. The crop is used for the production of sugar, molasses for livestock feeds, alcohol, bagasses used for cooking fuel, and trash used for mulching and as organic fertilizer (Gana, 2008). In Brazil, sugarcane is readily available as forage for dairy cattle. Sugarcane is used as strategic forage particularly

in the dry season to prevent overgrazing of the pasture and for wine making (Hussain et al., 2007). Chewing sugarcane can locally be processed into *mazarkwaila* and *alewa* for drinking *akamu* and *gari* (Busari et al., 1995). Sugarcane is one of the most important crops in the world because of its strategic position and immense uses in the daily life of any nation as well as for industrial uses aimed at nutritional and economic sustenance. It is an essential food commodity with great potentials for foreign exchange earnings. The main product which is sugar is used universally as sweeteners, blender and as preservatives. It has also become an essential part in many diets, and almost indispensable in the food manufacturing and pharmaceutical industries (NSDC, 2003; Girei and Giroh, 2012).

Sugarcane contributes about 60% of the total world sugar requirement while the remaining 40% comes from sugar beet (Onwueme and Sinha, 1999). Sugar as a by-product of sugarcane is still the most widely used as caloric food in all countries especially among those of lower income. It is a tropical crop that usually takes between 8 – 12 months to reach its maturity. Matured cane may be green, yellow, purplish or reddish. The cane is considered ripe when sugar content is at its maximum (Onwueme and Sinha, 1993).

Sugarcane is an economically important crop. It provides a rich source of sucrose, alcohol and organic matter waste which is utilized as fertilizer. Sugarcane was cultivated vegetatively as noble canes until the end of 20th century. Today sugarcane is known as an aneuploid hybrid crop derived from a cross between *Saccharum officinarum* L. and a wild relative *Saccharum spontaneum*, through the process of nobilization (Mumtaz et al., 2011).

The total world area and production of sugarcane as estimated in 1989 were 16.7 million hectares and 1,007 million metric tons, respectively. Brazil, China, Cuba, Mexico, Pakistan, Thailand, the USA, Colombia, Australia and Indonesia produced over half of the total world sugarcane production while Africa had 1.2 million hectares with 72.1 million metric tons, respectively (Onwueme and Sinha, 1993). The important sugar-producing countries in the tropical Africa are Mauritius, Kenya, Sudan, Zimbabwe, Madagascar, Ivory Coast, Ethiopia, Malawi, Zambia, Tanzania, Nigeria, Cameroon and Zaire. Nigeria is one of the most important producers of the crop with a land potential of over 500,000 hectares of suitable cane field capable of producing over 3.0 million metric tons of sugarcane. If processed, it will

yield about 3.0 million metric tons of sugar (NSDC, 2003). Nigeria is noted to be abundantly blessed with human, water and environmental potentials for the production of sugarcane. Areas with high potentials for commercial sugarcane and sugar production have been identified through studies sponsored by the Federal Ministry of Industry and conducted by Dutch consultants HVA in the early eighties. It should be pointed out that in most of the areas in the Northern States where water for irrigation is available; sugarcane cultivation in large quantities is feasible. The crop can be rotated or even inter-planted with other crops where land with adequate sources of water abounds like in the various River Basin Development Authority Areas.

Generally, sugarcane for domestic consumption is produced more than that produced for industrial use. Thus, chewing cane account for between 55 – 65 percent of the total cane production. The bulk of these chewing sugarcane is consumed raw for its sweetness of the juice but some of it also is processed into variety of products such as sugar, molasses, bagasse Jaggery (*Mazarkwaila*), sweets (*Alewa*) and left over leaves/stalks (Misari, 1997).

Use of inorganic fertilizers can improve crop yields and pH, total nutrient content and nutrient availability, but its use is limited due to scarcity, high cost nutrient imbalance and soil acidity.

Due to continuous application of only inorganic fertilizers and plant protection chemicals in agriculture, the soils have been badly degraded. It has destroyed stable traditional ecosystem of the soil (Palaniappan and Annadurai, 1999). There is need to encourage more productive, cost efficient and eco-friendly farming system (Bhattacharya and Gehlot, 2003). The use of organic manure is based on the need for improving the sustainable productivity of soil (Singh et al., 2003). With the increased emphasis on the impact on environmental quality due to continuous use of chemical fertilizers, the integrated nutrient management system or conjunctive use of different nutrient sources is an alternative and is characterized by reduced input of chemical fertilizers and combined use of chemical fertilizers with organic materials such as animal manures, crop residues, green manure, compost and organomineral fertilizers. Also, little researches have been conducted on the effects of organomineral fertilizers on sugarcane in previous years. From the foregoing, this study was conducted to examine the effects of different forms of fertilizers (NPK 20:10:10, organic fertilizer, organomineral fertilizer and

poultry manure) on the growth and yield of sugarcane; the study also aims at determining the proximate contents of the cane in terms of moisture, fibre, ash, fat and protein and also the nutrients present.

