SHORT COMMUNICATION

# PRELIMINARY RESULTS ON THE DESIGN AND TESTING OF THE ILLOVO MECHANICAL CANE CUTTER

LANGTON M I[1], PATERSON J W S[1], HILL A C[1], VAN ZYL R[1], SMITHERS J C[1], BEZUIDENHOUT C N[1] and LYNE P W L[2]

[1]*School of Bioresources Engineering & Environmental Hydrology, University of KwaZulu-Natal, P/B X01, Scottsville, 3209, South Africa. beeh@ukzn.ac.za, patersonj@quarry.kzntl.gov.za, hillac@ukzn.ac.za, VanZylRO@ukzn.ac.za, smithers@ukzn.ac.za, bezuidenhoutc@ukzn.ac.za*
[2]*South African Sugarcane Research Institute, P/Bag X02, Mount Edgecombe, 4300, South Africa. Peter.Lyne@sugar.org.za*

## Abstract

Labour for sugarcane cutting in South Africa is expected to become scarce as a result of rising aspirations, growth in the manufacturing sector and the effect of HIV/AIDS on the available work force. Manual harvesting in the South African sugar industry is often favoured or unavoidable because of steep slopes and the high cost of mechanical harvesters. It has therefore become important to re-evaluate manual cane cutting devices in an attempt to make sugarcane cutting easier, cheaper and more efficient. In this project a brush-cutter with a redesigned blade configuration was developed and various performance parameters were compared with conventional manual cane knife harvesting practices. A slicing blade was designed and fitted to a motorised brush-cutter, and the system was named the Illovo cutter. Field tests with the Illovo cutter showed an increased cutting performance of approximately 133%, reduced cane butts left in the field and also significantly reduced variability in the performance between different cane cutters. A full time postgraduate degree research project is currently being carried out to develop the system and will address issues such as topping, trashing, windrowing and loading.

*Keywords:* mechanical harvesting, brush-cutter, cutter performance, engineering design, Illovo cutter

## Introduction

Labour for sugarcane cutting in South Africa and many other developing countries is expected to become scarce. This is mainly a result of rising aspirations, growth in the industrial sector and the effect of HIV/AIDS on the available work force. In South Africa, sugarcane is often cultivated on steep slopes, making the use of mechanical harvesters impossible. It is therefore essential to move towards less labour intensive and more efficient harvesting practises, but at the same time to have a system in place that will allow harvesting on steep slopes.

A recent time survey by Brookes (1983) suggested that the harvesting capacity is more dependent on the time spent cutting, topping and trashing as opposed to stacking and clearing. A primary focus should therefore be to reduce the time spent cutting, topping and trashing. This short communication reports on promising results obtained by Langton and Paterson (2004) while testing a modified brush-cutter, namely the Illovo Mechanical Cane Cutter, for sugarcane cutting.

## Methods

A commercial brush cutter was modified and included designing a slicing blade and modifications to the mounting of the blade to enable the cane to be cut as low as possible. During a chopper harvester study, Mello and Harris (1999) found a blade angle of 22.7° to be the most efficient in cutting or slicing sugarcane. Although cane was sometimes pushed to the side, a 22.7° slicing blade required the least energy and caused the least damage to cane. The functioning of this blade is based on a 25% impact and 75% slicing component. A brush-cutter slicing blade with a 22° angle to the cutting front was hence designed by Langton and Paterson (2004). Based on the power equations of Srivastava *et al* (1993), this blade would need a 1.73 kW motor to cut sugarcane. A Stihl® FS500 brush-cutter was selected for this purpose and was mounted with an aluminium deflector arm to guide the cut cane. Figure 1 illustrates how the blade was fitted to the brush-cutter and the insert depicts the brush-cutter, with its deflector arm, in operation.

