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Original Research Article

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

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 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 p= 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 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 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 increase the dry matter components of the plant and which were found to be significant in % sucrose, glucose , total sugar and rude fibre. The highest % sucrose, Glucose and total sugar was obtained from Co6215, while the lowest was obtained from NCS003. Crude fibre percentage was also found to be significantly different in the four varieties at 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.

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; FA0 2004; Sreenivasan et al. 1987).The stems are the main target of cultivation from which sugar is extracted

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

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

~~Sugar is a very important dry matter of Sugarcane.~~ The principal components of dry matter in Sugarcane include: Total sugar, Sucrose, Reducing sugar (i.e Glucose and Fructose) and Crude fibre (Lingle and Irvine, 1994; Kang et al; 1983). It has also been noted that the amount of sugar stored by different sugarcane varieties and clones depend on the size and efficiency of the photosynthetic system, ability of the sugarcane to translocate, the size of the storage tissues and partition of the photosynthetes for growth and storage (Oworu, 1988). Sucrose stored in the sugarcane decreases relative to low soil fertility and soil moisture (Loehwin, 1953; Clement, 1959). Fibre is an important component of dry matter because of its inverse relationship to juice extraction. Breaux (1972) reported that sugarcane varieties with low sucrose concentration have high fibre content.

2.0 Materials and Methods

The study was carried out as field experiments. The field trials were conducted in 2000/2001 cropping seasons at the Teaching and Research Farm of Olabisi Onabanjo University, Ago-Iwoye (Latitude 06.47N; Longitude 03.58E). Prior to planting, surface soil samples (0-15cm) were collected from the site and bulked for routine analysis and the result is presented in table 1.

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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

Four varieties of sugarcane were used for the study namely: Co62175, NCS 005, NCS 004 and NCS 003 (where NCS means National Cereal Sugarcane). The experiment was laid out using a Randomized Complete Block Design (RCBD) and replicated three times. The whole area of land used was 8m by 11m. Each plot size was 2m by 2m with 1m alley way between the plots. Setts of sugarcane of 18cm in length with at least 2 auxiliary buds treated with furadam (fungicide) as seed dressing were planted in the furrows at an angle of 45° with one cuttings per stand at a spacing of 90 x 90 cm and spacing between furrows was 1.5m apart. The first weeding was carried out 3 Weeks after Planting (WAP) and followed by subsequent ones at 6 and 8 weeks respectively. Basal application of NPK fertilizer (20:10:10) was done at 6 weeks at a recommended rate of 112 KgNPK/ha. Rodents attack on the crop was prevented by use of traps and clearing of the surrounding bushes about 1m away. Diseases infestations were also controlled. The sugarcane was harvested at maturity. Data were collected on cane weight, yield and dry matter components (i.e. % Sucrose, Total sugar, Reducing sugars and Crude fibre).

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The data were later subjected to 2 ways ~~of~~ analysis of variance (ANOVA) and means separated using Least Significant Difference (LSD) at P = 0.05.

3.0 Results and Discussion

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

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

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

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

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

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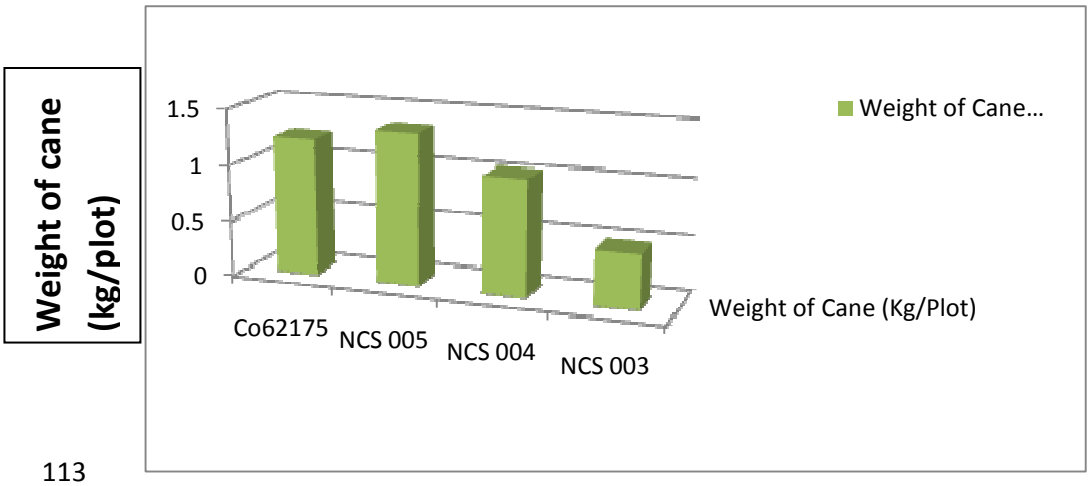

