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RESEARCH TITLE

EVALUATION OF THREE SUGARCANE CULTIVARS (*Saccharum officinarum* L.) FOR QUANTITATIVE AND QUALITATIVE TRAITS

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Abstract

A field experiment was carried out in season 2014-2015 at Sinnar Sugarcane Farm, Sinnar State, to evaluate and select sugarcane varieties of better performance specially quantitative and qualitative characteristics. The treatments comprised three varieties of sugarcane, namely Co 527, Co 997 and Co 6808. The experiment was laid out in a randomized complete block design with three replications. The main parameters which were studied to compare between the three varieties are internodes number, stalk height (cm), stem diameter (cm) and plant density for quantitative characters, Brix %, pol% and fiber % of cane and of juice for qualitative characters. The results showed that, internodes number, stalk height (cm) stem diameter (cm) and plant density were significantly increased with time at 7, 8 and 9 months after sowing. Highest internodes number, stalk height (cm), stem diameter (cm) and plant density were recorded to significant with Co 6806 variety then Co 997 variety and Co 527 variety. Brix % and pol % of cane and juice of Co 6806 variety were significantly higher than Co 997 variety and Co 527 variety. The study recommended that, the variety Co 6806 is better than the other varieties.

عنوان البحث

تقييم واختبار ثلاثة أصناف قصب سكر فيما يخص الصفات الكمية والنوعية

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المستخلص

أجريت تجربة حقلية بمزرعة سكر سنار (ولاية سنار/ السودان) في موسم 2014- 2015م لتقييم واختبار أصناف قصب سكر فيما يخص الصفات الكمية والنوعية. المعاملات شملت ثلاثة أصناف هي Co 997, Co 527 و Co 608. صممت التجربة بطريقة القطاعات العشوائية الكاملة بثلاثة مكررات. القياسات الرئيسية التي خضعت لمقارنة الأصناف للصفات الكمية تضمنت طول الساق، كثافة النباتات وعدد العقد، وللصفات النوعية Brix% وPol% ونسبة الألياف المئوية للقصب والعصير. أوضحت النتائج وجود زيادة معنوية في عدد العقد وطول الساق وسمك الساق وكثافة القصب مع الزمن. للصفات الكمية الصنف Co 6806 كان الأكثر معنوية في عدد العقد وطول الساق وسمك الساق وكثافة القصب من الصنف Co 527 و الصنف Co 997 ، وفي الصفات النوعية للقصب والعصير الصنف Co 6806 كان الأكثر معنوية من الصنف Co 997 و الصنف Co 527 ، توصي الدراسة بالصنف Co 6806 لانه الأعلى في الصفات الكمية والنوعية من الصنفين Co 997 و Co 527.

Introduction

Sugar cane is a tall growing monocotyledonous crop plant that is cultivated in tropical and subtropical regions of the world primarily for its ability to store high concentrations of sucrose or sugar in the internodes of the stem (Tai and Miller, 2001). Modern sugarcane varieties that are cultivated for sugar production is complex inter specific hybrids *Saccharum spp* that have arisen through intensive selective breeding of species within the Saccharum genus primarily involving crosses between the species *Saccharum officinarum* L and *Saccharum spontaneum* L (Cox *et al.* ,2000).

Sugarcane is capable of rapidly depleting nutrients of soil, particularly nitrogen, phosphorus and potassium, so there is need for addition of adequate amount of nitrogen, phosphorus and potassium fertilizers during the growth of sugarcane (Wood, 1990). Although there is no consistent statistically significant interaction has been shown to exist between nitrogen, phosphorus and potassium fertilizers, a review of literature shows that inputs of nitrogen, phosphorus and potassium fertilizers must be balanced to optimize sugarcane production for high yield and good juice quality, in most sugarcane producing countries of the world the nitrogen, phosphorus and potassium fertilizers ratio is 2:1:3 or 2:1:2 or 3:1:5 (Milford *et al.*, 2000).

The origin of sugar cane is in the South Pacific Islands and New Guinea, and it is cultivated as far as north as 36.7˚ (Spain) and as far as south as 31˚ (South Africa) (Irvine, 1981).

The genus Saccharum consists of 35- 40 species and has two centers of diversity: the old world (Asia and Africa) and the new world (North, Central and South America). Asia has approximately twenty five native species, North America has six native species and four or five introduced species, and Central America has three or four native species and some introduced species (Webster and Shaw, 1995). Africa has two native species and Australia have one naturalized species (Darke, 1999; Bonnett *et al.*, 2008).

The modern sugarcane cultivars originated from South East Asia (Daniels and Roach, 1987). *Saccharurm officinarum* and *Saccharum spontaneum* are the major contributors to the genomes of modern verities of sugar cane.

The center and origin of *Saccharm officinarum* is Polnesia, and the species was disseminated throughout South East Asia, where modern center of diversity was created in Papua, New Guina and Java (Indonesia) (Daniels and Roach, 1987).