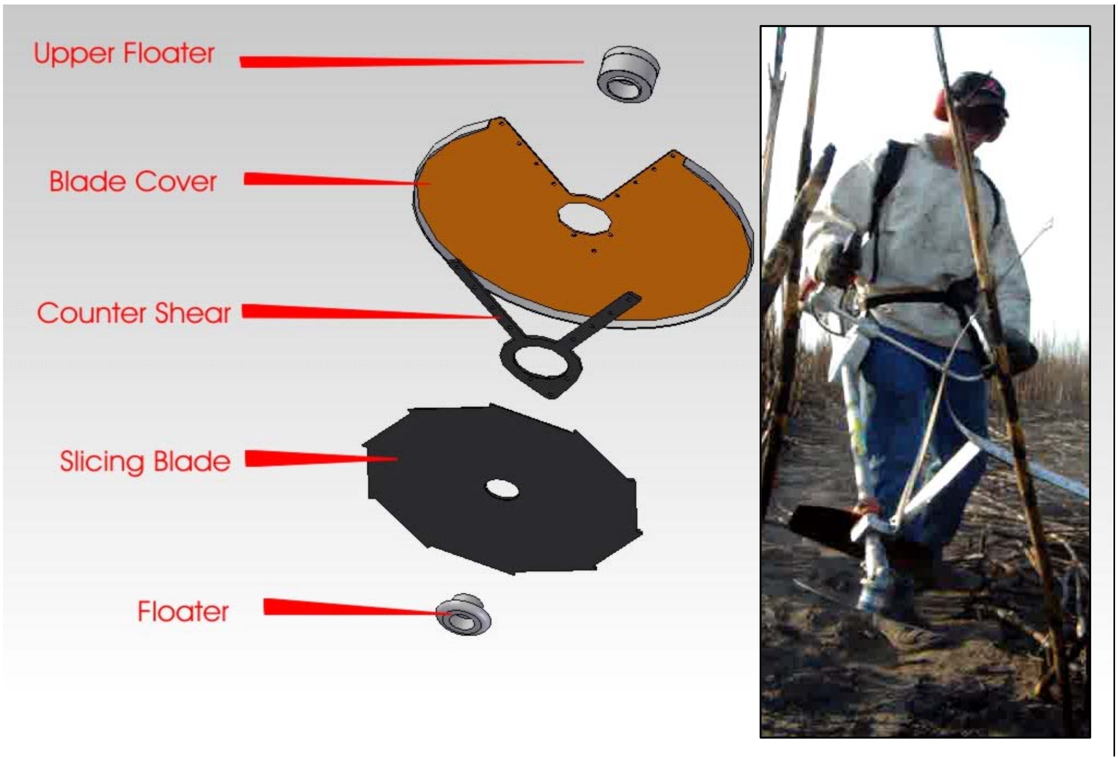


**Figure 1. A 22° slicing blade mounted to a brush-cutter, which is used to cut sugarcane.**

This design was tested against standard manual cutting on a lower south coast farm. Tests were performed cutting a 10 m long sugarcane row. With each test, (1) the time taken to cut the row, (2) the amount of cane left behind (butt height) and (3) the stalk damage at the impact zone were recorded. Stalk damage was subjectively assessed using a damage classification developed by Kroes (1997). This classification scores a zero for a very clean cut and an eight for an extensively damaged stalk. Each test was repeated at least eight times, allowing for the calculation of means and standard deviations. It should also be noted that manual cane cutting was performed by inexperienced persons, and improved performances may be expected among experienced labourers.

In addition to the above-mentioned evaluation, the following criteria were also assessed:

- Ease of use
- Hazards to workers and the environment
- Light weight
- Ability to operate on slopes of up to 40°
- Ability to cut cane at the correct height and not include extraneous matter.

## Results and Discussion

Figure 2 summarises the comparative measurements made between standard manual cane cutting and the brush-cutter. On average the brush-cutter performed faster, cut cane closer to the ground and caused less stalk damage at the impact zone. The brush-cutter also significantly reduced the deviation in time taken to cut a 10 m row. This was mainly due to the fact that, with a brush-cutter, cutting rate does not depend on physical strength. Using brush-cutters should therefore not only significantly speed up cutting performance, but will provide a more consistent performance.

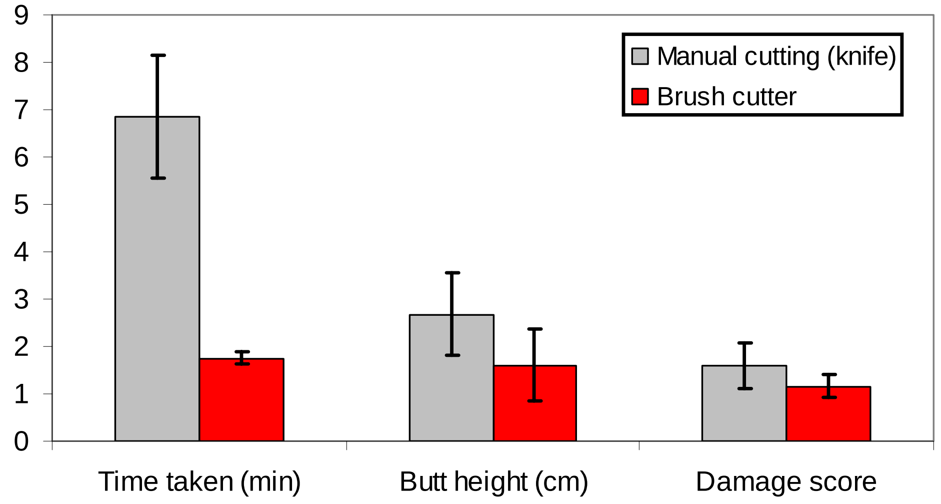


**Figure 2. A comparison in mean cutting performance between standard manual cane cutting (grey) and a brush-cutter (red). Standard deviations over repetitions are depicted by whisker plots.**

The brush-cutter was found to be easy to use, even with no previous experience in cane cutting, and although not tested, it is believed that it could be used on steep slopes. Various safety measures, such as protective clothing, glasses, ear covers and a blade cover were required to safeguard the brush-cutter operator. The brush-cutter weighs 15 kg compared with 0.8 kg for a standard cane knife. The brush-cutter, however, is supported by a waist harness, which eases movement and reduces ergonomic stresses.

Further research needs to be carried out to optimise the blade with respect to the number of edges on the cutting blade, the material used for manufacturing the blade, the ridges on the blade surface and sharpening. Further work is also required to find suitable ways for moving cut cane away from the blade, windrowing and stacking, as well as topping the cane. Research is currently underway to address these issues.

## Conclusions

The brush-cutter appears to be a viable solution for cane harvesting in the future. The design presented in this short communication requires further research, but a solid base has been established from which further work can be carried out. The concept of the slicing blade was successful and is a significant step forward. Current blade configurations, windrow placement and topping still present the biggest challenges.


## Acknowledgements

Illovo Sugar, in particular Mr Carl Pfotenhauer and Mr Keith Domleo (Sezela), provided valuable guidance and financed a significant portion of the project. Okapi Knives, in particular Mr John Faul, assisted in the manufacturing of the brush-cutter blades. Mr Deon van der Merwe (Andreas Stihl) provided background information on brush-cutters and assisted with the selection and purchasing of a suitable brush-cutter. Mr Alan Hill (University of KwaZulu-Natal) manufactured a number of critical components for the brush-cutter. Mr Eddie Meyer provided valuable background information on manual cane cutting.


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