## Materials and methods

Field experiment was conducted at the Teaching and Research Farm of the Federal University of Technology Akure, Ondo State Nigeria between July, 2013 and July, 2014 to determine the effects of organic, inorganic and organomineral fertilizer on the growth and yield of sugarcane (*Saccharum officinarum* L.). The area lies within the tropical rainforest belt, latitude 5°N and longitude 15°E. The rainfall pattern of Akure is bimodal with a wet season of about eight months occurring from April to October and with a brief dry spell, which in most cases occurs in the second half of August. The peak rainfall periods are June, July, September and October while the short dry season is from November, December through February and March. The mean daily temperature in Akure ranges from about 25°C and 37°C. The site has been cultivated in previous years continuously for maize, vegetables and water melon. The experimental field was manually cleared and divided into plots. The experiment was a 3 x 6 factorial scheme arranged in a randomized complete block design (RCBD) with three replicates. Each replicate consists of eighteen treatments which are; (i) Ibon 007 + 250 kg/ha organomineral fertilizer; (ii) F141 + 250 kg/ha organomineral fertilizer; (iii) Hausani + 250 kg/ha organomineral fertilizer; (iv) Ibon 007 + 5 tonnes/ha organic fertilizer; (v) F141 + 5 tons/ha organic fertilizer; (vi) Hausani + 5 tonnes/ha organic fertilizer; (vii) Ibon 007 + 200 kg/ha NPK; (viii) F141 + 200 kg/ha NPK; (ix) Hausani + 200 kg/ha NPK; (x) Ibon 007 + 5tons/ha poultry manure; (xi) F141 + 5tonnes/ha poultry manure; (xii) Hausani + 5tonnes/ha poultry manure; (xiii) Ibon 007 + 200kg/ha organomineral fertilizer; (xiv) F141 + 200 kg/ha organomineral fertilizer; (xv) Hausani + 200 kg/ha organomineral fertilizer; (xvi) Ibon 007 only; (xvii) F141 only; and (xviii) Hausani only. Total land area measured 21 m x 13 m. Plot sizes measures 2 m x 1 m with 1m alley ways between plots and 1.5 m between the replicates. There were nine (9) sugarcane plants per plot. Two sugarcane varieties (Ibon 007; T141;) were sourced from the National Cereals Research Institute, Badegi Niger State, while the third variety (Hausani) was obtained locally at the Shasha market in Akure, Ondo State. The application of the various fertilizer treatments was done at exactly two months after planting; after which the various growth and yield parameters were taken. The growth parameters evaluated include height

(cm) of 5 randomly selected plants measured in centimetres from the surface of the soil to the tip of the flag leaf; stem girth (cm) measured in centimetres by Vernier calliper from bottom, mid and top portion; number of leaves, and number of tillers was done by visual counting; while the yield parameters evaluated include total yield of the matured cane (kg) on spring balance. The percentage fat (% fat) was determined using Soxhlet extraction method and calculated as follows:

$$\%FAT = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

From the dried sample, 2g was weighed and digested for nitrogen determination using Kjeldahl method. The nitrogen determined was then multiplied by a constant (6.25) to determine the protein content. For ash determination, crucibles were dried over the hot plate and cooled in the desiccator for about one hour. The crucibles were weighed ( $W_1$ ). Thereafter, 1 gram of each sample was weighed inside the crucibles and weighed ( $W_2$ ). The samples were pre ashed with Bunsen burner flames until sample becomes charred. The crucible was then transferred to the muffled furnace set at 550°C. Ashing continued until a light grey or white ash was obtained. The crucibles were then cooled in the desiccator and weighed ( $W_3$ ).

$$\%Ash = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

All data collected were subjected to analysis of variance (ANOVA) to test treatment effects for significance using Minitab Version 17.1.0 statistical package. Significant means were separated using Tukey test at 5% level of probability.

