

Figure 2. *New plantain breeding strategy using diploid TMPx germplasm*

methods for germplasm enhancement are explored in collaboration with Dr. Robert L. Jarret (USDA-Georgia) and the Biotechnology Research Unit of IITA. The aim is to develop a molecular map of *Musa* using restriction fragment length polymorphisms (RFLPs), random amplified polymorphic DNA (RAPDs) and variable number of tandem repeats (VNTRs). Currently, the segregating populations (F2 and test crosses) have been field-established, phenotypically scored and the DNA extracted. The molecular map will be used for (a) germplasm management, (b) mapping important agronomic genes, (c) marker-assisted selection, and (d) development of a secure and rational management system for *in vitro* propagation and conservation of germplasm.

Plant regeneration from somatic cells, important for genetic engineering, is investigated in cooperation with the Catholic University of Leuven (KUL, Belgium). This research should lead to practical and reliable methods for the regeneration of transgenic *Musa* plants.

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East Africa

Domestic Banana-Beer Production in Mpigi District, Uganda

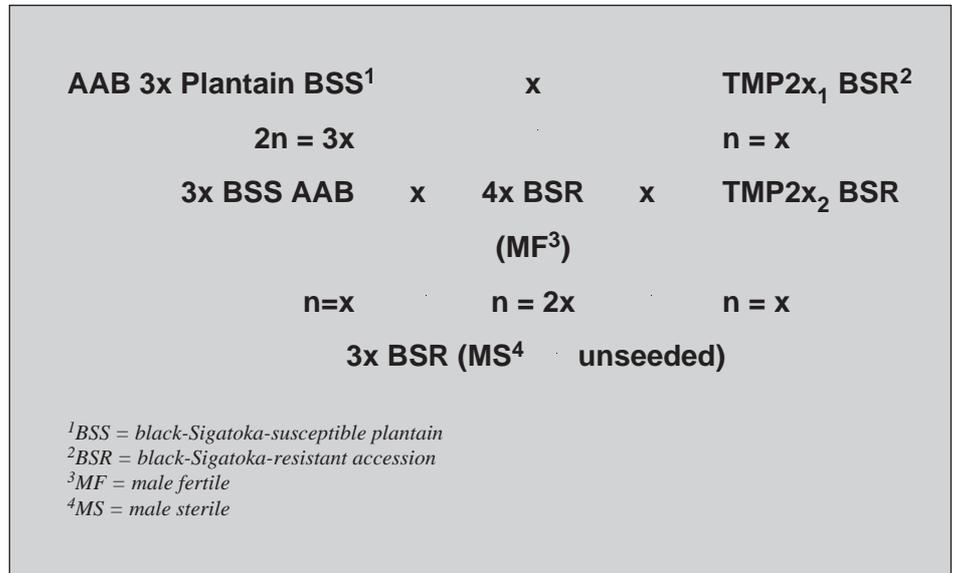
by Gareth Davies*

Introduction

Extraction of juice from banana and fermentation to produce beer using traditional methods is an important post-harvest activity in family banana-farming systems in Eastern Africa.

In Uganda, a number of banana varieties are used principally or exclusively in the brewing of beer. Early survey data indicate that "beer" varieties occupied nearly one-third of banana gardens. Home-brewed banana beer is used to signify hospitality, to affirm bonds of social cohesion and to pay tribute. Brewing beer for sale has

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increased economic importance for households.

"Beer" and "cooking" bananas are harvested when the fruit is ripe but still green. Boiled banana is the most appreciated staple food in the main production area.

The four principal categories of East African highland banana are distinguished by the presence and characteristics of brownish droplets on freshly peeled pulp. Traditional "beer" bananas display large droplets, and adjoining droplets may fuse together. Exotic "beer" bananas introduced to East Africa display small individual droplets. Plantains have fewer, large droplets, but these do not fuse together. "Dessert" bananas display very small

droplets. "Cooking" types display no droplets.

In Rwanda, Burundi and Zaire, beer is made from the blended juice of "beer" and other banana varieties. In Uganda, beer generally was made from "beer" varieties alone. Combining "beer" and other varieties for beer making becomes more common.

Techniques of beer making

In Eastern Africa, preparation of banana beer involves four principal stages:

a) Accelerated ripening of green banana, either by burial in pits in the banana grove or by heating over the kitchen fire. Bananas ripen after 3-7 days.

