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GROWTH, CANE YIELD AND SUGAR CONTENT OF SIX GENOTYPES OF SUGARCANE IN A FOREST ZONE OF SOUTHEASTERN NIGERIA

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ABSTRACT

The growth and yield of six sugarcane genotypes were studied in field plots between 1999 and 2001, at Umudike, in the humid forest zone of southeastern Nigeria. Treatments comprised five improved sugarcane genotypes (NCS 001, NCS 003, NCS 004, NCS 005 and C062175) and one local variety (Umudike Local) arranged in a randomized complete block design (RCBD) with three replications. Cultivar NCS 003 gave significantly the highest stalk lengths and cane yields in both the plant-cane and ratoon crops. The genotype NCS 005, on the other hand, gave the highest cane yield in the plant-cane but not in the ratoon crop, while C062175 gave the least yield in the plant-cane but had one of the highest yields in the ratoon crop. Sugar concentration (Brix %) was highest in Umudike Local in the plant-cane crop.

Key words: Sugarcane, genotypes, growth, cane yield, sugar content.

INTRODUCTION

Sugarcane (*Saccharum* officinarum L.), a member of the Poaceae family, originated in New Guinea (Brandes, 1956) and is an important cultivated crop in the inland valleys of Nigeria (Busari *et al.*, 1997). While industrial cane is grown mainly in sugar estates and processed into sugar, the chewing cane is grown by traditional farmers and normally chewed raw for its sweet refreshing juice. Although domestic sugar industries only produce about five percent of the national sugar requirements, very little proportion of the chewing cane is processed into sugar (Busari *et al.*, 1997).

Commercial sugarcane production in Nigeria has been concentrated in the north of the country, where sugar estates and industries exist. Consequently, there are more research information on sugarcane production in the northern states (Kwon-Ndung, 1998; Ishaq *et al.*, 1998; Ndarubu *et al.*, 1998). Despite the lack of information on sugarcane production in the eastern states of Nigeria, farmers grow sugarcane on small farm holdings in the region. Research information is therefore necessary for advising the farmers, because sugarcane production is currently being encouraged nationwide, through the Nationally Coordinated Research Projects (NCRP).

Research into the diversity of morphological characteristics and yield of different genotypes of any crop has generally been recognized as fundamental for improvement programme of the crop. Alexander (1987) noted that development and selection of the right varieties have contributed 30 percent to increased sugar yield and biomass production while improved agronomic practices have contributed 70 percent. The objective of this study is, therefore, to evaluate and select promising sugarcane genotypes, based on growth and yield performance at Umudike, in the humid forest zone of southeastern Nigeria.

MATERIALS AND METHODS

Two field studies were carried out between 1999 and 2001 at the inland valley swamp of Michael Okpara University of Agriculture Research Farm, Umudike (Longitude 07^{o} 33^{1}E, Latitude 05^{o} 29^{1}N, Altitude 122m). Composite soil samples were collected from the experimental site at 0-15cm depths for analysis. Rainfall data were collected from the National Root Crops Research Institute (NRCRI) agrometeorological station, which is located a few metres from the experimental site.

The experiment was conducted as a randomized complete block design (RCBD) with three replications. Treatments comprised five improved sugarcane genotypes (NCS 001, NCS 003, NCS 004, NCS 005 and C062175) obtained from National Cereals Research Institute (NCRI), Badeggi, and one local variety (Umudike Local). Each plot (4m x 4m) had four 1-metre ridges. Three - bud - cane setts of each genotype were laid end-to-end on the base of grooves created on the crest of the ridges and covered with soil on 17^{th} September, 1999. There were 9 setts of each genotype per ridge. These setts were obtained from seven months old plants established earlier in the year for the purpose of generating planting materials.

Fertilizer was applied at the rate of 100kgN/ha as urea, $60kgP_2O_5$/ha as single super phosphate and

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90kg$K_2$0 as muriate of potash at 2 months after planting (MAP). Earthening up of the canes was done with hoe at 5 MAP while hoe weeding was done thrice at 2, 5 and 8 MAP.

Measurements and yield data were based on the two middle rows in each plot. The plant-cane crop was harvested at 10 MAP on 4th July, 2000 while the first-ratoon crop was harvested 8 months after harvest of the plant-cane crop on 5th March, 2001. Records were made on the number of stalks, number of leaves, number of internodes/stalk, number of millable stalks/ m^2, stalk length (cm) and girth (cm). Plant height was obtained by measuring the distance from the ground to the top visible dewlap and getting the average, while girth was measured using venier calipers. At each harvest, the middle two rows of each plot were cut and fresh weight obtained. Sugar concentration (% Brix) in the stalk was estimated using a field refractometer. Brix reading was recorded after dropping the juice of each genotype on the refractometer.