## Results

The soil physico-chemical properties (Table 1) were analysed and the results showed that the soil of the experimental site was fairly acidic and contained various nutrients (Nitrogen, Phosphorus, Calcium and Magnesium) at moderate proportions. The soil of the experimental area was sandy loam containing sand (525.16 g/kg), silt (172.54 g/kg) and clay (302.30 g/kg). Table 2 shows the effects of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers on the height of sugarcane. Plant height differed significantly ( $p < 0.05$ ) across treatments throughout the experiment except at the 7<sup>th</sup> month after planting. At the 9<sup>th</sup> month after planting, plots treated

with 200 kg/ha organomineral fertilizer recorded the highest plant height (229.35 cm) while the least plant height (194.78 cm) was recorded in the control plots.

**Table 1.** Pre-cropping soil analysis

Routine analysis	Value
pH 1:1 H <sub>2</sub> O	6.15
Nitrogen (g kg <sup>-1</sup> )	9.8
Organic carbon (g kg <sup>-1</sup> )	17.8
Phosphorus (mg kg <sup>-1</sup> )	8.8
<b>Exchangeable cations (cmol/kg)</b>	
Potassium	0.54
Calcium	0.85
Magnesium	1.76
<b>Particle size (g/kg)</b>	
Sand	525.16
Silt	172.54
Clay	302.3

Table 2 also shows the effects of the fertilizer types on the stem girth of sugarcane. Stem girth differed significantly ( $p < 0.05$ ) across treatments. Plots treated with fertilizers/manure consistently recorded higher stem girth over the control. At nine months after planting (9 MAP), plots treated with 200 kg/ha NPK fertilizer recorded the highest stem girth (4.40 cm) while the lowest stem girth (3.68cm) was recorded in the control plots. The effects of the fertilizer types on number of tillers of sugarcane are presented in Table 2. Number of tillers differed significantly ( $p < 0.05$ ) across treatments

and also throughout the experiment. The highest number of tillers (13.78) was recorded in plots treated with 250kg/ha organomineral fertilizers at 9 months after planting while the lowest number of tillers (8.00) was recorded in the control plots. Table 3 shows the effects of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers on the height of sugarcane varieties. Plant height differed significantly ( $p < 0.05$ ) across the varieties throughout the experiment. The improved varieties (F141 and Ibon 007) consistently recorded the highest plant height. At nine months after planting (9MAP) plant height ranged from 193.45 cm in the Hausani variety to 236.15 cm in Ibon 007. Table 3 also shows the effects of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers on stem girth of the sugarcane varieties. Stem girth differed significantly ( $p < 0.05$ ) across all the varieties throughout the experiment. The Hausani varieties consistently recorded the highest stem girth. Stem girth ranged from 3.9 cm in F141 to 4.20 cm in Ibon007 to 4.32 cm in Hausani variety. The effects of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers on number of tillers of the sugarcane varieties are also presented in Table 3. The number of tillers differed significantly ( $p < 0.05$ ) across varieties used for the experiment. At 9 months after planting, the highest number of tillers (11.56) was recorded in the F141 variety while the lowest number of tillers (9.67) was recorded in the Hausani variety.

**Table 2.** Effects of fertilizer types on height (cm), stem girth and number of tillers of sugarcane.

Fertilizer types	Months after planting			
	3	5	7	9
	<b>Height (cm)</b>			
250 kg/ha Organomineral fertilizer	97.22a	144.48a	171.67a	214.49ab
200 kg/ha Organomineral fertilizer	86.92ab	137.63ab	172.90a	229.35a
5 t/ha organic fertilizer	85.64ab	131.93ab	169.5a	216.74ab
200 kg/ha NPK fertilizer	87.29ab	143.05ab	176.57a	220.60ab
5 t/ha Poultry manure	76.95bc	126.89ab	159.65a	222.09ab
Control	68.17c	110.89b	157.02a	194.78b
	<b>Stem girth (cm)</b>			
250 kg/ha Organomineral fertilizer	0.55ab	1.43cd	3.40ab	3.98a
200 kg/ha Organomineral fertilizer	0.56ab	1.89a	3.64a	4.16a
5 t/ha organic fertilizer	0.63a	1.70ab	3.57a	4.40a
200 kg/ha NPK fertilizer	0.52b	1.35d	3.47ab	4.11a
5 t/ha Poultry manure	0.51b	1.63bc	3.51a	4.28a
Control	0.52b	1.23d	3.02b	3.68a
	<b>Number of tillers</b>			
250 kg/ha Organomineral fertilizer	4.78a	7.33a	9.89a	13.78a
200 kg/ha Organomineral fertilizer	3.78bc	6.00bc	8.11bc	10.22c
5 t/ha organic fertilizer	4.33ab	6.44abc	8.56ab	10.33c
200 kg/ha NPK fertilizer	4.00ab	7.00ab	9.56ab	12.22ab
5 t/ha Poultry manure	3.78bc	5.89c	8.56ab	10.56bc
Control	3.00c	4.11d	6.89c	8.00d