- b) Ripened, peeled bananas are pressed underfoot or worked by hand in large wooden mortars to extract juice. Selected grasses are used to assist juice extraction. The preferred grasses may differ from one region to another.
- c) Straining juice and fermentation of beer. Ingredients such as water or sorghum, added to fresh banana juice at the onset of fermentation, determine the alcohol content of the final brew. Fermentation requires between 1 and 3 days.
- d) After fermentation, beer is drawn off, strained, and allowed to cool before consumption.

Most banana beer has a low alcohol content (2°-5°). Under traditional rural storage conditions such banana beer remains palatable only for some 4-6 days.

Strong beer, with an alcohol content of 11°-15° is sometimes made from undiluted banana juice. Strong banana beer remains palatable for periods up to one month, and is considered a delicacy.

Banana beer sales

The short shelf-life of banana beers and year-round domestic demand is met by brewing at regular intervals. Cultural practises which promote greater availability of bananas facilitate beer making throughout the year. Production and sale of beer provides additional family income, and may contribute significantly to the level of monetary transactions in rural areas. Rural brewers may serve urban markets. Brewing households may sell directly to their customers. Middlemen may also purchase beer from rural producers for resale in urban markets.

Banana farmers also supply fruit and beer to "banana wine" breweries or banana-alcohol distilleries. Some brewers and distilleries operate under government license. However, industrial banana-based alcoholic beverages are only in limited demand in East Africa. Low level of demand may arise from the following factors:

- The high price of industrial banana alcoholic beverages relative to agricultural income may restrict their access by the population in rural areas,
- Prices paid to producers by liquor factories may be lower than the current market price for fruit or home-brewed beer, thereby restricting supply,
- Urban consumers may prefer bottled beer to commercial banana "wine".

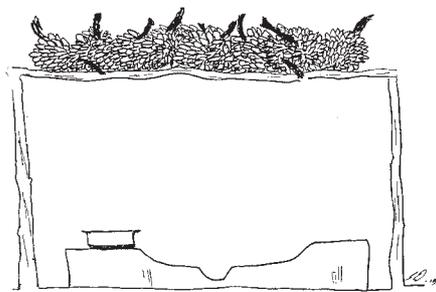


Figure 1. The maturing of beer-bananas over a hearth –Uganda–

These factors may induce households to retain excess banana output for their own production and sale of beer.

Mpigi District, Uganda

A traditional brewer was interviewed at her home in Mpigi District, Uganda. The contact had been arranged by scientists of the Working Group on Banana at Kawanda Agricultural Research Station. The principal operations in beer preparation, demonstrated and explained by the brewer, are described below. Some socio-economic aspects of production and sale of banana beer at the household level will also be discussed.

The brewer was female, 55 years of age, married to a government employee. The homestead was set in a banana garden and comprised a principal dwelling unit and a separate roofed kitchen.

The raw materials, equipment and methods used in traditional preparation of beer were demonstrated during the visit. Members of the Working Group on Banana obligingly translated the information given by the brewer and subsequent questions and answers.

Preparation of beer

Bunches of beer banana - which had been harvested when ripe but green - are arranged on a wooden rack ("kibanyi") built over the cooking hearth. Large bunches are split. Ripening of banana is induced initially by continuous smoking over a smoldering log or tree stump for three days. Twigs, which are regularly renewed, generate smoke. Ripening of banana continues on the fourth day onwards in the heat from normal cooking.

Bananas are matured on the "kibanyi" for 6-7 days (Figure 1). Fruit is covered with banana leaves to avoid desiccation during smoking. Bananas, viewed on the sixth day of processing, were a yellow color. On the seventh day the extraction of juice and its fermentation into beer commences.

Bananas are transferred to a large wooden mortar outdoors (Figure 2), which is filled with a mixture of peeled, ripened banana and spear-grass ("Lusenke", *Imperata cylindrica*). The grass is chopped to lengths of about 30 cm. Juice is extracted by trampling the banana and spear-grass mixture. *I. cylindrica* is most commonly used in juice extraction.

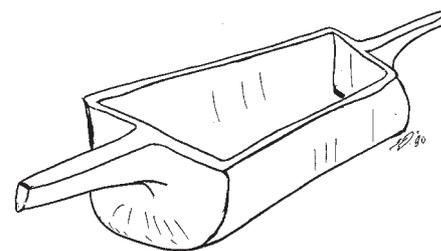
Banana juice is subsequently cleared by pouring through a filter of *I. cylindrica* stems supported by twin, newly felled mature banana pseudostems. Filtered juice falls onto a run-off of banana leaf which leads to a collecting metallic pan (Figure 3). Water is poured over the banana-pulp/grass residue and the liquid obtained added to the pure juice.

