

Original Research Article

Differential Response of Four Sugarcane (*Saccharum officinarum* L.) varieties to NPK 20:10:10 Fertilizer in South western Nigeria

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Comment [b21]: Rewrite to include moisture regime as a variable since trial was under irrigation and rainfed

ABSTRACT

The study was carried out during the wet cropping season of 2000 and dry season of 2001 respectively at the farm site of Olabisi Onabanjo University, Ago-iwoye, Ogun State in South-West zone of Nigeria to determine ~~and compare~~ the weight of cane, dry matter and yield of four varieties of sugarcane (*Saccharum officinarum* L.) in response to NPK 20: 10: 10 fertilizer. Varieties of sugarcane used ~~in the study~~ were Co62175, NCS005, NCS004 ~~AND and~~ NCS003 and the treatments were laid out in Randomized Complete Block Design (RCBD) replicated three time. The statistical analysis was done using Analysis of Variance (ANOVA) and means were separated with LSD (Least Significant Difference) at ~~pP~~ = 0.05. Results ~~after statistical analysis~~ showed ~~that there were~~ significant differences between the varieties of the sugarcane with respect to ~~the~~ weight of cane and yield for the two seasons. During the wet season, the ~~values of~~ cane weight ranged from 1.35 kg to 0.48kg. NCS005 had the highest cane weight ~~value of at~~ 1.35 kg while the lowest ~~value was obtained from~~ NCS003 (0.48kg). This was also reflected in the yield which ranged from 9.74 t/ha to 4.11 t/ha with NCS005 having the ~~h~~ highest (9.74 t/ha) and NCS003 the lowest (4.11 t/ha), suggesting close relationship between weight of cane and yield. The application of NPK 20:10:10 fertilizer ~~also increased~~ the dry matter components of ~~cane the plant and~~ which were ~~found to be~~ significant in % sucrose, glucose, total sugar and ~~ru~~de fibre. The highest % sucrose, ~~g~~Glucose and total sugar was obtained from Co6215, while the lowest was obtained from NCS003. Crude fibre ~~percentage was also found to be was~~ significantly different ~~in among~~ the four varieties at ~~P~~ = 0.05 levels with the highest obtained in NCS003 and Co6215. The same trend was obtained under ~~the~~ irrigation in 2001 cropping season. In conclusion, the application of NPK fertilizer on the different varieties of sugarcane showed that NCS005 and Co6215 gave more yield and sugar concentration than NCS003 and NCS004.

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Comment [b22]: State the experimental design e.g. factorial, latin or split plot etc.

Comment [b23]: What is the difference between weight of cane and yield?

Comment [b24]: Weight of a cane stalk

Comment [b25]: Less than 10 tons per ha!!!!!!

Comment [b26]: This is obvious. No need to write

Comment [b27]: Is it rude!! Or crude

Keywords: Sugarcane; NPK 20:10:10; Dry matter; Weight of cane; Nigeria

1. INTRODUCTION

Sugarcane belongs to the genus *Saccharum* L. of the tribe Andropogoneae in the grass family (Poaceae) and the most importance source of cane-sugar (Derr. 1949; FAO 2004; Sreenivasan et

