

SUGARCANE VARIETY IMPROVEMENT IN KENYA

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Abstract

Sugarcane (*Saccharum* spp. hybrids) has been cultivated commercially in Kenya since the early 1900s. Early efforts to identify improved sugarcane varieties for the young sugar industry involved importing and testing varieties for adaptation to local conditions. The major commercial varieties currently grown are of Indian and South African origin, and include Co 421, Co 617, Co 945 and N14. The first organised breeding programme was established in the mid-1960s to serve the then East African Community. The expansion of sugarcane cultivation into diverse agroclimatic conditions over the past 40 to 50 years has increased the demand for new improved varieties. At present the sugar industry occupies approximately 122 580 ha, distributed mainly along the equator. Mean annual rainfall in the main sugarcane producing zone is 1700 mm. Smut is the major disease of economic importance. The objective of the current variety improvement programme is to develop high yielding, pest and disease resistant varieties that are adapted to the cane growing conditions in Kenya. Intensive efforts to develop superior varieties for the Kenyan sugar industry over the past two decades have produced a substantial number of promising varieties. Six new Kenyan (KEN) varieties were released in November 2002. This paper gives a brief overview of the progress made in developing improved varieties for the Kenyan sugar industry.

Keywords: breeding, selection, Kenya, germplasm, variety release

Introduction

Commercial cultivation of sugarcane (*Saccharum* spp. hybrids) in Kenya was begun in the early 1900s in the Kibos area by Indian settlers, who used it to manufacture jaggery (Luckman, 1959), and by the early 1920s production had spread to the lowland coast at Ramisi. Between the mid-1960s and early 1980s, sugarcane production expanded to the Western and Nyanza provinces. Early efforts to identify improved sugarcane varieties for the Kenyan sugar industry involved the importation and testing of varieties for adaptation to local conditions and possible production (Anon, 1952; Sheffield, 1959). This led to the commercialisation of varieties such as Co 421, Co 617 and Co 331 in the 1950s and 1960s (Anon, 1952). More recently, Co 945, Co 1148, CB 38-22 and N14 were recommended for commercial production (Anon, 1990). The major commercial varieties in Kenya, Co 617, Co 421, N14 and Co 945 occupy 7.5, 15.4, 27.6 and 32.3% of the sugarcane acreage in Kenya, respectively.

The sugar industry in Kenya covers about 122 580 ha and produces about 500 000 tons of sugar annually. Although sugarcane is grown mainly in the highlands (Chemelil, Mumias, Nzoia, Kibos and South Nyanza) at an elevation of 1300 to 1700 m above sea level, there is great potential in the lowland coast. Mean annual rainfall ranges from 1000-1400 mm in the coastal lowlands and 1200-1900 mm in the highlands. The main physical constraints to sugarcane production are low and erratic rainfall, poorly draining soils and drought. Major

diseases include smut (*Ustilago scitaminea*, Sydow), sugarcane mosaic virus (SCMV), ratoon stunting disease (*Clavibacter xyli* subsp. *Xyli*), red rot (*Glomerella tucumanensis* [Speg.] Arx and Muller) and leaf scald (*Xanthomonas albilineans* Ashby, Dowson) (Jamoza, 2003).

The first attempt to produce varieties through an organised breeding programme was made in 1967 at Mtwapa on the Kenyan coast, under the aegis of the East African Community (Inniss, 1967). The programme initially developed and released the East African (EA) varieties, such as EAK 70-97 (Anon, 1990). The expansion of sugarcane cultivation into diverse agroclimatic conditions over the years has increased the demand for new improved varieties. Consequently, efforts to develop superior varieties for the Kenyan sugar industry have intensified during the past two decades (Jagathesan and Jamoza, 1987; Jamoza *et al*, 1994, 1996). The primary goal of the sugarcane variety improvement programme is to contribute to increased productivity and profitability through the development, dissemination and adoption of improved cultivars, thus enhancing the long-term competitiveness of the Kenyan sugar industry. Specifically, the programme aims at developing high yielding, pest and disease resistant varieties that are adapted to the cane growing conditions in Kenya.

Germplasm

Parental varieties for crossing are drawn from a collection of more than 500 varieties from diverse geographical origins assembled at the Kenya Sugar Research Foundation (KESREF) at Kibos (Table 1). The germplasm collection at Kibos is limited in number and variability. To provide more variability to the collection, an ample programme of variety exchange with other cane producing countries is required and has been initiated. In addition, locally bred varieties identified as having desirable characteristics during the selection process, have continuously been added to the collection over the past two decades. This approach will ensure that a gene pool adapted to regional conditions in Kenya is developed.

