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A Promising Early Maturing Sugarcane Variety from the East African Sugar Development Project (EASDP)

Jonathan Mutonyi[1*], Michael Jones Khaemba[2]

[1]Faculty of Science, Department of Agriculture and Veterinary Sciences, Kibabii University, Bungoma, Kenya
[2]Department of Agriculture, Agronomy Section, Mumias Sugar Company Limited, Mumias, Kenya
Email: *jmutonyi@kibu.ac.ke, mkhaemba@mumias-sugar.com

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Abstract

Variety FR 95-2345 imported from Visacane, Cirad germplasm collection in Montpellier, France through the East African Sugar Development Project was evaluated along with five locally bred sugarcane varieties KEN 98-530, KEN 98-533, KEN 00-3811, KEN 82-472 and KEN 83-737 from 2017-2019 at Mumias in Western Kenya. The varieties were selected for earliness in maturity. Variety KEN 83-737 was included as a local standard and the plant crop was harvested at the age of 17 months. There were significant differences ($p \leq 0.05$) among the varieties in all sampled parameters. The highest yielding variety was KEN 83-737 at 135.6 t/ha followed by KEN 98-530 at 111.5 t/ha and FR 95-2345 at 95.6 t/ha. The lowest yield was recorded on variety KEN 82-472 at 37.9 t/ha. No common diseases and pests were observed on the crop throughout the experiments. From the result, one locally bred variety KEN 98-530 and FR 95-2345 imported from Cirad were promising, having achieved 82.7% and 70.5% yield compared with the local standard. There was no significant difference ($p < 0.05$) in cane quality from the Brix readings, however, variety FR 95-2345 recorded the highest top:bottom ratio of 0.77, a desirable indicator for earliness in maturity. Testing of the two varieties for ratooning ability is recommended. Promotion and expansion of the area under fast-maturing varieties will address the raw material shortage that has negatively affected the sugar industry in Kenya.

Subject Areas

Agricultural Science

Keywords

Early Maturing Variety, Germplasm, *Saccharum officinarum*, Sugarcane, Brix

1. Introduction

Overall performance of the sugar industry in Kenya has been on the decline in the last decade. The year 2017 recorded the lowest ever attained as total cane milled dropped to 4,640,771 tons from 7,411,303 tons representing a 37% decrease. Sugar made dropped by an enormous 41% from a high of 638,653 tons achieved in 2016 to a low of 375,012 tons in 2017. This was attributed to sugarcane shortage in the industry leading to underutilization of factory capacities [1]. The major commercial varieties currently in Kenya are of Indian and South African origin, and include Co 421, Co 617, Co 945 and N14 [2]. These varieties are of medium or late maturity (20 - 24 months). Promotion and expansion of fast maturing (14 - 18 months), high yielding, pest and disease-resistant varieties that are adapted to the cane growing conditions in Kenya could lead to faster recovery for the industry.

The East African Sugar Development Project (EASDP) was launched on 4th June 2007 and implemented for a period of six years till 2013. It was funded by Common Fund for Commodities (CFC) and supervised by International Sugar Organization (ISO). The project was conceptualized due to common sugarcane production challenges faced by the three East Africa Community (EAC) countries (Kenya, Tanzania and Uganda). Amongst the challenges faced by the EAC, sugar industry was low sugarcane productivity, high cost of production, and small and fragmented farms of out-growers. The overall project objective was to initiate measures that could increase cane productivity in the EAC sugar industry in order to improve industry performance, lower production costs, raise the incomes of out-growers and secure sustainability of the industry [3]. The project addressed the major limiting factors facing the industry, *i.e.*, low sugarcane productivity caused by the use of old varieties with low genetic potential; negative impact of diseases and pests; use of untreated seed cane and low level of crop management especially by out-growers. Specific intervention and measures were undertaken to mitigate major limiting factors. These included new varieties importation, selection and testing; clean seed cane production and distribution scheme targeting cane growers, and technology transfer to growers through participatory approaches [3]. It was through this project that the variety FR 95-2345 was received and subjected to further evaluation at Mumias in western Kenya.

2. Materials and Methods

Study Site

The study was conducted from 2017-2019 on the Mumias sugar estate farm situated 0˚21'N and 34˚30'E and 1314 m above sea level. The zone receives bi-modal rainfall ranging from 1500 - 2000 mm per annum with long rains peaking in April-May and short rains in September-October each year [4].