Comment [b28]: Old literature

al. 1987).The stems are the main target of cultivation from which sugar is extracted
(Artschwagger, 1940; Mackintosh, 2000). -It is widely grown throughout the tropical and sub-
tropical regions of the world. It inversely depletes the soil of its major nutrients hence there is
need to constantly supply supplementary nutrients to the soil under cultivation in order to
sustain and replenish the lost nutrients and to increase the yield tonnage of the plant.
~~Although, s~~ Sugarcane is an important sugar crop in Nigeria, the rate of consumption of sugar in
Nigeria is ~~extremely~~ high but the production is ~~very~~ low (Oworu, 1985). ~~And this~~ This makes
Nigeria imports about 93% of its sugar requirement ~~from countries that produce sugar in~~
~~commercial sale~~ and this gulps millions of Naira from the country's foreign reserve (Oworu,
1985). In lieu of this, a study was carried out to determine the effect of NPK (20:10:10) fertilizer
on the weight of cane, yield and dry matter components of different sugarcane varieties
(*Saccharum officinarum* L), in order to identify the variety that can be ~~greatly~~ influenced by the
NPK fertilizer to increase sugarcane tonnage in the ~~country~~.
The plant nutrients which are vital to the growth of sugarcane comprises of the major
elements: Nitrogen (N), Phosphorus (P) and Potassium (K), others are Iron (Fe), Magnesium
(Mg) and Calcium (Ca), which are supplied in ~~assimilable~~ form by the gradual soil
transformation, which occur at a rate sufficient to provide other nutrients for the need of the
plant. ~~It was proved that Phosphorus, Potassium and especially nitrogen were used at a higher~~
~~rate by the plant than what the soil can generate (Barnes 1954).~~ These nutrient elements have
been found to have different effects and performance on the growth and development of the
sugarcane. -Phosphates stimulate the rooting and tillering of the plant while potassium is
essential for the synthesis of sugar in the leaf, with movement to the storage cells in the stem

Comment [b29]: State the figures

Comment [b210]: Transfer sentence line 43 -46 to starting line 72

Comment [b211]: What does it mean?

Comment [b212]: Rephrase the sentence. Long and unclear.

Comment [b213]: Old literature

Comment [b214]: Rewrite to make it clear

56 (Barnes, 1954). Nitrogen was found to increase the sugar tonnage of the crop (Humbert, 1968).

Comment [b215]: Old literature

57 Also, according to Lakshmi, et al., 2003 application of the recommended dose of fertilizer (150

58 kg ha⁻¹) in two equal splits either at planting and within 30 days after planting (DAP) or at 30

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59 and 60 DAP benefited the crop so that more millable canes were produced at harvest which

60 ultimately resulted in increased cane and sugar yield. Application of N in splits increased the

61 fertilization program cost, but its use was justified by increased sugar yield (Obreza and Pitts,

62 1998).

63 Sugar is a very important dry matter of Sugarcane. The principal components of dry matter in

64 Sugarcane include: Total sugar, Sucrose, Reducing sugar (i.e Glucose and Fructose) and Crude

65 fibre (Lingle and Irvine, 1994; Kang et al; 1983). It has also been noted that the amount of sugar

66 stored by different sugarcane varieties and clones depend on the size and efficiency of the

67 photosynthetic system, ability of the sugarcane to translocate, the size of the storage tissues

68 and partition of the photosynthetes for growth and storage (Oworu, 1988). Sucrose stored in

69 the sugarcane decreases relative to low soil fertility and soil moisture (Loehwin, 1953; Clement,

Comment [b216]: Old literature

70 1959). Fibre is an important component of dry matter because of its inverse relationship to

71 juice extraction. Breaux (1972) reported that sugarcane varieties with low sucrose

72 concentration have high fibre content.

73

74 2.0 Materials and Methods

75 The study was carried out as field experiments. The field trials were conducted in 2000/2001

76 cropping seasons at the Teaching and Research Farm of Olabisi Onabanjo University, Ago-Iwoye

77 (Latitude 06.47N; Longitude 03.58E). Prior to planting, surface soil samples (0-15cm) were
 78 collected from the site and bulked for routine analysis and the result is presented in table 1.