The center and origin and diversity of *Saccharm spontaneum*n is more temperate regions of subtropical India, because, these species can grown in wide range of habitats and latitude (in both tropical and temperate regions), it is currently spread over latitudes ranging from 8˚S to 40˚N in three geographic zone,

a) East in the South Pacific Island, Philippines, Taiwan, Japan, China, Vitnam, Thailand, Malaysia and Myanmar.

b) Central, in India, Nepal, Bangladesh, Srilanka, Afghnistan, Iran and the Middle East.

c) West, in Egypt, Kenya, Sudan, Uganda, Tenzania and other Mediterranean

Countries.

These zones roughly represent natural cytogeographical clusters because *Saccharm spontenum* trends to present a different number of chromosomes in each of these locations (Tai and Miller, 2001).

The genus Saccharum comprises six species:

i. *Saccharum officinarum* L. has a chromosome number of 2n= 80, with basic chromosome number (x) of 10 making this species a polyploidy (having more than two chromosome sets). However, *Saccharum officinarum* L. is not a simple polyploidy, it is complex hybrid of different species it is an autopolyploid (more than two sets of homologous chromosomes derived from a single species) and also allopolyploid (possessing two or more unlike sets of chromosome (Sreenivasan *et al*., 1987).
ii. *Saccharum spontaneum* is smaller, high polymorphic disease resistant, high fiber and highly vigorous species, having 2n= 40 to 128 chromosomes, it is also a complex polyploidy with a probable basic chromosome number of 8 to 10 (Sreenivasan *et al*., 1987; D"Hont *et al*., 1996). It can be distinguished from the other cultivated Saccharum by thinner canes and narrow panicle (Pursglove, 1972).
iii. *Saccharum barberi* and *Saccharum sinense* are thought to be wild species, but have been in cultivation since prehistoric times in northern India and China respectively, this had lead to considerable interbreeding with other genera and species, and consequently these species are thought to be ancient intergenric hybrids (Daniels and Roach, 1987).
iv. *Saccharum robustum* is a wild species thought to be an intermediate step in the evolutionary pathway between *Saccharum spontaneum* and *Saccharum officinarum* L., the two major groups with species are known that have 2n= 60 and 2n= 80 chromosomes respectively (Jeswiet,1929). *Saccharum robustum* is a wild sugar cane adapted to broad environmental condition, it possesses a high fiber content and vigorous stalk that are 2.2 to 4.4 cm in diameter, and up to10 meter high, the culms are hard and have little juice and poor in sugar content.
v. *Saccharum edule* is similar morphologically to *Saccharum robustum*, except that, the flower spike or inflorescence is compacted, and it is cultivated as a vegetable in the Islands of the Pacific and Papua New Guinea, *Saccharm edule* is thought to be derived from introgression of *Saccharum officinarum* L. or *Saccharum robustum* with other genera (Daniels and Roach, 1987).

The objective of this study is to evaluate of three sugarcane *Saccharum officinarum* L. cultivars for quantitative and qualitative traits in clay soil, Sudan.

MATERIALS AND METHODS

A field experiment was conducted for one season 2014-2015 to evaluate of three sugarcane *Saccharum officinarum* L. cultivars for quantitative and qualitative traits in clay soil, Sudan. The experiment was conducted in Sinnar Sugar Factory Farm 280 kilometers south of Khartoum in Central Clay Plain of Sudan. The experimental site lies within Latitude of 13.6° N, Longitude 33° E and Altitude 135 meter above the sea. The area lies in semi tropical savanna, the annual rain fall is 400-450 mm mostly

falling from June to October, and annual temperature about 28˚C per day, maximum of 32˚C in May and minimum of 23˚C in January.

The area of the experiment was prepared by ploughing, harrowing, leveling and ridging, the distance between rows was 1.5 m and the width of row was 0.75 m. The rows were divided into 12 sections, each one contains four treatments, and the channels go through these sections.

The treatment was laid out in a factorial randomized complete block design with four replicates. The treatments consisted of three varieties (Co 6806, Co 997 and Co 527).

Seed prepared by obtain stalk from young plant age from 9-11 months, then cut to a part which contain at least three internodes with active, healthy and not damage buds (this cutting called sets). Cane sets arrangement was sown as continuous double set arrangement along with at the bottom of the ridges in the experimental units, this method was used to avoid replanting, frequently irrigation was carried out after buried cane sets with soil manually using hand hoe. Gesapax and Gesaprium were used at rate of 2.4: 2.4 Kg /ha. Application of herbicide was done before the second irrigation.

Ten millable stalks were randomly cut and collected from the inner two rows of each plot to measure the mean of stalk height (cm), internodes number, stem diameter (cm) and plant density.

When the cane was 12-months old, ten millable stalks were selected at random from the sampling area in each plot. The juice was extracted with a 3-rollerr mill, analyzed according to the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) (1979).The following measurement were taken from the sample extract Brix %, Pol % juice, Pol % cane, Fibre % cane

Analysis of variance (ANOVA) was used to analyze the data. The computer Package Statistical Analysis System (SAS) version (21) was used for all data analysis according to the standard procedure of the Factorial Randomized Complete Block Design. Means were separated using LSD. The level of significance was set to$\leq$ 0.05.

