IMPACTS OF HARVEST TO CRUSH DELAY ON GROWER REVENUE

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Abstract

Growers have become aware that once sugarcane has been harvested, the RV% as reported by CTS would usually increase over the following few days. Because of this increase, they have assumed that their revenue would also increase with the delay. They have rationalised that, although there is a mass loss with time (assumed to be evaporation of water) and a corresponding loss in tons RV, this would also reduce their transport costs and therefore cancel out any loss. Growers also believed that, in a cool climate, the deterioration of the cane and loss in recoverable sugar would be minimal and therefore reduce the impact of deterioration. In extreme cases some growers have deliberately increased their harvest to crush delay (HTCD) in an attempt to benefit from this assumption.

In an effort to determine the merits and impacts on revenue of increasing HTCD a statistically rigorous experiment was run at an inland site at high altitude. The experiment was designed for a delay of four days and was set up to monitor mass loss, moisture loss and RV% at a cool, warm and hot time of the season.

The results showed that there was an increase in RV%, a significant loss in mass and no improvement in overall revenue, even at long haulage distances. An interesting phenomenon observed was that the mass loss as indicated by a reduction in moisture content of the cane over the delay period was only one third of the mass loss, the other being respiration losses, and therefore one cannot use moisture loss as an indicator of mass loss.

Keywords: sugarcane, harvest to crush delay, moisture loss, mass loss, respiration, cane revenue

Introduction

There is overwhelming evidence from past research (Bacci and Guichard, 1994; Cox and Sahadeo, 1992; Eggleston *et al*, 2001; Kirby, 1968; Lauritzen *et al*, 1948; Lionnet, 1996; Morel du Boil, 2001; Turner and Rojas, 1962) that any delay in the crushing of harvested sugarcane will result in a loss of recoverable sugar and a subsequent loss in revenue to the industry.

However, in cooler climates growers have become aware that once sugarcane has been harvested, the RV% as reported by the Cane Testing Service (CTS) would usually increase over the following few days. Because RV% is a factor in the grower revenue calculation (see equation 1), it was often believed that a delay in HTCD would result in an increase in revenue.

Revenue (R) = RV price (R/ton) x RV% x Tons cane over the weighbridge …… Eqn 1

Growers have rationalised that although there was a mass loss with time (assumed to be evaporation of water as indicated by a change in moisture content) and a corresponding loss in tons RV, this would also reduce their transport costs and therefore cancel out any loss. The growers also believed that, in a cool climate, the deterioration of the cane and loss in recoverable sugar would be minimal.

In an effort to determine the merits and the impact on revenue of increasing HTCD, an experiment was run at Barberton in Mpumalanga, an inland site at an altitude of 890 m. The experiment was set up to monitor mass loss, moisture loss and RV% at three different periods over the 2004 harvesting season; a cool, warm and hot period.

Method

Fifty random samples, each comprised of 15 stalks, were selected from an area of 5 rows x 56 m in a field of sugarcane variety N19 which was irrigated, dried off and not ripened. The cane was burnt, cut and placed in windrows consisting of six rows of cane. Each of the 50 samples was weighed after cutting, and 10 of these were delivered to CTS for crushing and analysis on the first day. The remaining 40 samples were randomly replaced in the windrow and on each subsequent day, 10 samples were removed, weighed and delivered to CTS. Each sample was crushed and analysed for mass, moisture content, sucrose, non-sucrose, fibre, RV% and purity for delays from 0 to 4 days.

In an attempt to run the experiment in cool, warm and hot conditions, experiments were carried out in July and repeated in October and December, 2004. July turned out to be abnormally cold, October was normal and December was warm and wet.

Results

Cool trial

The ‘cool’ experiment was carried out from 5 to 10 July 2004. Temperature and humidity were recorded, and soil samples were taken to determine the nutritional level in the fields. A cold front moved over the area the day before the experiment was started and it remained cold until the last day when the weather cleared and it warmed up a little. The temperature varied between a minimum of 0ºC and a maximum of 16ºC, with an average of 9ºC and an average relative humidity (RH) of 78%.

Figure 1 shows the results of the CTS analysis for the ‘cool’ trial, where the RV% increased from 13.3 to 14.3%. It is interesting to note that there was a substantially higher mass loss with delay (see Figure 2) than the apparent decrease in moisture content of the cane as measured by CTS. After four days in the field the cane sample had lost 4.3% mass, while the moisture content of the same sample had decreased by only 1.4% after four days. It was postulated that the 2.6% balance of the mass loss was consumed by the respiration process and given off as CO_2 and water, and that the increase in RV% was the result of an increased concentration of sucrose due to the mass loss.