Experimental Design and Treatments

The experiment was laid out in a randomized complete block design (RCBD) with treatments replicated 3 times. Five locally bred sugarcane varieties KEN

83-737, KEN 98-530, KEN 98-533, KEN 00-3811, KEN 82-472 were tested along one imported variety FR 95-2345. KEN 83-737 was included as the local standard. The varieties were selected for earliness in maturity. Gross plot size was 1.5 m × 6 rows × 10 m = 90 m^2. The net plot size for data collection was 1.5 m × 4 rows × 10 m = 60 m^2. Three eye-budded setts were laid in furrows spaced 1.5 m apart. A physical count of the number of 3-eye budded setts planted hence the total number of eye buds expected to germinate per plot was done. Recommended basal P was supplied from Di-ammonium phosphate (DAP) and the recommended Nitrogen (N) from Urea at 92 kg P_2O_5/ha and 128 kg N/ha respectively. Other necessary agronomic practices were carried out as per the local recommendation.

Emergence, Tillering, Diseases and Pests

A physical count of emerged shoots was done at 30, 45 and 60 days after planting in the net plots. Emergence was calculated as the highest number of emerged shoots expressed as a percentage (%) of the expected. Tillering was assessed from 3 - 9 months after planting. A physical count of the total number of shoots in the net plot was done and extrapolated to establish the number of tillers/ha. Disease and pest observation were done monthly from 3 - 9 months after planting.

Stalk Height, Girth, Internode Length and Population

Stalk height, girth and internode length expressed in cm were recorded at harvest on 50 stalks from each net plot. A physical count of all stalks in the net plot was done and extrapolated to establish the stalk population per ha.

Cane Yield

Cane yield at harvest was determined by weighing all stalks from the net plots. A tripod stand and calibrated suspension balance were used. The weight (kg) realized was extrapolated to determine the cane yield in tons per hectare (t/ha).

Statistical Analyses

The data collected was subjected to analysis of variance (ANOVA) and means compared by the LSD test [5].

3. Results

Emergence, Tillering, Stalk Number, Height, Girth and Internode Length

Results obtained in this study showed that sugarcane emergence, tillering and the stalk parameters differed significantly ($p < 0.05$) among the treatments. Variety FR 95-2345 out-performed the local standard KEN 83-737 in tillering and girth but had lower final stalk population perhaps due to high tiller mortality (**Table 1**). The locally bred variety KEN 83-737 and imported FR 95/2345 compared favourably in stalk appearance (**Plate 1** and **Plate 2**).

Cane Yield and Juice Quality

There were significant differences ($p < 0.5$) in final yield among the varieties (**Table 1**). Variety KEN 83-737 recorded the highest yield at 135.6 t/ha followed by KEN 98-530 at 111.5 t/ha, FR 95-2345 at 95.6 t/ha, KEN 00-3811 at 78.7 t/ha,

Plate 1. General stalk appearance of the local standard.

Plate 2. General stalk appearance of the test variety.

Table 1. Performance of selected early maturing varieties at Mumias.

Variety	Emergence (%) (45 DAP)	Tillers/ha (`000) (3 - 7 m)	Stalk population/ha (`000)	Internode length (cm)	Stalk girth (cm)	Stalk height (cm)	Cane yield (t/ha)	Brix (T/B) ratio
KEN 83-737	75.6^{b}	111.741^{b}	139.610^{a}	10.4^{a}	1.7^{b}	231.8^{b}	135.6^{a}	0.62
KEN 98-530	80.6^{a}	124.185^{a}	115.943^{b}	8.8a^{b}	2.3^{a}	244.9^{a}	111.5^{b}	0.65
KEN 98-533	68.2^{c}	100.704^{c}	111.933^{b}	6.2^{b}	1.9^{b}	144.^{7e}	59.0^{e}	0.67
FR 95-2345	72.3^{bc}	123.518^{a}	111.167^{b}	9.5^{a}	2.3^{a}	208.7^{c}	95.6^{c}	0.77
KEN 00-3811	73.3^{b}	93.630^{c}	103.557^{b}	6.4^{b}	2.0^{b}	166.5^{b}	78.7^{d}	0.66
KEN 82-472	68.2^{c}	82.445^{d}	70.777^{c}	6.1^{b}	1.8^{b}	137.^{0f}	37.9^{f}	0.65
Mean	73.0	106.037	108.831	7.9	2.0	189.0	86.4	0.67
STDEV	4.7	16.771	22.3111	1.89	0.25	45.86	35.49	0.05
$LSD_{0.05}$	4.4*	10,067*	7.719*	2.7*	0.1*	4.17*	9.7*	0.17ns
CV (%)	12.8	20.1	8.7	10.3	0.7	2.7	13.7	7.4

*Means with the same superscript are not significantly different ($p < 0.05$) using Fischer's Least Significant Difference (LSD) procedure at 5% level of significance.

