

# AN ASSESSMENT OF THE OPTIONS FOR MECHANICAL HARVESTING OF SUGARCANE IN SOUTH AFRICA

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## ABSTRACT

Due to rising wages and the uncertain availability of labour to cut sugarcane by hand the South African industry should now consider various options for mechanical sugarcane harvesting. Whole-stalk and chopper harvesters are commercially available which, with the necessary field preparation, could harvest large percentages of our sugarcane very efficiently. Present overseas development of harvesting systems are aimed at refinement of existing chopper harvesters and at means of harvesting and cleaning green cane. Practical chopper harvesters for green cane will probably result from this in the near future. No real interest is presently being shown anywhere outside South Africa in developing new systems for harvesting whole-stalk cane or for harvesting systems on steep slopes. Any answer to this requirement will therefore have to be locally developed.

## Introduction

Costs of harvesting sugarcane by hand are rising rapidly and are approaching those which could be attained if efficient mechanical harvesting systems were used. The erratic availability of labour, which is caused by factors such as droughts in the Homelands and competition from commerce, is such that mechanical harvesting cannot be too far ahead.

This should therefore be an opportune time to ask what the ideal sugarcane harvester would be for South Africa. One answer, satisfying most growers, would probably be:

“A whole-stalk machine which cuts, tops and de-trashes burnt or green sugarcane of all lengths and yields, growing either straight or recumbent. The harvester should leave the cut cane in ordered windrows or bundles on the ground for easy subsequent mechanical loading. The machine should be inexpensive, simple, easy to operate and maintain and be able to harvest sugarcane on slopes as steep as 20°.”

The preference for whole-stalk machines is based on the fact that our industry is presently geared for this form of cane handling.

## Available harvesters

Harvesters are presently available from various parts of the world and can be broadly classified as whole-stalk or chopper harvesters.

### *Whole-stalk harvesters*

Cane harvested as whole-stalks has the inherent advantages of easy stockpiling on any reasonable surface and fairly extended storage capability without serious quality deterioration.

An example of whole-stalk harvesters is the so-called “soldier-type” machine developed in Louisiana. This harvester tops and base cuts cane while it is held tightly between sets of chains. These chains subsequently convey the cut cane to the back of the machine where as many as six rows can be put into one windrow with the stalks at right angles to the direction of the rows. Loading is done with a push-piler and mechanical grab, which could lead to an increase in the amounts of soil and stones loaded with the cane and transported to the mill. This problem is aggravated under wet conditions.

A variation of this cane harvesting principle is found in another type of whole-stalk machine which places the cane down in bundles instead of a windrow so that push-piling is not required and a mechanical loader moves across the rows to load the bundles of cane. Typical of these machines are the harvesters available from Australia.

All examples of the above harvesters suffer from a common disadvantage in that they are generally unable to handle cane which is badly lodged, or leaning over in the direction of the row. With cane of this kind problems are usually encountered due to blockages all along the length of the conveyor system and in addition the configuration of the conveyor chains on some of these harvesters prevents them from handling short cane. In certain cases chain conveyors cannot handle burnt cane, because the thinner stalks tend to slip out when the chains are adjusted for thick cane. These harvesters have been designed for green cane, and a certain amount of de-trashing is then done by burning the windrow a day or two after the cane has been cut.

A recent development in whole-stalk harvesting is a machine which tops and then lays the cane down in the direction of the row before the base is cut. The end result is a “sausage” of intertwined stalks lying directly over the row which has been cut. Hand labour is required to pull the stalks from the “sausage” and to stack them. Although trained cane cutters are replaced by this machine, a fairly large labour force is still required to complete harvesting. An advantage of this harvester, however, is that more recumbent cane can be handled than would be possible in the case of the other types of whole-stalk machines.

All of the disadvantages notwithstanding, it is still surprising that whole-stalk harvesters have had so little impact on the South African industry to date. Many of these machines have been built, and provided they are used under suitable conditions they can do an excellent job of harvesting sugarcane.

### *Chopper harvesters*

The chopper harvester principle is probably the ultimate in cane harvesting concepts. No other system can compare in cleanliness of cane delivered to the mill, with a minimum loss of millable cane in the field and a minimum field labour requirement. Chopper harvesters are also the only answer to badly lodged cane. Other advantages of chopper harvesters are more consistent, higher density payloads for transportation to the mill, the elimination of cane slings and time-consuming transshipment methods. A more efficiently scheduled and organized transport system becomes essential because the chopped cane must be milled before deterioration takes place and this results in higher quality cane being milled.