Roasted red sorghum, which is coarsely crushed and not ground, is added to the filtered juice. Fermentation of the juice/sorghum mixture occurs in the wooden mortar, which is covered with banana leaves during fermentation.

After three days of fermentation, beer is filtered and poured into storage containers; plastic jerry-cans are now common in Uganda. On cooling, the filtered beer is drinkable. Maturation of banana, juice extraction and fermentation required 9-10 days. These details concur with Masefield's description in 1938.

The bananas viewed would yield approximately 120 litres of beer, the capacity of the brewing trough. The beer was intended for sale. The brewer and her husband indicated that the current market price (March 1990) for a 20-litre jerry-can of banana beer was 1,000-1,200 Uganda shillings (1 US\$ = 367 Uganda shillings in March 1990), 50-60 shillings a litre. Brewing during 9-10 days would generate income of some 6,000-7,200 Uganda shillings. The brewing cycle observed had been timed to enable beer to be available for sale and consumption on a Friday.

Figure 2. Mortar shaped from tree-trunk to press banana-juice –Uganda–



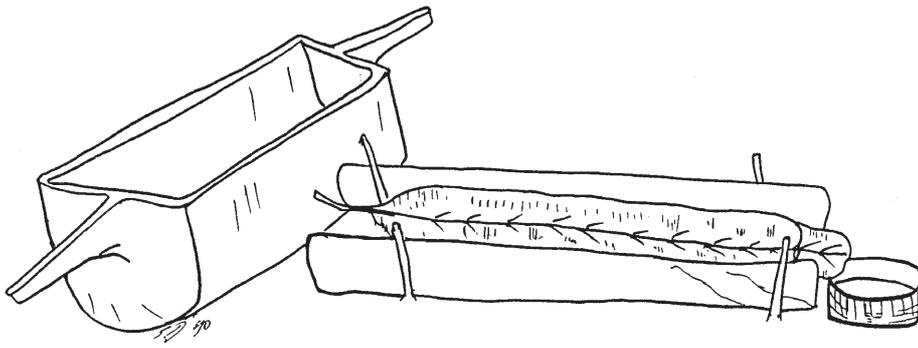


Figure 3. Filter system for banana-juice employing banana pseudo-stems (trunks) and banana leaves. Juice is collected by gravity-flow to pot (right) –Uganda–

Changes in beer-making and banana varieties

Banana varieties now used for beer-making are shown in Table 1.

Table 1. Preferred Beer banana varieties (March 1990)

Nomenclature	Name in literature	Constitution
"Kayinja"	Pisang awak legor	ABB
"Kisubi"	Kisubi	AB

The brewer indicated that banana varieties commonly used in beer-making had changed. Varieties previously preferred for beer-making are noted in Table 2.

Table 2. Beer banana varieties remembered as previously used

Nomenclature	Name in literature	Constitution
"Kabula"	Embidde Kabula	AAA (EA)
"Gonja"	French plantain	AAB

I. cylindrica (spear-grass), now widely used in the preparation of beer made from "Kayinja" and "Kisubi" beer varieties, replaces "mtete" (*Cymbopogon excavatus* or "turpentine grass") - appreciated in some regions of Uganda for the characteristic flavor it imparts to beer. *C. excavatus*, it was stated, was formerly used in the preparation of beer using the varieties "Kabula" and "Gonja".

Changes in beer-making may involve use of "exotic" new banana varieties introduced to East Africa (which replace traditional Highland varieties), and changes in the grasses used in the extraction of juice.

The trend to more productive "exotic" cultivars and the increased importance of sales of home-brewed beer to household incomes may relate to the devaluation of the Uganda shilling in recent years. Consumer prices rose 11,544 percent in the period 1980-1987. The significant rise in prices requires

households to diversify the sources of domestic income.

Productivity and banana varieties

Earlier studies in Uganda associate banana yields to resistance of cultivars to weevil (*Cosmopolites sordidus*), to the impoverishment of soils, and to changes in cultural practise. A 1987 survey of banana production in Uganda indicated that weevil attack, declining soil fertility and insufficient plant protection affect crop productivity.

Masefield (1944) reports increased acceptance of "Kisubi" on account of its resistance to weevil. Researchers at Makerere University note that "Kisubi" beer bananas dominate other traditional varieties. "Kisubi" is planted at the edge of family banana gardens.

Income from beer sales

The farmgate price of 120 litres of beer from bananas viewed (1990) was 6,000-7,200 Uganda shillings. In compensation, government employees in Salary Scale U 5 (Senior Agricultural Assistant) earned, at that time, between 3,352 and 3,933 Uganda shillings a month (in 1990, US\$ 9.13 - US\$ 10.71).