**Table 3.** Effects of fertilizer types on height (cm), stem girth and number of tillers of sugarcane varieties.

Variety	Months after planting			
	3	5	7	9
<b>Height (cm)</b>				
F141	87.04b	133.24ab	172.58a	219.42a
Ibon 007	102.78a	146.68a	183.59a	236.15a
Hausani	61.28c	117.50b	147.50b	193.45b
<b>Stem girth (cm)</b>				
F141	0.50b	1.10c	3.21b	3.90b
Ibon 007	0.56a	1.45b	3.35b	4.20ab
Hausani	0.58a	2.06a	3.74a	4.32a
<b>Number of tillers</b>				
F141	4.39a	6.56a	9.39a	11.56a
Ibon 007	4.17a	6.61a	9.28a	11.32a
Hausani	3.28b	5.22b	7.11b	9.67b

Means followed by the same letter in the same column for each parameter are not significantly different from each other at 5% level of probability by Tukey test.

The interaction effects of sunshine organic fertilizer, N.P.K (20-10-10), poultry manure and organomineral fertilizers and varieties on the height of sugarcane are presented in Table 4. Plant height increases appreciably but did not differ significantly ( $p > 0.05$ ) across treatments in the 5<sup>th</sup> and 7<sup>th</sup> month after planting. However, plant height differed significantly ( $p < 0.05$ ) at 3 and 5 months after planting. The highest plant height were recorded at 9 months after planting (9MAP) in plots treated with 200 kg/ha organomineral fertilizer + Ibon 007 (250.89 cm) and 5 ton/ha organic fertilizer + Ibon 007 (249.20 cm). The interaction effects of sunshine organic fertilizer, N.P.K (20-10-10), poultry manure and organomineral fertilizers and varieties on stem girth of

sugarcane are shown in Table 5. Stem girth differed significantly ( $p < 0.05$ ) across treatments and throughout the experiment. At nine months after planting (9 MAP), plots treated with 200 kg/ha NPK fertilizer + Hausani and 250 kg/ha organomineral fertilizer + Hausani recorded the highest stem girth while the lowest stem girth (0.47 cm) was recorded in the control + Hausani. At 5 months after planting, plots treated with 200 kg/ha organomineral fertilizer + Hausani recorded the highest stem girth with 2.38cm. At 7 months after planting, plots treated with 5tons/ha Poultry manure + Hausani recorded the highest stem girth with 4.09cm. However, at 9 months after planting, stem girth increases appreciably but did not differ significantly across treatments.

**Table 4.** Interactions of fertilizer types and varieties on height (cm) of sugarcane.

Fertilizer types	Variety	Months after planting			
		3	5	7	9
250 kg/ha Organomineral fertilizer	F141	87.13bcde	131.84a	166.79a	209.12ab
250 kg/ha Organomineral fertilizer	Ibon 007	126.72a	170.74a	201.22a	243.27ab
250 kg/ha Organomineral fertilizer	Hausani	77.82bcdefg	130.87a	147.02a	191.06ab
200 kg/ha Organomineral fertilizer	F141	92.56abcde	129.82a	164.25a	231.42ab
200 kg/ha Organomineral fertilizer	Ibon 007	110.94ab	159.73a	196.70a	250.89a
200 kg/ha Organomineral fertilizer	Hausani	57.27efg	123.33a	157.76a	205.74ab
5 t/ha organic fertilizer	F141	97.87abc	156.35a	188.52a	223.51ab
5 t/ha organic fertilizer	Ibon 007	102.16abc	159.17a	196.99a	249.20a
5 t/ha organic fertilizer	Hausani	60.96defg	113.63a	144.21a	189.09ab
200 kg/ha NPK fertilizer	F141	85.86bcdef	130.11a	187.11a	220.72ab
200 kg/ha NPK fertilizer	Ibon 007	97.68abcd	143.25a	176.66a	229.78ab
200 kg/ha NPK fertilizer	Hausani	73.38cdefg	122.42a	144.77a	199.72ab
5 t/ha Poultry manure	F141	82.12bcdefg	138.24a	163.43a	230.82ab
5 t/ha Poultry manure	Ibon 007	99.34abc	128.12a	162.56a	241.01ab
5 t/ha Poultry manure	Hausani	49.39fg	114.29a	152.96a	194.45ab
Control	F141	75.78bcefg	113.10	165.387a	200.91ab
Control	Ibon 007	79.87bcdefg	119.09a	167.387a	202.77ab
Control	Hausani	48.85g	100.47a	138.283a	180.67b