79 Table 1: PRE- PLANTING SOIL ANALYTICAL RESULTS

Soil properties	Values
pH 5.6	
Organic carbon (g kg ⁻¹)	2.11
Total Nitrogen (g kg ⁻¹)	0.30
Available P (mg kg ⁻¹)	0.06
Exchangeable Ca (cmol kg ⁻¹)	0.30
Exchangeable Mg (cmol kg ⁻¹)	0.31
Exchangeable Mn (cmol (+) kg ⁻¹)	72.10
Exchangeable K (cmol kg ⁻¹)	0.03
Exchangeable Na (cmol kg ⁻¹)	0.74
Sand (g kg ⁻¹)	670
Silt (g kg ⁻¹)	170
Clay (g kg ⁻¹)	160

80
 81 Four varieties of sugarcane were used for the study namely: Co62175,
 82 NCS 005, NCS 004 and NCS 003 (where NCS means National Cereal Sugarcane). The experiment
 83 was laid out using a Randomized Complete Block Design (RCBD) and replicated three times.
 84 The whole area of land used was 8m by 11m. Each plot size was 2m by 2m with 1m alley way
 85 between the plots. Setts of sugarcane of 18cm in length with at least 2 auxiliary buds treated
 86 with furadam (fungicide) as seed dressing were planted in the furrows at an angle of 45° with
 87 one cuttingscutting per stand at a spacing of 90 x 90 cm and spacing between furrows was 1.5m
 88 apart. The first weeding was carried out 3 Weeks after Planting (WAP) and followed by
 89 subsequent ones at 6 and 8 weeks respectively. Basal application of NPK fertilizer (20:10:10)
 90 was done at 6 weeks at a recommended rate of 112 KgNPK/ha. Rodents attack on the crop was
 91 prevented by use of traps and clearing of the surrounding bushes about 1m away. Diseases

Comment [b217]: Use correct SI units

Comment [b218]: Rephrase. Not clear.

Comment [b219]: Consider: Soil properties of the experimental site

Comment [b220]: Realign correctly

Comment [b221]: Correct the SI unit for other parameters

Comment [b222]: Units are usually in %

Comment [b223]: Include a column on method of analysis e.g. pH in water or KCl etc

Comment [b224]: State the experimental design

Comment [b225]: Rephrase to make it clear

92 infestations were also controlled. The sugarcane was harvested at maturity. Data were
93 collected on cane weight, yield and dry matter components (i.e. % Sucrose, Total sugar,
94 Reducing sugars and Crude fibre). The data were later subjected to 2 ways of analysis of
95 variance (ANOVA) and means separated using Least Significant Difference (LSD) at P = 0.05.

Comment [b226]: State the age of harvesting

Comment [b227]: State the method used and cite literature

96 3.0 Results and Discussion

97 **PRE-PLANTING SOIL ANALYSIS:** The result of the pre-planting soil analysis (to affirm the soil
98 conditions) is presented in Table 1.

Comment [b228]: Briefly interpret the soil test results

99 3.1. Response of the sugarcane varieties to NPK fertilization during the wet season 2000

100 The results of the cane weight and yield of sugarcane (*Saccharum officinarum* L) are shown
101 below in Fig 1 and 2.

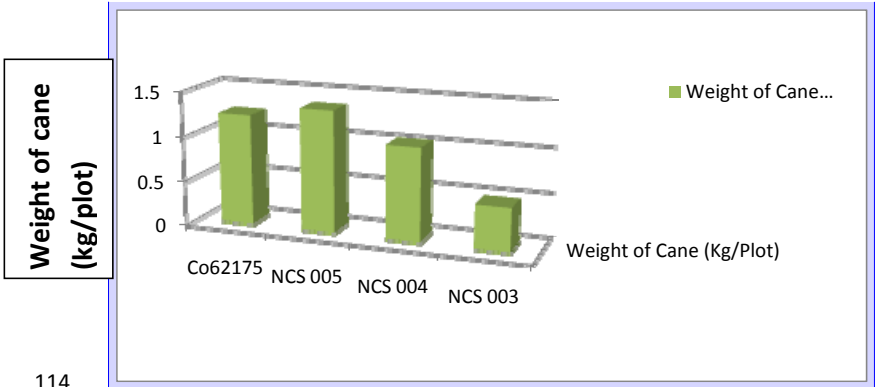
102 There was significant differences between the varieties in terms of cane-weight and yield to the
103 application of NPK (20:10:10) Fertilizer. The values of cane weight ranged from 1.35 to 0.48
104 kg/plot. NCS 005 had the highest value of 1.35 kg while the lowest was obtained from NCS 003
105 (0.48kg) (Figure 1). This result was reflected in the yield of the sugar-cane which ranged from
106 9.74 t/ha to 4.11 t/ha. The NCS 005 had the highest yields of 9.74 t/ha while the lowest value
107 was from NCS 003 (4.11 t/ha) (Fig. 2). Thereby suggesting a close relationship between the
108 weight of cane and yield of the sugarcane.