Table 1. Germplasm held in the collection at KESREF, Kibos, in 2005.

Variety	Origin	Number
B	Barbados	37
Bo, Co, CoK, CoS	India	79
CB, IAC	Brazil	10
CP, H, L	Canal Point (USA), Hawaii, Louisiana	48
D, DB	Demerara, Guyana, Barbados	17
EA	East Africa	101
F	Formosa	10
KEN	Kenya	159
M	Mauritius	13
MEX	Mexico	5
N, NCo	KwaZulu-Natal (South Africa)	17
Phil	Philippines	2
POJ	Java	5
PR	Puerto Rico	8
Q	Queensland (Australia)	11
Other	Other countries	28
Total		550

Hybridisation and variety selection

Crossing or hybridisation is conducted at KESREF's Sugarcane Breeding Centre, situated at Mtwapa (3°56'S, 39°44'E and 15 m above sea level) near Mombasa on the Kenyan coast, where flowering occurs under natural conditions (Jagathesan, 1985). The crossing season runs from September to December. About 20-40 thousand seedlings are produced yearly at Mtwapa by cross-pollinating desirable parents. The resulting seedlings are subjected to selection through a series of field trials in a five stage scheme that extends over 13-15 years (Table 2). The scheme comprises the following six stages: Individual Seedlings (stools), Single Row Plot, Observation Trial, Preliminary Variety Trial, Final Variety Trial, Bulking and Release.

Table 2. Generalised sugarcane variety selection scheme at KESREF.

Selection stage and year	Particulars	Selection criteria
	Hybridisation	Desirable parental traits
Stage 1 Year 1	Seedling Nursery 20,000-40,000 individual seedlings at Mtwapa	Brix, vigour, stalk number, freedom from naturally occurring diseases, freedom from major agronomic defects.
Stage 2 Year 2	Single Row Plots 2000-4000 varieties at Mtwapa including check varieties	Brix, stalk numbers, stalk diameter, flowering, freedom from naturally occurring diseases. Preliminary selection on plant cane. Final selection on combined plant and ratoon data.
Stage3 Year 3	Observation Trial 500-1000 varieties (including introductions) 2 locations (Mtwapa, Kibos)	Cane yield, brix, diseases, agronomic parameters. Pathology trials. Propagation plots established at Kibos. Pathology trials.
Stage 4 Years 4-7	Preliminary Variety Trial 40-60 varieties Plant cane + 2 ratoon crops 3 locations (Nyando, South Nyanza, Western)	Yields in plant and 2 ratoon crops, brix, ratoon assessment. Pathology trials. Initial selection on plant cane. Final selection made on basis of combined plant and ratoon crop data.
Stage 5 Years 8-12	Final Variety Trial 25-30 varieties Plant cane + 2 ratoon crops 3 locations Nyando, South Nyanza, Western	Cane yield, sugar yield, Pol % cane, mill test. Acceptable resistance levels to smut, mosaic. Agronomy trials. Elite varieties recommended for release.
Stage6 Years 13-14	Bulking and Release	Pre-release demonstration on growers' farms. Elite varieties are bulked to supply seedcane and released after examining performance data on yield, pest and disease resistance.

Early-stage selection trials are conducted at Mtwapa, while 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. The programme develops 'KEN' series varieties.

Promising varieties

During the past decade, the current programme has produced and tested more than 8500 varieties at stage 2, of which 40 have reached the final stage. KEN varieties with potential to replace the current commercial varieties have been identified (Jamoza *et al*, 1994; Jamoza, 1998). Final Variety Trials conducted in the Mumias, Chemelil, Kibos, Nzoia and South Nyanza zones from 1998 to 2003 indicate that six varieties, namely KEN 82-62, KEN 82-472, KEN 83-311, KEN 85-83, EAK 73-335 and EAK 73-293, are adaptable to at least two test environments and have been proposed for release (Jamoza, 2003).

Release of new varieties

In November 2002, the Ministry of Agriculture and Rural Development, through the National Variety Release Committee, released the following KEN varieties for commercial cultivation: 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 include early maturity (harvest in 15-19 months), high sucrose content and high cane yield. Varieties KEN 82-216, KEN 82-247, KEN 82-808 and KEN 82-737 currently cover 0.1 to 0.2% of the acreage in the Mumias and South Nyanza zones. Variety EAK70-97, which was released in 1992 and occupies about 20% of the cane area in South Nyanza (Anon, 2001), is so far the most successful of the EAK series. It is envisaged that locally bred varieties will soon replace the old imported varieties on commercial farms.

Conclusion

In view of the progress made over the past few years, KESREF is now capable of entering variety exchange ventures with other sugarcane breeding programmes around the world.

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