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

**Table 5.** Interactions of fertilizer types and varieties on stem girth (cm) of sugarcane.

Fertilizer types	Variety	Months after planting			
		3	5	7	9
250 kg/ha Organomineral fertilizer	F141	0.45c	0.87g	3.26abc	4.03a
250 kg/ha Organomineral fertilizer	Ibon 007	0.51abc	1.16defg	3.55ab	4.03a
250 kg/ha Organomineral fertilizer	Hausani	0.68a	2.27a	3.39abc	4.29a
200 kg/ha Organomineral fertilizer	F141	0.55abc	1.10efg	3.27abc	4.09a
200 kg/ha Organomineral fertilizer	Ibon 007	0.55abc	2.19ab	3.65ab	4.06a
200 kg/ha Organomineral fertilizer	Hausani	0.58abc	2.38a	4.01a	4.40a
5 t/ha organic fertilizer	F141	0.43c	0.97fg	3.25abc	3.78a
5 t/ha organic fertilizer	Ibon 007	0.58abc	1.01efg	3.48ab	4.20a
5 t/ha organic fertilizer	Hausani	0.53abc	1.71bc	3.66ab	4.37a
200 kg/ha NPK fertilizer	F141	0.56abc	1.48cde	3.35abc	4.06a
200 kg/ha NPK fertilizer	Ibon 007	0.64ab	1.46cdef	3.55ab	4.43a
200 kg/ha NPK fertilizer	Hausani	0.68a	2.17ab	3.81ab	4.71a
5 t/ha Poultry manure	F141	0.48bc	1.15defg	3.47ab	4.21a
5 t/ha Poultry manure	Ibon 007	0.53abc	1.48cde	3.49ab	4.29a
5 t/ha Poultry manure	Hausani	0.52abc	2.25a	4.09a	4.35a
Control	F141	0.54abc	1.05efg	3.21abc	3.75a
Control	Ibon 007	0.53abc	1.42cdef	2.39c	3.81a
Control	Hausani	0.47bc	1.58cd	2.93bc	3.83a

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

**Table 6.** Interactions of fertilizer types and varieties on number of tillers of sugarcane.

Fertilizer types	Variety	Months after planting			
		3	5	7	9
250 kg/ha Organomineral fertilizer	F141	5.00abc	8.00ab	10.33ab	14.33a
250 kg/ha Organomineral fertilizer	Ibon 007	5.67a	8.33a	11.00a	13.33abc
250 kg/ha Organomineral fertilizer	Hausani	3.67bcd	5.67cdef	8.33abcde	13.67ab
200 kg/ha Organomineral fertilizer	F141	4.00abcd	5.33cdef	9.00abcde	11.00abcd
200 kg/ha Organomineral fertilizer	Ibon 007	4.00abcd	7.00abcd	8.67abcde	11.00abcd
200 kg/ha Organomineral fertilizer	Hausani	3.33cd	5.67cdef	6.67de	8.67de
5 t/ha organic fertilizer	F141	5.33ab	8.33a	10.00abc	11.67abcd
5 t/ha organic fertilizer	Ibon 007	4.33abcd	6.67abcd	8.67abcde	10.67abcde
5 t/ha organic fertilizer	Hausani	3.33cd	4.33ef	7.00cde	8.67de
200 kg/ha NPK fertilizer	F141	4.67abcd	7.33abc	10.00abc	12.67abc
200 kg/ha NPK fertilizer	Ibon 007	4.00abcd	6.67abcd	10.33ab	13.67ab
200 kg/ha NPK fertilizer	Hausani	3.33cd	7.00abcd	8.33abcde	10.33bcde
5 t/ha Poultry manure	F141	4.33abcd	6.00bcde	9.33abcd	11.00abcd
5 t/ha Poultry manure	Ibon 007	4.00abcd	6.67abcd	10.00abc	11.00abcd
5 t/ha Poultry manure	Hausani	3.00d	5.00def	6.33de	9.67cde
Control	F141	3.00d	4.33ef	7.67bcde	8.67de
Control	Ibon 007	3.00d	4.33ef	7.00cde	8.33de
Control	Hausani	3.00d	3.67f	6.00e	7.00e