Comment [b229]: 0.48 to 1.35

Comment [b230]: Clarify. These values seem not to add up with kg/plot. Convert 1.35kg per 4m² plot to ha which is 10000m².

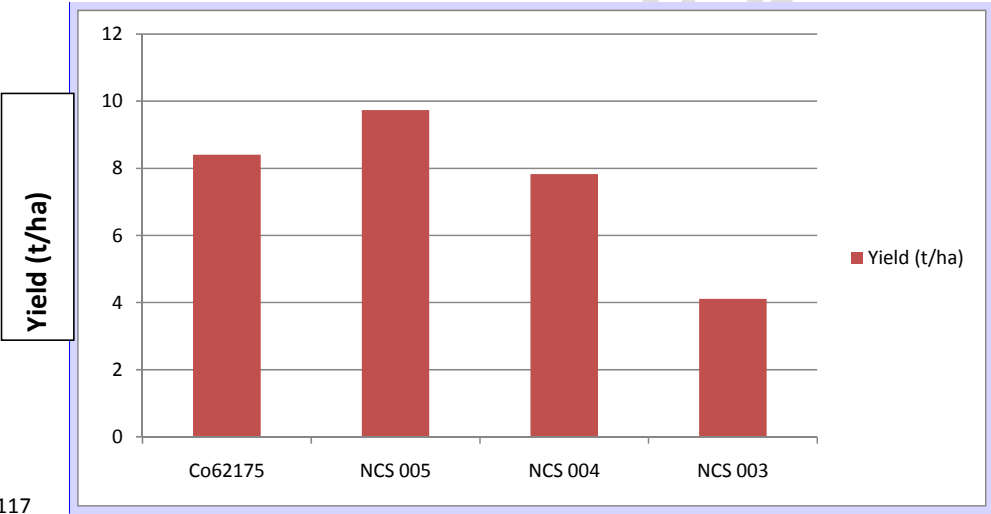
Comment [b231]: This is obvious

109 Application of the recommended dose of fertilizer (150 kg ha⁻¹) in two equal splits either at planting
110 and within 30 days after planting (DAP) or at 30 and 60 DAP benefited the crop so that more
111 millable canes were produced at harvest which ultimately resulted in increased cane and sugar yield
112 (Lakshmi *et al.*, 2003). Application of N in splits increased the fertilization program cost, but its use
113 was justified by increased sugar yield (Obreza and Pitts, 1998).



Comment [b232]: Include the y and x axis labels

114
115 Fig.1: Effect of NPK (20:10:10) Fertilizer on Cane_weight of different sugarcane varieties during
116 the wet season in South-west Nigeria.



Comment [b233]: Include the x and y axis labels.

117
118 Fig.2: Yield response of different sugarcane varieties to NPK Fertilizer (20:10:10) during the wet
119 season in South -West Nigeria.

120 The dry matter components of the four varieties of sugarcane in response to NPK fertilizer
121 (20:10:10) is also shown in the table 3

There were significant differences between the varieties in all the components of dry matter (% sucrose, % glucose, % total sugar and % crude fibre) except % Fructose (Table 3). The value of % sucrose ranged from 6.83 % for variety Co62175 to 2.73 % for variety NCS 003 (Table 3). Similar results were obtained for % glucose, % fructose and % total sugar. Highest value of % glucose (2.33) was obtained for Co62175 and lowest value of 0.55 in the NCS 003 (Table 3) while in the % fructose, highest value was also recorded in variety Co62175 with 1.27 and lowest value of 0.39 was obtained in the NCS 003 (Table 3). The value of % total sugar ranged from 12.61 for variety Co62175 to 7.81 for NCS 003 variety (Table 3). Conversely, the % crude fibre values ranged from 9.34 for variety NCS 003 to 2.61 for variety Co62175 (table 3).