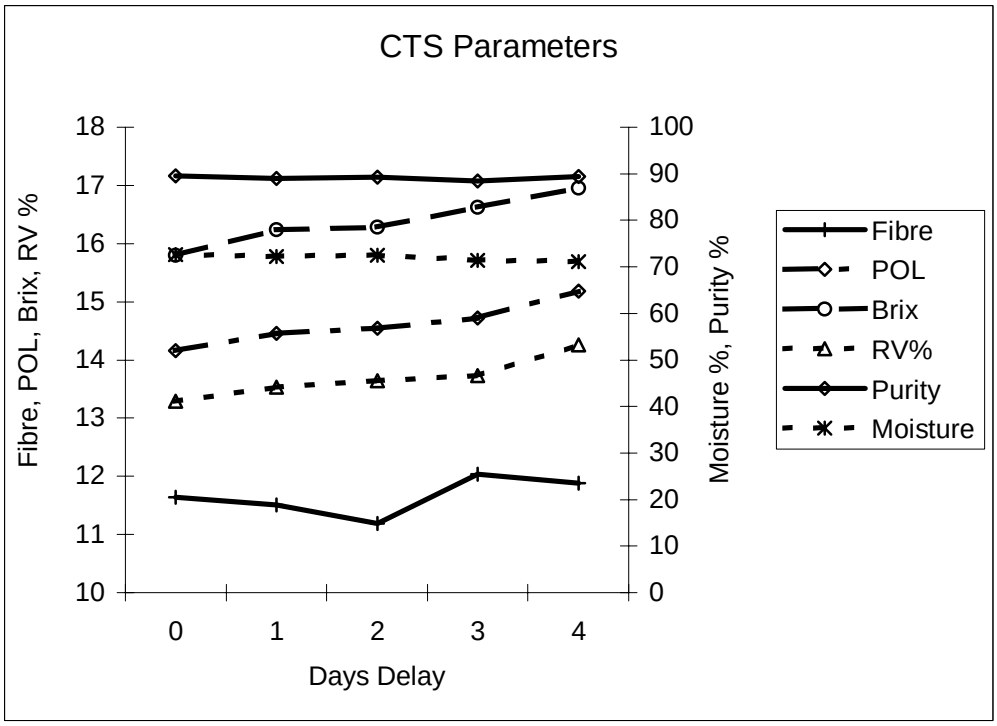

Figure 1. Changes in fibre, Pol, Brix, RV%, purity and moisture content over a four day period in the 'cool' period in July 2004.

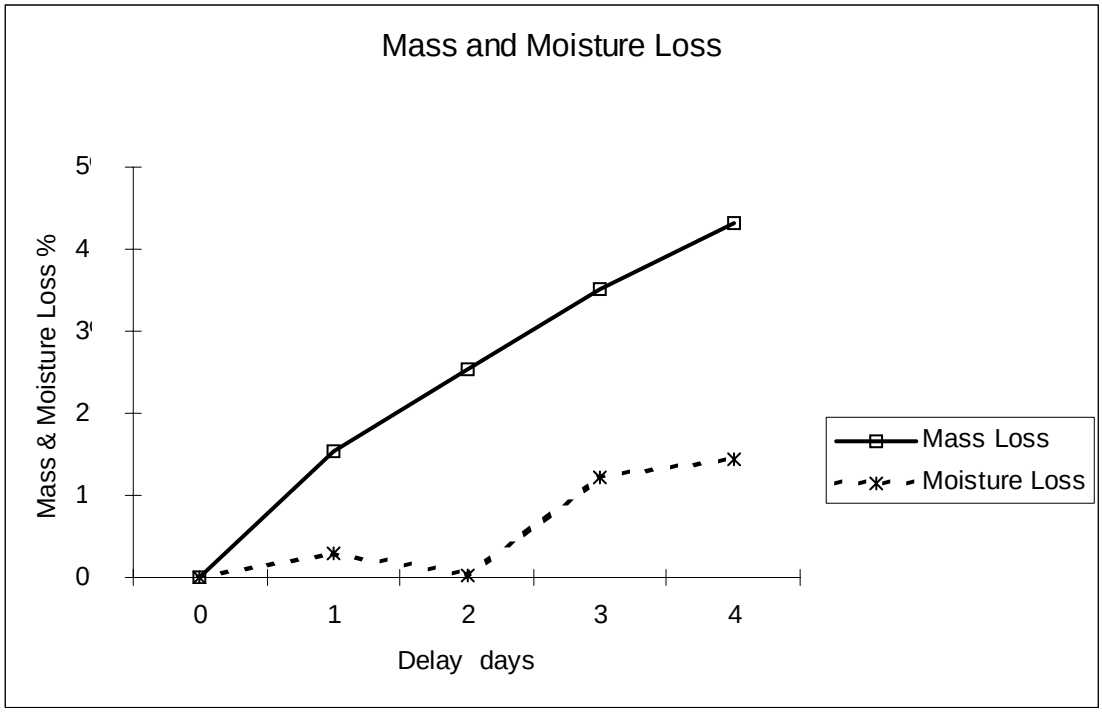

Figure 2. Mass loss and moisture loss over the four day 'cool' period in July 2004.