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

Table 6 shows the interaction of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers and varieties on number of tillers of sugarcane. Number of tillers differed significantly ( $p < 0.05$ ) across varieties in the treatments and also throughout the experiment. The highest number of tillers was recorded in plots treated with 250kg/ha organomineral fertilizer + Ibon 007. At 9 months after

planting the highest number of tillers (14.33) was recorded in plots treated with 250kg/ha organomineral fertilizer + F141; while the lowest number of tillers (7.00) was recorded in the control plots. Data presented in Table 7 shows the effects of the fertilizer/manure types on number of leaves of sugarcane. Number of leaves differed significantly ( $p < 0.05$ ) across treatments. Plots treated 250kg/ha organomineral fertilizer

consistently recorded the highest number of leaves throughout the experiment. Number of leaves produced by plants in the plots treated with 200kg/ha NPK fertilizer and those planted in plots treated with 200kg/ha sunshine organomineral fertilizers were similar. Number of leaves ranged from 18.89 in the control plots to 26.89 in plots treated with 250kg/ha organomineral fertilizer. The effects of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers on number of leaves of the sugarcane varieties are shown in Table 8. Number of leaves differed significantly ( $p=0.05$ ) across the sugar cane varieties till the 5 MAP. The

Hausani variety recorded the least number of leaves throughout the experiment; while the highest was produced in Ibon007 variety. Table 9 shows the interaction effects of the fertilizer types and the sugarcane varieties on number of leaves of the sugarcane. Number of leaves differed significantly ( $p < 0.05$ ) across the sugarcane varieties under the different fertilizer types. The highest number of leaves was produced by variety 2 (Ibon007) planted on the plots treated with 250kg/ha organomineral fertilizer; while the least number of leaves was also recorded in the control plots with Ibon007.

**Table 7.** Effects of fertilizer types on number of leaves of sugarcane.

Treatments	Months after planting		
	3	5	7
250 kg/ha Organomineral fertilizer	10.33b	18.00a	26.89a
200 kg/ha NPK fertilizer	12.22a	17.89ab	24.11b
5 t/ha organic fertilizer	10.33b	16.33cd	21.78c
5 t/ha Poultry manure	9.56b	16.00d	21.89c
Control (No fertilizer application at all)	7.56c	12.11e	18.89d

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

**Table 8.** Effects of organic, inorganic and organomineral fertilizers on number of leaves of sugarcane varieties.

Variety	Months after planting		
	3	5	7
F141	10.44a	16.44a	22.67a
Ibon 007	9.78b	16.61a	23.00a
Hausani	9.61b	15.67b	22.72a

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

**Table 9.** Interactions of fertilizer types and varieties on number of leaves of sugarcane.

Fertilizer types	Variety	Months after planting		
		3	5	7
250 kg/ha Organomineral fertilizer	F141	11.00bcd	18.33abc	23.00bcde
250 kg/ha Organomineral fertilizer	Ibon 007	10.00cde	19.33a	28.33a
250 kg/ha Organomineral fertilizer	Hausani	10.00cde	16.33def	26.33ab
5 t/ha organic fertilizer	F141	10.33bcde	16.67cdef	22.67cde
5 t/ha organic fertilizer	Ibon 007	11.00bcd	16.67cdef	22.33cde
5 t/ha organic fertilizer	Hausani	9.67de	15.67ef	20.33def
200 kg/ha NPK fertilizer	F141	13.00a	17.33bcde	24.67bc
200 kg/ha NPK fertilizer	Ibon 007	11.67abc	19.00ab	23.67bcd
200 kg/ha NPK fertilizer	Hausani	12.00ab	17.33bcde	24.00bc
5 t/ha Poultry manure	F141	10.00cde	16.67cdef	22.33cde
5 t/ha Poultry manure	Ibon 007	9.67de	16.00def	22.00cde
5 t/ha Poultry manure	Hausani	9.00efg	15.33f	21.33cde
200 kg/ha Organomineral fertilizer	F141	11.00bcd	16.67cdef	23.67bcd
200 kg/ha Organomineral fertilizer	Ibon 007	8.67efg	17.67abcd	24.33bc
200 kg/ha Organomineral fertilizer	Hausani	9.33def	17.00cdef	24.67bc
Control	F141	7.33g	13.00g	19.67ef
Control	Ibon 007	7.67fg	11.00h	17.33f
Control	Hausani	7.67fg	12.33gh	19.67ef