Table 3: Dry Matter Components of Four (4) Varieties of Sugarcane varieties as Influenced by NPK fertilizer (20:10:10) during the wet season in South-west Nigeria.

Varieties	% Sucrose	% Glucose	% Fructose	% Total Sugar	% Crude Fibre
Co62175	6.83	2.33	1.27	12.61	2.61
NCS 005	5.75	2.07	1.25	10.98	4.74
NCS 004	4.93	1.40	1.20	10.66	4.01
NCS 003	2.73	0.55	0.39	7.81	9.34
LSD (0.05)	1.680	1.780	17.53	2.225	2.063
CV (%)	7.64	20.43	25.07	7.02	9.27

Comment [b234]: Re - Check this value!!

	xx	xx	NS	xx	xx
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136 **xx** = highly significant, **NCS** = National Cereal Sugarcane hybrid, **NS** = Not significant.

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138 **3.2. Response of the four varieties of sugarcane to NPK fertilization under irrigation**

Comment [b235]: Consider the comments showed in section 3.1 especially the graphs and tables

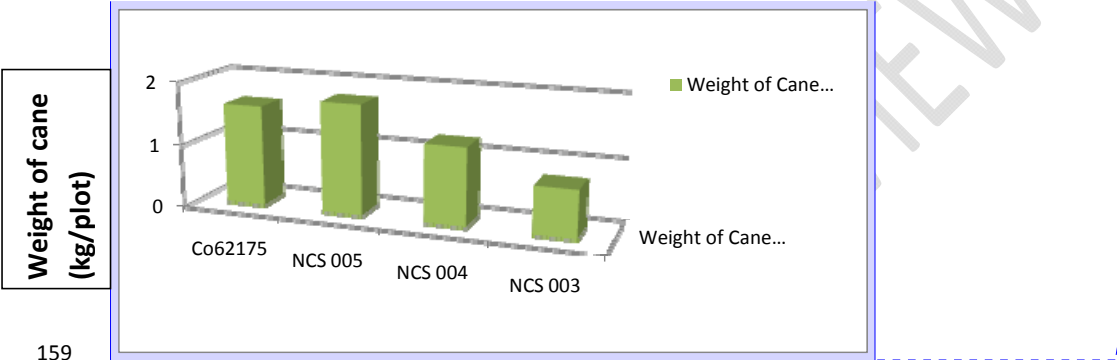
139 The results of the dry matter, cane weight and yield of sugarcane (*Saccharum officinarum* L)
140 under irrigation are shown below in Table 4, Fig 4, 5 respectively. The same trend that was
141 observed under wet season was recorded during the irrigation.

142 The values of cane weight ranged from 1.75 to 0.70 kg/plot. NCS 005 had the highest value of
143 1.75 kg while the lowest was obtained from NCS 003 (0.70kg) (Figure 4). The same result was
144 recorded in the yield of the sugar-cane which ranged from 10.1 t/ha to 3.95 t/ha. The NCS 005
145 had the highest yields of 10.1 t/ha while the lowest value was from NCS 003 (3.95 t/ha) (Fig. 5).
146 There was significant differences between the varieties in terms of cane-weight and yield to the
147 application of NPK (20:10:10) Fertilizer.