Data were subjected to Analysis of variance according to the procedures for a randomized complete block design as outlined by Little and Hills (1978). Significant treatment means were separated using the Duncan's New Multiple Range Test (DNMRT).

Table 1: Soil physical and chemical characteristics of the experimental site

Physical characteristics	
Sand (%)	60.1
Clay (%)	25.1
Silt (%)	14.8
Textural class	Sandy clay loam
Chemical characteristics	
OM (%)	1.82
N (%)	0.11
Avail. P ($mgkg^{-1}$)	19.0
Exch. K ($Cmol\ kg^{-1}$)	0.11
pH (H_2O)	5.2

RESULTS AND DISCUSSION

The soil of the experimental site was a sandy clay loam with low pH and high potassium and phosphorus but low nitrogen contents (Table 1). Rainfall was generally high during the cropping season of April to October but very low during the dry months of November to February (Table 2). Annual rainfall was adequate in 2000 (1669.5mm) but high in 1999 (2701.3mm) and 2001 (2189.8mm). Sugarcane needs 1500-1800mm rain (Rehm and Espig, 1991). The minimum and maximum temperatures fell mostly within the range of 21°C – 35°C recommended by Onwueme and Sinha (1991) for sugarcane.

Cane genotype NCS 001 produced significantly the least number of leaves but the highest number of internodes while Umudike Local gave the highest number of leaves but the least number of internodes in the ratoon crop (Table 3). The NCS 003 genotype produced significantly the longest stalks while C062175 and NCS 005 gave the shortest stalks in the plant-cane and ratoon crops, respectively. Earlier workers (Boerma, 1979; Ugbaja *et al.*, 1994; Okpara and Ibiam, 2000; Tanimu *et al.*, 2000) have reported variations in plant height among cultivars of various crops. Cane stalk girth was significantly higher in NCS 005 than in others which were similar. In general, higher values for number of leaves, number of internodes and stalk height were obtained in the ratoon than the plant-cane crop in most genotypes.

Sugar concentration in the genotypes varied significantly in the plant-cane crop, with Umudike Local producing the highest brix of 28.3 percent while the lowest value of 21.7 percent occurred in C062175, which did not differ from the other genotypes (Table 4). The number of millable stalks/m^2 in the ratoon crop was significantly highest in NCS 003 and C062175 but least in NCS 001, which was statistically similar to the other genotypes.

Cane yields ranged from 21.2 t/ha in C062175 to 71.0t/ha in NCS 005 with a mean of 51.7t/ha in the plant-cane crop and 13.9t/ha in NCS 001 to 38.6t/ha in NCS 003 with a mean of 25.3t/ha in the ratoon crop (Table 4). In the plant-cane crop, NCS 005, NCS 003, NCS 001 and Umudike Local had statistically similar yield values which were significantly higher than the yield of C0 62175. In the ratoon crop, however, NCS 003 and C062175 had statistically similar cane yield values which were markedly higher than the yields in other genotypes. NCS 005 and C062175 genotypes exhibited differential cane yield responses in the plant-cane and ratoon crops. For example, NCS 005 gave the highest cane yield (71.0t/ha) in the plant-cane crop but had one of the least yields (20.6t/ha) in the ratoon crop. C062175 genotype gave the least yield (21.2t/ha) in the plant-cane crop but was a top yielder (37.9t/ha) in the ratoon crop. Except for C062175, yields were much lower in the ratoon than in the plant-cane crop. Glaz *et al.*, (1989) had reported that yield of cane usually declines from the plant-cane through the second – ratoon crop. The highest yields of 69.3 and 71.0t/ha obtained for NCS 003 and NCS005 genotypes, respectively, in the plant-cane crop were satisfactory when compared with the yield of 73.1t/ha obtained by Agboire and Ishaq (1999) for the NCS 003 (BD 95-030) genotype in the southern guinea savanna of Nigeria.