Disadvantages are that special, costly containers are required for transportation, transshipping and storage. A breakdown of either the harvester or the transportation system brings harvesting operations to a stop. Much higher levels of management and organization are required for chopper harvesting than for other methods.

With proper field preparation, large areas under sugarcane in South Africa could be harvested by these machines. Most choppers are able to operate on slopes as steep as 12°, while side-mounted models with wheel spacings as wide as 3 m could probably work on slopes as steep as 18°.

All commercially available chopper harvesters are high-capacity, expensive machines and to approach figures of 70 to 80 cents per ton loaded into in-field transport, full utilization of them is required. Cost figures such as these are, however, attained where harvesting is done on a 24-hour basis.

All of these machines have been designed to harvest burnt cane. They will operate in green cane, delivering reasonably clean billets but their capacity is then seriously reduced.

The obvious advantages of chopper harvesters have led to the domination of the world market by the Australian machines. All the well-known sugarcane harvester manufacturers in the U.S.A. are now planning or developing chopper harvesters to catch up with this trend.

#### **New overseas developments**

Extensive research into green cane harvesting and handling methods has been conducted in America by the U.S.D.A. De-trashing has received intensive attention over the years and practically all factors pertaining to trash removal are now understood. Cleaning rolls have been developed that incorporate selective topping due to the difference in hardness between immature and mature joints. These can remove more than 60% of total trash from chopped cane. Coupled to pneumatic trash separation, this could result in almost total trash removal in chopper harvesters used to cut green cane.

However, no satisfactory means of de-trashing whole-stalk cane has yet been found. Attempts to de-trash whole-stalk cane in a commercial harvester were made in the 1960's in Cuba. Success was very limited in that even with subsequent chopping and

further pneumatic trash separation, trash content was still as high as 13%.

Prototypes of the Joe Mizzi and Creber green cane harvesters are already in operation in Australia, with promising results, but these machines are not yet commercially available. Other chopper harvesting systems for particular circumstances are being developed and tested in Hawaii and Florida. These are all large, specialized machines with little to offer our industry over the production harvesters.

Overseas development of harvesters is thus largely geared toward chopper machines for green cane. Nowhere are machines being specially developed to harvest cane on steep slopes.

#### **Local developments**

Various harvesting systems are presently being considered or developed under the subsidy scheme of the South African Sugar Association and by independent concerns. Any of these could result in the ideal South African sugarcane harvester. Plans for devices ranging from simple cutting aids to extremely sophisticated and intricate machines are under study.

In developing a harvester for South Africa, it should always be remembered that, for the foreseeable future, labourers (even if limited in number) should be available as permanent workers on farms in South Africa. Man-machine systems, requiring two or three times as many labour units per ton of cane harvested as are acceptable in Australia or the U.S.A., might thus serve us quite adequately and could be cheaper to run and more suited to individual growers' requirements.

High development and production costs of machines designed for a limited market nevertheless could inhibit manufacturers from taking a real interest in putting a local machine on the market.

#### **Conclusions**

If we insist on whole-stalk harvesting with no burning we will have to accept cane at the mill with only the tops having been removed. A partial solution to this could be drycleaning plants at the mills where the cane would be chopped and the trash removed just prior to the milling of the cane. Whole-stick machines capable of harvesting green and burnt cane are available and with suitable field preparation and cultivation practices, could be acceptable for large areas of our industry.

Commercially available chopper harvesters, capable of doing excellent work in burnt cane of all varieties and configurations could harvest most of our cane provided fields are adequately prepared and the necessary transportation systems are available. Some of these harvesters would operate on the contour on any slope where tractors with trailers are able to go. Harvesting costs would be comparable with those of our present hand cutting, stacking and loading, provided the capacity of the machines were fully utilized.

If we demand a machine to harvest green cane and clean it well in the field, a chopper harvester will probably be the only answer. Machines capable of satisfying this requirement are being developed and should be available in the near future.

If none of the above options are acceptable, a specialized harvester will have to be developed locally.