148

149 Also, there were significant differences between the varieties in all the components of dry
150 matter (% sucrose, % glucose, % total sugar and % crude fibre) except % Fructose (Table 4).
151 The value of % sucrose ranged from 7.15 for variety Co62175 to 3.70 for variety NCS 003 (Table
152 4). Similar results were obtained for % glucose, % fructose and % total sugar. Highest value of
153 % glucose (3.40) was obtained for Co62175 and lowest value of 1.23 in the NCS 003 (Table 4)

154 while in the % fructose, highest value was also recorded in variety Co62175 with 2.21 and
155 lowest value of 1.03 was obtained in the NCS 003 (Table 4).
156 The value of % total sugar ranged from 12.90 for variety Co62175 to 8.41 for NCS 003 variety
157 (Table 4). Conversely, the % crude fibre values ranged from 9.63 for variety NCS 003 to 3.14 for
158 variety Co62175 (table 4).



Comment [b236]:

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160 Fig.4: Effect of NPK (20:10:10) Fertilizer on Cane-weight of different sugarcane varieties under
161 irrigation in South-west Nigeria.

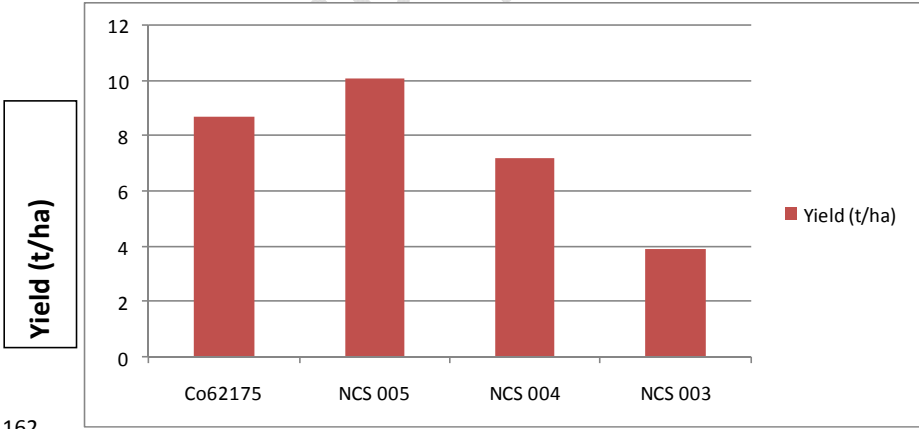


Fig.5: Yield response of different sugarcane varieties to NPK Fertilizer (20:10:10) under irrigation in South -West Nigeria.

Table 4: Dry Matter Components of Four (4) Varieties of Sugarcane as Influenced by NPK fertilizer (20:10:10) under irrigation in South -west Nigeria.

Varieties	% Sucrose	% Glucose	% Fructose	% Total Sugar	% Crude Fibre
Co62175	7.15	3.40	2.21	12.90	3.14
NCS 005	6.50	3.12	2.13	10.24	4.81
NCS 004	5.12	2.40	2.06	9.78	4.25
NCS 003	3.70	1.23	1.03	8.41	9.63
LSD (0.05)					
CV (%)	xx	xx	NS	xx	xx

Comment [b237]: Where are the values!!!!

xx = highly significant, **NCS** = National Cereal Sugarcane hybrid, **NS** = Not significant.

4. Conclusion:

The results obtained from the study showed that application of 112kgNPK /ha Fertilizer increased the Weight of cane, yield and improve the dry matter components of the sugarcane (*Saccharum officinarum* L.) depending on the varieties of the cane. It also affirmed that varieties Co66175 and NCS005 gave more sugar concentration and yield respectively in response to NPK (20:10:10) fertilizer when compare to NCS 004 and NCS 003. Also, it showed

Comment [b238]: The concentration of sugar is usually measured in pol % and not dry matter components. Please explain why you did not measure pol %, brix % and fibre %, purity, CCS – commercial cane sugar

176 that NCS 003 gave the highest crude fibre content than the other varieties. Therefore, if these
177 two varieties (Co66175 and NCS005) can be incorporated into sugarcane production
178 programme, it might turn around the fortune of the country.

Comment [b239]: Rephrase. Being released varieties means they are in the cultivation programme. Is the issue being not incorporated or adoption by the cane growers!!!!

179 **References:**

Comment [b240]: Ensure is as per the requirements of the paper

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