Fig.1: Effect of NPK (20:10:10) Fertilizer on Cane-weight of different sugarcane varieties during the wet season in South-west Nigeria.

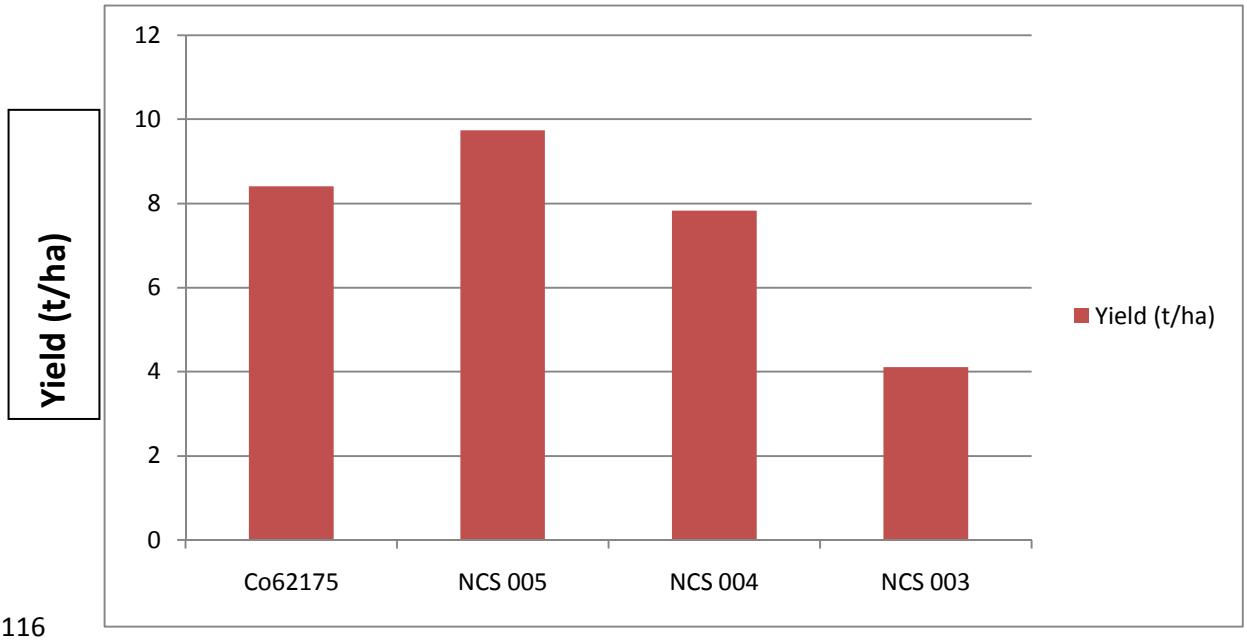

Fig.2: Yield response of different sugarcane varieties to NPK Fertilizer (20:10:10) during the wet season in South -West Nigeria.

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

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There were significant differences between the varieties in all the components of dry matter (% sucrose, % glucose, % total sugar and % crude fibre) excerpt % 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 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

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	xx	**xx**	**NS**	**xx**	**xx**

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

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

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

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

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

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while in the % fructose, highest value was also recorded in variety Co62175 with 2.21 and lowest value of 1.03 was obtained in the NCS 003 (Table 4).

The value of % total sugar ranged from 12.90 for variety Co62175 to 8.41 for NCS 003 variety (Table 4). Conversely, the % crude fibre values ranged from 9.63 for variety NCS 003 to 3.14 for variety Co62175 (table 4).