KEN 98-533 at 59.0 t/ha and lastly KEN 82-472 at 37.9 t/ha. Compared with the local standard KEN 83-737, yield of the test varieties in descending order was 82.7%, 70.5%, 58.0%, 48.5% and 27.9% for KEN 98-530, FR 95-2345, KEN 00-3811, KEN 98-533 and KEN 82-472 respectively. High yield in the local standard was attributed to low tiller mortality and high final stalk population. Low yield in variety KEN 82-472 was attributed to the low tiller number and final stalk population due to chewing in plots under this variety. From the juice quality, highest Brix top:bottom ratio of 0.77 was recorded on variety FR 95-2345

followed by KEN 98-533 with 0.67. The local standard KEN 83-737 recorded a ratio of 0.62 (Table 1). The maturation curve plotted on variety FR 95-2345 from 6 - 13 months showed that the variety achieved an estimated Brix T:B ratio of 0.84 at 13 months (Figure 1).

4. Discussion and Recommendation

Preliminary observations obtained in this study indicated that variety FR 95-2345 imported from Cirad through the East Africa Cane Improvement Network had shown promise in the plant crop trial in terms of yield and juice quality. The desired attribute of earliness in maturity was demonstrated by data on the maturation curve that estimated maturity at 14 months when a Brix T:B ratio of 1.0 was likely to be achieved (Figure 1). This work could complement efforts initiated by EASDP through the importation of 325 varieties selected from cane industries with similar growing conditions to those of the East Africa region [3]. Ongoing selection and evaluation of the imported varieties were reported to be in progress in growers' fields with some promising varieties likely to be adopted under rain-fed conditions in Tanzania [3]. Results of this study also suggest that variety FR 95-2345 that showed promise in western Kenya should be evaluated further in the first and second ratoon stages to establish its ratooning ability. The juice quality, % fibre levels and sugar yield potential per unit area should also be evaluated in the subsequent studies.

In Kenya, breeding of early maturing varieties (EMV) and early-stage selection trials are conducted at Mtwapa, Mombasa on the Kenyan coast and the varieties are designated as KEN series [6]. Advanced selection trials (Preliminary and Final) are conducted in various cane growing zones up-country in collaboration with sugar mills and farmers. Varieties that show promising results in one cycle (plant cane, first ratoon and second ratoon) in Final Variety Trials are released for commercial production [6]. The current study evaluated five KEN varieties released from this program for commercial production. From earlier

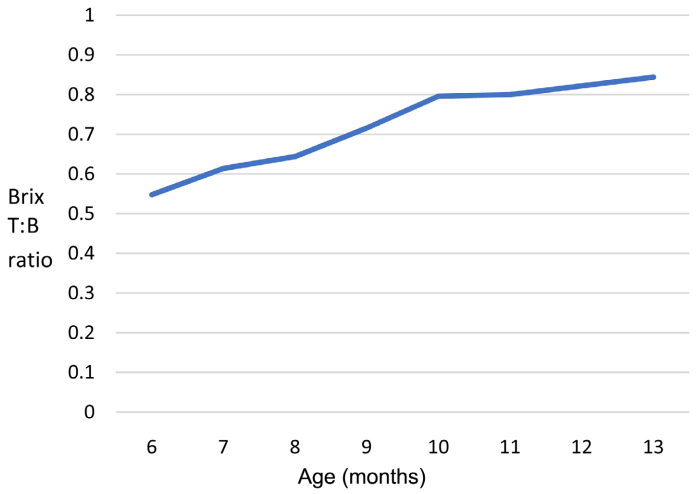

Figure 1. Maturation curve in variety FR 94-2345.

work, locally bred early maturing KEN varieties with potential for commercialization had been identified [7]. Final Variety Trials conducted in the Mumias, Chemelil, Kibos, Nzoia and South Nyanza zones from 1998 to 2003 indicated that six varieties, namely KEN 82-62, KEN 82-472, KEN 83-311, KEN 85-83, EAK 73-335 and EAK 73-293 were adaptable to at least two test environments and were proposed for release [6]. Further work recommended the release of KEN 82-216, KEN 82-219, KEN 82-247, KEN 82-401, KEN 82-808 and KEN 83-737. The key attributes of these varieties included early maturity (14 - 19 months), high sucrose content and high cane yield. Variety KEN 83-737 was subsequently adopted by growers and cultivated in the Mumias and South Nyanza zones [6]. The result from the current study corroborates these earlier findings.

5. Conclusion

From the current study, the variety FR 95-2345 imported from Cirad through the East Africa Cane Improvement Network (EACIN) showed the desirable attribute of earliness in maturity in the plant crop. The variety should be evaluated further in the first and second ratoon stages to establish its ratooning ability. The juice quality, % fibre and sugar yield should also be addressed in subsequent studies to ascertain the potential for commercial production in western Kenya and the larger East African region.

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Conflicts of Interest

The authors declare no conflicts of interest.

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