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

Table 10 shows the effects of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers on the proximate composition of sugarcane. The proximate composition of the sugarcane differs significantly across all the treatments. Plots treated with 200 kg/ha organomineral fertilizer recorded the highest percentage of ash (1.06) and fibre (15.29) respectively; and plots treated with 250 kg/ha organomineral fertilizer recorded the

highest percentage of moisture content (44.98). The highest percentage of crude protein and fibre was recorded in plots treated with 5t/ha poultry manure. Plots treated with 5 tons/ha organic fertilizer recorded the highest percentage of fat; while plots treated with 200 kg/ha organomineral fertilizer has the highest percentage of carbohydrate. However, the control plots recorded the lowest proximate composition across the treatments.

**Table 10.** Effects of fertilizer types on proximate composition of sugarcane.

Treatments	Proximate composition (%)					
	Ash	Mc	Cp	Fat	Fibre	Cho
250 kg/ha organomineral fertilizer	0.83b	44.98a	5.25a	0.11c	13.47a	32.78e
5 t/ha organic fertilizer	0.83b	30.65e	5.29a	0.27a	10.22b	43.65d
200 kg/ha NPK fertilizer	1.01a	43.94b	3.95c	0.23ab	8.67b	52.72a
5 t/ha Poultry manure	1.00a	30.79e	5.33a	0.16bc	15.29a	47.31c
200 kg/ha organomineral fertilizer	1.05a	41.12c	5.00b	0.11c	13.04a	48.54b
Control	0.76c	37.57d	3.70d	0.10c	8.18b	28.90f

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

Table 11 shows the effects of sunshine organic manure, poultry manure, NPK (20-10-10), and organomineral fertilizers on the nutrient composition of sugarcane. The nutrient uptake differed significantly across all the treatments. Plots treated with 5 t/ha poultry manure the highest nitrogen (1.31), plots treated with 250 kg/ha organomineral fertilizer had the highest percentage phosphorus and manganese content (0.55 and 0.05) while Plots treated with 200 kg/ha NPK fertilizer has the highest percentage of potassium and sodium and magnesium (1.59, 1.76 and 3.08).

Data presented in Table 12 shows the effects of organic, inorganic and organomineral fertilizers on yield of sugarcane. Yield differed significantly ( $p < 0.05$ ) across treatments with plots treated with

250kg/ha organomineral fertilizer having the highest yield value (28.22 kg/ha). The lowest yield (11.24 kg/ha) was recorded in the control. The effects of organic, inorganic and organomineral fertilizers on the yield of the sugarcane varieties are also shown in Table 12. No significant differences were observed in the yield across the varieties. However, cane yield was higher in the Hausani variety compared with others. The interaction effects of organic, inorganic and organomineral fertilizers and varieties on sugarcane yield are presented in Table 13. Yield differed significantly ( $p < 0.05$ ) across treatments with plots treated with 250 kg/ha organomineral fertilizer + Hausani having the highest yield value (30.00 kg/ha). The lowest yield (8.97 kg/ha) was recorded in the Control + Ibon 007 plots.

**Table 11.** Effects of fertilizer types on the nutrient composition of sugar cane.

Treatment	Nutrient uptake							
	N	P	K	Na	Ca	Fe	Mg	Mn
250 kg/ha Organomineral fertilizer	1.20b	0.55a	1.00c	1.76a	1.00a	0.21c	2.75b	0.05a
200 kg/ha Organomineral fertilizer	1.12c	0.55a	1.00c	1.40b	1.00a	0.25b	0.96de	0.04b
5 t/ha organic fertilizer	1.10c	0.43d	1.26b	1.10c	1.00a	0.32a	1.04d	0.03bc
200 kg/ha NPK fertilizer	1.13c	0.52b	1.59a	0.43d	1.00a	0.23bc	3.08a	0.03bc
5 t/ha Poultry manure	1.31a	0.47c	1.21b	0.86c	1.00a	0.26b	1.75c	0.036b
Control	0.52d	0.41e	0.50d	0.31d	0.92b	0.16d	0.88e	0.02c

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

**Table 12.** Effects of fertilizer types on cane yield (kg) of sugarcane and sugarcane varieties.

Treatments	Mean
250 kg/ha organomineral fertilizer	28.22a
200 kg/ha organomineral fertilizer	19.17b
200 kg/ha NPK fertilizer	25.43a
5 t/ha organic fertilizer	26.39a
5 t/ha poultry manure	20.78b
Control	11.24c
<b>Variety</b>	
F141	21.38a
Ibon007	21.47a
Hausani	22.77a