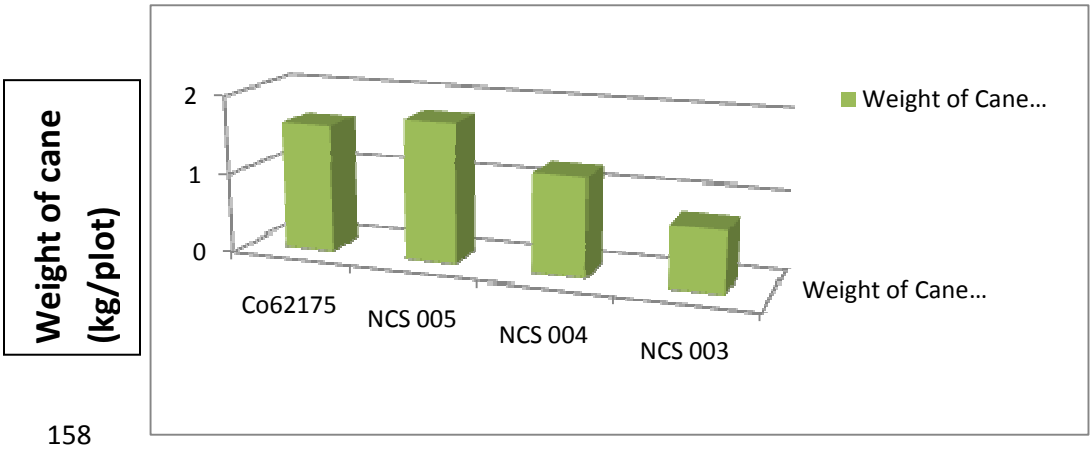

Fig.4: Effect of NPK (20:10:10) Fertilizer on Cane-weight of different sugarcane varieties under irrigation in South-west Nigeria.

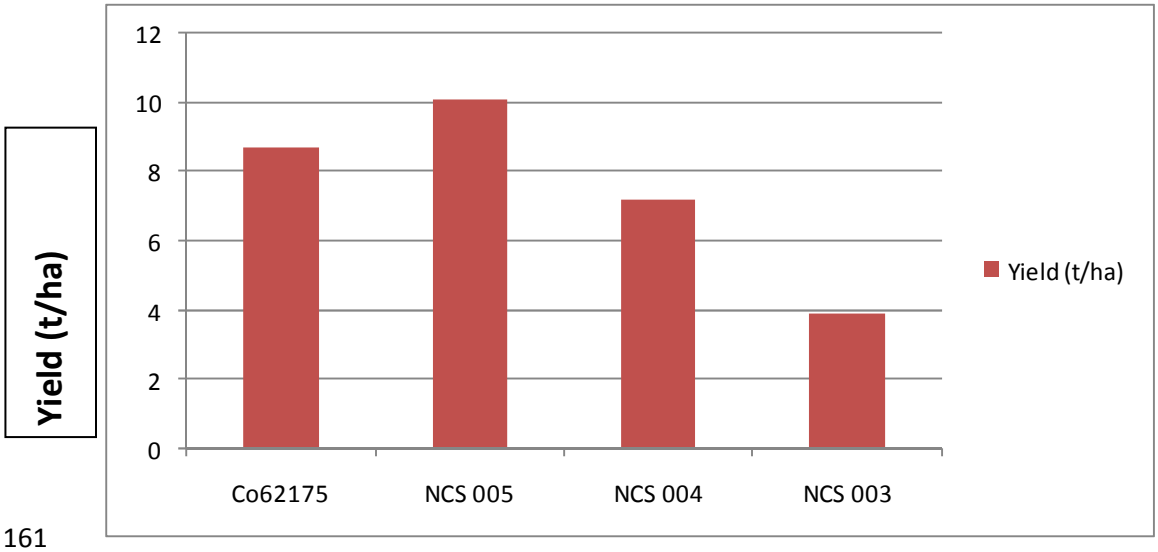

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Fig.5: Yield response of different sugarcane varieties to NPK Fertilizer (20:10:10) under irrigation in South -West Nigeria.

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**

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

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

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