RESULTS

Internodes number, stalk height, stem diameter and plant density of the three varieties of sugarcane (Co 6806, Co 527 and Co 997) were significantly ($p\leq 0.05$) increased within time at 7, 8 and 9 months after sowing. The higher of internodes number, stalk highest, stem diameter and plant density were significantly ($p\leq 0.05$) given by the variety Co 6806 followed by Co 527 and Co 997 at 7,8and 9 months after sowing (Table 1, Table 2, Table 3 and Table 4). The improved sugarcane varieties developed through increasing the sugarcane productivity in all cane growing countries (Mohamed *et.al*. 2004). Information of internodes number, stalk height, stem diameter and plant density is required for evaluation and selection of sugarcane varieties as they are indicators for yield (Chang and Milligan, 1992; Mohamed et. al., 2004). The variety Co 6806 overcame the two other varieties in internodes number; stalk heighest, stem diameter, which was reported to be a reliable trait for selection (Tai and Miller, 1989) and plant density that reported to be most important component of cane yield (Milligan *et. al*., 1990).

Characteristics quality of variety Co 6806 cane were significantly ($p \leq 0.05$) increased more than variety Co 997 and variety Co 527. The highest Brix% cane , Pol% cane and fiber % cane, and the highest Brix % juice and Pol % juice significantly ($p \leq 0.05$) given by variety Co 6806 followed by Co 997 and Co 527 (Table 5 and Table 6). Improvement of sugar content is believed to be more beneficial as that of improvement of cane yield (Jackson, 2005). The variety Co 6806 also out matches the two varieties in two qualitative characters of cane and of juice, Brix% and pol%.

Table (1): Evaluation of internodes number of three sugarcane varieties at 7, 8 and 9 months after planting

Time (month)	Varieties			
	Co 527	Co 997	Co 6808	Mean
7	16.67^{d}	20.83^{bc}	21.08^{bc}	19.53^{c}
8	18.66^{c}	22.00^{bc}	22.33^{ab}	21.00^{b}
9	22.08^{bc}	23.66^{ab}	23.83^{a}	23.33^{a}
Mean	19.14^{b}	22.16^{ab}	22.41^{a}	
LSD		1.77		
C.V.%		13.44		

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (2): Evaluation of stalk heights (cm) of three sugarcane varieties at 7, 8 and 9 months after planting

Time (month)	Varieties			
	Co 527	Co 997	Co 6808	Mean
7	345.00^{e}	358.67^{d}	378.83^{cb}	360.83^{b}
8	347.50^{e}	371.08^{c}	383.58^{a}	367.39^{ab}
9	355.50^{de}	369.80^{cd}	390.58^{a}	371.96^{a}
Mean	349.33^{c}	366.51^{b}	384.33^{a}	
LSD	6.04			
C.V.	19.65			

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (3): Evaluation of stem diameter (cm) of three sugarcane varieties at 7, 8 and 9 months after planting

Time (month)	Varieties			
	Co 527	Co 997	Co 6808	Mean
7	1.90^{h}	1.83^{i}	1.93^{g}	1.89^{c}
8	2.02^{e}	1.99^{f}	2.13^{d}	2.05^{b}
9	2.16^{c}	2.23^{b}	2.28^{a}	2.22^{a}
Mean	2.03^{b}	2.02^{c}	2.11^{a}	
LSD	0.01			
C.V.	15.23			

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (4): Evaluation of plant density/ plot of three sugarcane varieties at 7, 8 and 9 months after planting

Time (month)	Varieties			
	Co 527	Co 997	Co 6808	Mean
7	137.50^{d}	136.83^{d}	143.33^{cd}	139.22^{c}
8	147.08^{c}	152.58^{bc}	153.42^{b}	151.03^{b}
9	162.00^{ab}	163.33^{ab}	164.08^{a}	163.14^{a}
Mean	148.86^{b}	150.91^{ab}	153.61^{a}	
LSD	4.73			
C.V.%	12.78			

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (5): Evaluation of cane quality of three sugarcane varieties

Character	varieties			
	Co 527	Co 997	Co 6808	Mean
Brix % cane	14.92^{cd}	15.16^{c}	15.97^{b}	15.35^{b}
Pol % cane	13.89^{d}	14.08^{d}	14.78^{cd}	14.25^{c}
Fiber % cane	17.33^{ab}	17.67^{ab}	17.76^{a}	17.59^{a}
Mean	15.38^{b}	15.44^{b}	16.17^{a}	
LSD	0.16			
C.V.	14.34			

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

Table (6): Evaluation of cane quality of three sugarcane varieties

Character	varieties			
	Co 527	Co 997	Co 6808	Mean
Brix % juice	20.86^{bc}	21.55^{ab}	22.28^{a}	21.56^{a}
Pol % juice	19.95^{cd}	20.22^{c}	21.15^{b}	20.44^{b}
Fiber % juice	17.33^{ab}	17.58^{d}	17.76^{d}	17.56^{c}
Mean	15.38^{b}	19.82^{a}	20.26^{a}	
LSD	0.91			
C.V.	11.90			

* Means within the same column followed by the same letter (s) are not significantly different at 0.05 level of probability according to LSD.

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