Correlation analysis showed that stalk length was positively and significantly correlated with cane yield in the plant-cane crop while number of millable stalks was positively and highly significantly correlated with cane yield in the ratoon crop (Table 5). *Cerrizuela*

Table 2: Weather records during the period of the experiment

	Rainfall (mm)			Minimum Temp. (°C)			Maximum Temp. (°C)		
Month	1999	2000	2001	1999	2000	2001	1999	2000	2001
Jan	45.6	4.8	0.0	21	23	20	32	33	33
Feb	98.1	0.9	7.6	24	22	22	36	34	35
Mar	203.4	13.6	175.9	24	23	23	35	35	34
April	192.0	164.5	224.1	25	24	23	34	33	32
May	319.9	153.6	194.3	24	24	23	33	32	32
June	296.6	265.2	522.5	23	23	23	31	31	30
July	284.4	265.2	273.5	23	23	22	30	30	29
Aug.	382.2	216.1	179.0	23	24	22	29	30	28
Sept.	395.3	277.5	317.2	23	24	22	29	30	29
Oct.	433.7	228.4	277.1	23	24	23	30	31	30
Nov.	50.1	75.9	18.6	23	24	23	32	32	32
Dec.	0.0	3.8	0.0	22	21	22	31	32	32
Total	**2701 3**	**1669.5**	**2189.8**						

Table 3: Crop growth characteristics of six sugar cane genotypes (1999-2001)

	Number of leaves/stalk		Number of internodes/stalk		Stalk length (cm)		Stalk girth (cm)	
Variety	Plant-cane	Ratoon	Plant-cane	Ratoon	Plant-cane	Ratoon	Plant-cane	Ratoon
NCS 001	10.3	10.2^{e}	18.2	29.5^{a}	200.3^{abcd}	217.3^{b}	4.3^{b}	3.5
NCS 003	10.0	18.7^{ab}	21.0	25.7^{ab}	254.3^{a}	261.7^{a}	3.7^{b}	3.3
NCS 004	9.7	10.3^{e}	19.3	27.5^{ab}	183.7^{cd}	202.0^{bc}	3.7^{b}	3.7
NCS 005	9.2	13.5^{bc}	21.2	22.0^{bc}	197.7^{bcd}	174.2^{c}	5.3^{a}	4.1
C062175	9.2	11.8^{bc}	22.0	26.0^{ab}	146.5^{d}	186.5^{bc}	4.3^{b}	4.2
Umudike Local	9.2	22.2^{a}	19.8	18.2^{c}	179.8^{d}	199.7^{bc}	3.9^{b}	4.1

Within each column, means not followed by the same letter(s) are significantly different ($P<0.05$) according to Duncan's New Multiple Range Test.

Table 4: Cane yield number of millable stalks and brix % in six sugar cane genotypes

	Cane yield (t/ha)		Number of millable stalks/m^2		Brix %	
Variety	Ratoon	Plant-cane	Plant-cane	Ratoon	Plant-cane	Ratoon
NCS 001	56.9^{a}	13.9^{b}	9.3	3.2^{b}	25.7^{ab}	18.3
NCS 003	69.5^{a}	38.6^{a}	10.1	8.2^{a}	22.7^{b}	13.3
NCS 004	38.2^{ab}	17.6^{b}	10.2	4.7^{b}	23.3^{b}	14.7
NCS 005	71.0^{a}	20.6^{b}	8.3	4.4^{b}	22.7^{b}	13.0
C062175	21.2^{b}	37.9^{a}	3.8	8.1^{a}	21.7^{b}	15.7
Umudike Local	53.2^{a}	22.9^{b}	9.5	5.4^{ab}	28.3^{a}	15.3

Within each column, means not followed by the same letter(s) are significantly different ($P<0.05$) according to Duncan's Multiple Range Test.

et al., (1965) and Ibrahim (1984) had attributed yield reductions in sugarcane to fewer number of millable stalks. The number of internodes/stalk was negatively but not significantly correlated with cane yield in both the plant-cane and ratoon crops. Umudike Local had the greatest number of green leaves in the ratoon crop but this did not proportionately reflect in cane yield. On the basis of consistency of yields obtained in both plant-cane and ratoon crops, the NCS 003 genotype was the highest while NCS 004 had the least under Umudike conditions.

Table 5: Correlations between plant attributes and cane yield in the plant cane and ratoon crops (1999-2001)

Attribute	Cane yield	
	Plant-cane	Ratoon
Number of green leaves/stalk	0.291	0.345
Number of internodes/stalk	-0.151	-0.085
Number of millable stalks/m^2	0.652	0.963**
Stalk girth	0.279	0.023
Stalk length	0.811*	0.350
Brix content	0.197	-0.400

* Significant at 5% probability level.
** Significant at 1% probability level.

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