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

**Table 13.** Interaction fertilizer types and varieties on the cane yield (kg) of sugar cane.

Fertilizer types	Variety	Mean
250 kg/ha Organomineral fertilizer	F141	25.33abc
250 kg/ha Organomineral fertilizer	Ibon 007	29.33a
250 kg/ha Organomineral fertilizer	Hausani	30.00a
200 kg/ha Organomineral fertilizer	F141	20.00bcd
200 kg/ha Organomineral fertilizer	Ibon 007	19.67bcd
200 kg/ha Organomineral fertilizer	Hausani	22.67abcd
5 t/ha organic fertilizer	F141	26.67abc
5 t/ha organic fertilizer	Ibon 007	27.33ab
5 t/ha organic fertilizer	Hausani	25.17abc
200 kg/ha NPK fertilizer	F141	26.83ab
200 kg/ha NPK fertilizer	Ibon 007	24.00abc
200 kg/ha NPK fertilizer	Hausani	25.47abc
5 t/ha Poultry manure	F141	19.67bcd
5 t/ha Poultry manure	Ibon 007	19.50bcd
5 t/ha Poultry manure	Hausani	18.33cd
Control	F141	9.77e
Control	Ibon 007	8.97e
Control	Hausani	15.00de

Means followed by the same letter in the same column are not significantly different from each other at 5% level of probability by Tukey test.

## Discussion

The differences obtained in plant height among the sugarcane varieties may be attributable to genetic diversity, since they were grown under the same condition of fertilizer/manure application. However, the non significant differences in the plant height at seven months after planting might be due to the physiological maturity of the plants as plants tends to attained the same

height at flowering. The higher plant height observed in the plots treated with 250 kg/ha organomineral fertilizer might be due to higher nutrient contents in the 250 kg/ha organomineral which was able to sustained the plant to maturity. The initial higher number of sugarcane leaves in plots applied with 200 kg/ha NPK over the other treatments might be as a result of quick release of nutrients present in the NPK fertilizer which are responsible for leaves and root formation. This

observation is in line with the findings of Moyinjesu (2007) who pointed out that organomineral and mineral fertilizers release their nutrients to the soil faster than organic manure.

Application of 250 kg/ha organomineral fertilizer was slightly superior to the use of 200kg/ha NPK fertilizer on yield of sugarcane. This is in line with the results of Sridhar and Adeoye (2003) and Ogunlade et al. (2011) who reported that the use of organomineral fertilizer performed better on crop yield. The least performance of the plants in the control plots was a reflection of the soil nutrient deficit; while the significant response of yield attributes to N.P.K and organomineral fertilizers could be due to the effect of the nitrogen element on crop growth. Govinda et al. (1971) reported that the influence of N on shoot development (number of tillers) at early growth phase greatly influence cane development and yield. The higher yield observed in Ibon 007 varieties could be due to its increased number of tillers it produced during its growth. This was reported by Toomsan and Limpinuntana (2005) who suggested that higher cane yield could be attributed to the higher number of tillers and millable cane.

The lower values of crude protein found in plots treated with 200 kg/ha NPK fertilizer and control could be due to the ease at which nutrients such as N, P, and K in NPK fertilizer was lost by leaching during the rainy season. The highest crude protein was recorded in poultry dropping at 5 tons/ha and this could be due to the fact that organic materials are more readily available in this type of manure since the materials have to be slowly decomposed and organic nutrients mineralized. This was observed by Bhullar et al. (2005) who reported that the slow decomposition of organic material release the nutrients over a long time during the crop growth period and also improves soil properties.

### Conclusion and recommendation

The results of this study showed that the fertilizer examined had positive effects on sugarcane growth, yield and nutrition. However, organomineral fertilizer applied at 250 kg/ha and Ibon 007 variety produced best results in terms of growth and yield. It can also be concluded that organomineral fertilizer can be a substitute for inorganic fertilizer in sugarcane production. This is due to the fact that the organomineral fertilizers are cheaper and boost soil fertility compared with non-N fortified organic fertilizers.

There is a need to encourage sugarcane farmers on the use of organomineral fertilizers to boost yield and quality. Planting of improved varieties of sugarcane should be encouraged by farmers in order to achieve optimum sugar yields. Additional research should also be carried out in various parts of Nigeria so as to give the findings a wider and more universal acceptance.

### Conflict of interest statement

Author declares that he has no conflict of interest.

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