A single monthly episode of banana beer-brewing, sold at 6,000 Uganda shillings, contributes 152% to 179% of additional household income. Preparation and sale of 12 brewings per year (each returning 6,000 shillings for 10 days of preparation), augments annual household earnings by 72,000 shillings annually, 164% of the median annual salary earned in formal employment.

Retail prices for commercial beverages in March 1990 in the Kampala-Entebbe area varied between 1,000 and 1,200 shillings for a litre of beer, and 666 shillings a litre for soft drinks (Pepsi Cola); the farmgate price of banana beer was 4.1%-6% of the price of bottled beer. A time-series of consumer retail prices in Kampala City in 1981-1987,

quoted by the World Bank, indicates that on average the price of banana beer was 9.5% of the price of bottled beer in this period. Banana beer is competitive with commercial beverages on the basis of cost at prevailing salary levels in Uganda.

Concluding Remarks

The visit enabled a better appreciation of the contribution of domestic manufacture of banana beer to family income. The brewing episode observed was timed to yield beer on a Friday, when weekend social activities begin.

Further study of changes resulting from shifts to brewing principally for sale should consider:

- a) The effects, in the longer term, of the shift to the banana varieties "Kisubi" and "Kayinja", which replace "Kabula" and "Gonja".
- b) Selection of grasses used in the pressing of juice. *Imperata cylindrica* is preferred to *Cymbopogon afronardus*. Factors may include:
 - i) Consumers acceptability;
 - ii) Changing environmental factors and distribution of grasses suitable for juice extraction;
 - iii) Mechanical or biochemical properties which facilitate juice extraction.
- c) Post-production aspects relating to:
 - i) Input costs, including firewood, etc;
 - ii) The pricing of banana beer marketing;
 - iii) The channels for marketing of banana beer.

Coffee international economic trends may also affect household incomes. The value of coffee declined during the 80s.

Further investigation of the contribution of domestic enterprises to incomes and decision-taking, including patterns of intra-household decision-making regarding expenditure, are to be examined in the course of a subsequent study.

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East Africa

Rapid rural appraisal of highland banana production in Uganda

by P.R. Rubaihayo* and C.S. Gold**

The Highland bananas (AAA), which are grown in Uganda between 1000-2000 metres above sea level, are unique to the East African highland region. They are a staple food for more than 7 million people in Uganda, with about 66% of the country's urban population depending on them.

Banana is the most extensively grown food crop in Uganda, covering more than 1.2 million hectares, producing over 7 million tons annually, and representing nearly 20% of the total world production. It is estimated that the crop is grown by 75% of the farmers on 40% of Uganda's arable land. It is considered a key component of sustainable agricultural systems in densely populated, high rainfall zones where it reduces soil erosion and acts as a principal source of mulch for maintaining and improving soil fertility.

Moreover, compared to other staples, bananas are the most economical source of carbohydrates in terms

of cost per hectare and per ton. An extended harvest period ensures food and income sources throughout the year.

In spite of its importance, Highland banana production has been declining in Uganda. Yields have dropped from 8.42 ton/ha in 1970 to the current level of 5.58 ton/ha. This has led to the replacement of traditional Highland cooking bananas (Matooke) and beer banana (Mbidde) by the hybrid beer cultivars (AB and ABB) which are considered more tolerant to most stresses.

In response to this growing problem, the national banana program has recently undertaken a rigorous, multi-disciplinary rapid rural appraisal (RRA) survey of the Highland banana systems. The RRA has integrated local farmer knowledge with that of the researchers involved in the survey. Its major objectives have been to provide baseline data which will serve to focus research attention on the major banana production constraints.

Knowledge has been gained *inter alia* on the following:

1. Key farming system and market parameters which influence banana

importance, cultivar distribution and productivity levels.

2. Farmer priorities pertaining to the crop and other farm activities.
3. Farmer perceptions of banana production constraints and management options and responses.

The banana-growing region was stratified by ecological zone and level of banana production, and 25 villages were randomly selected across these strata. A semi-structured questionnaire was developed and data were collected through group and key informant interviews, transect walks and visits to farms.

The RRA revealed that the different banana-growing regions of Uganda are characterized by small farms and dynamic cropping systems. Households attend to a variety of needs, including cash and subsistence agriculture, often under conditions of limited land, labor and financial resources. As a result, most cropping systems are complex; as many as 10-15 crops were encountered on a single farm. The crops were mainly intercropped in different combinations.

Intercropping with banana usually occurred in newly planted fields,

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