Warm trial

The 'warm' portion of the experiment was conducted from 18 to 23 October 2004. The temperature varied between a minimum of 16ºC and a maximum of 29ºC, with an average of 21ºC and an average RH of 63%. A cold front passed over the area on the fourth day, which resulted in a cool day and a reduced rate of moisture loss.

Again there was a substantially higher mass loss in the cane measured in the field (see Figure 3) than that indicated by the decrease in moisture content of the cane as measured by CTS. After four days in the field the cane sample has lost 5.1% mass, the moisture content of the same sample had decreased by only 1.7%, and the RV% increased from 15.9 to 16.6%.

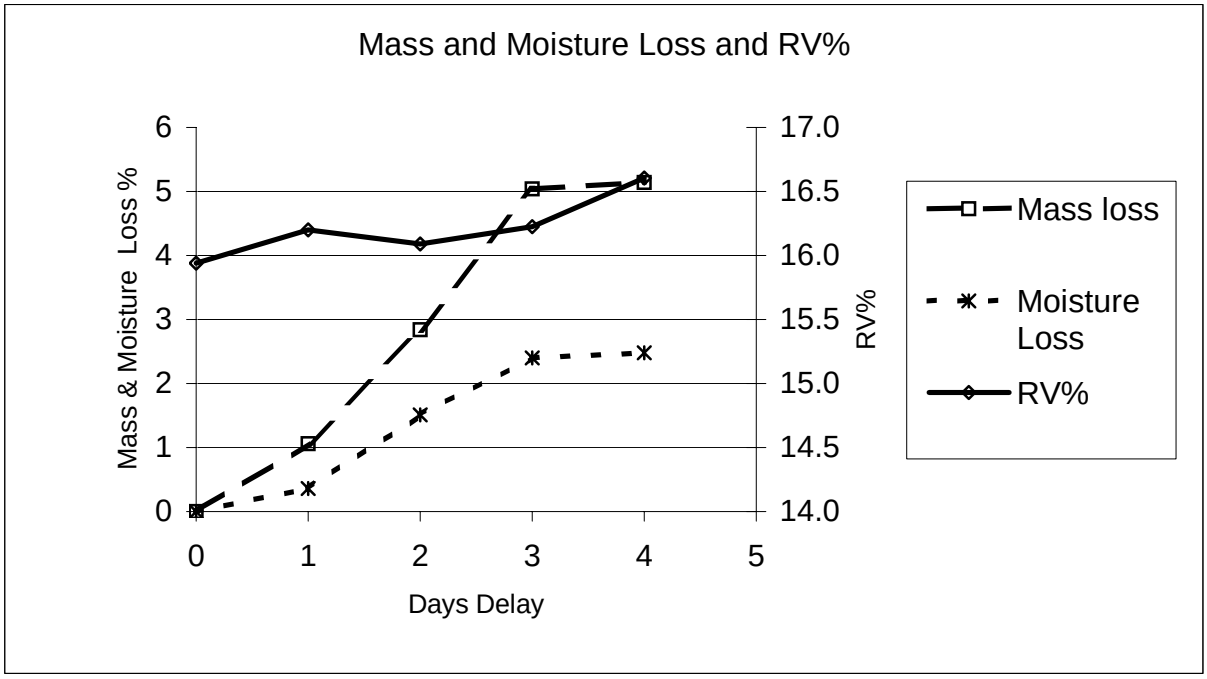

Figure 3. Mass loss, moisture loss and RV% over the four day period of the 'warm' trial in October 2004.

Hot trial

The 'hot' portion of the experiment was carried out from 6 to 11 December 2004. It was not a hot week, but turned out a warm, overcast and wet week. The temperature remained almost constant at 21ºC, and there was 60 mm of rain during the week. The average RH for the first three days was 92%, and this dropped to 72% on the fourth day.

Again, there was a substantially higher mass loss in the cane measured in the field (see Figure 4) than the apparent decrease in moisture content of the cane as measured by CTS. After four days in the field the cane sample had lost 2.3% mass, while the moisture content of the same sample had decreased by only 0.8% after four days. The RV% dropped initially, then recovered to the original level. This was related to the mass loss.

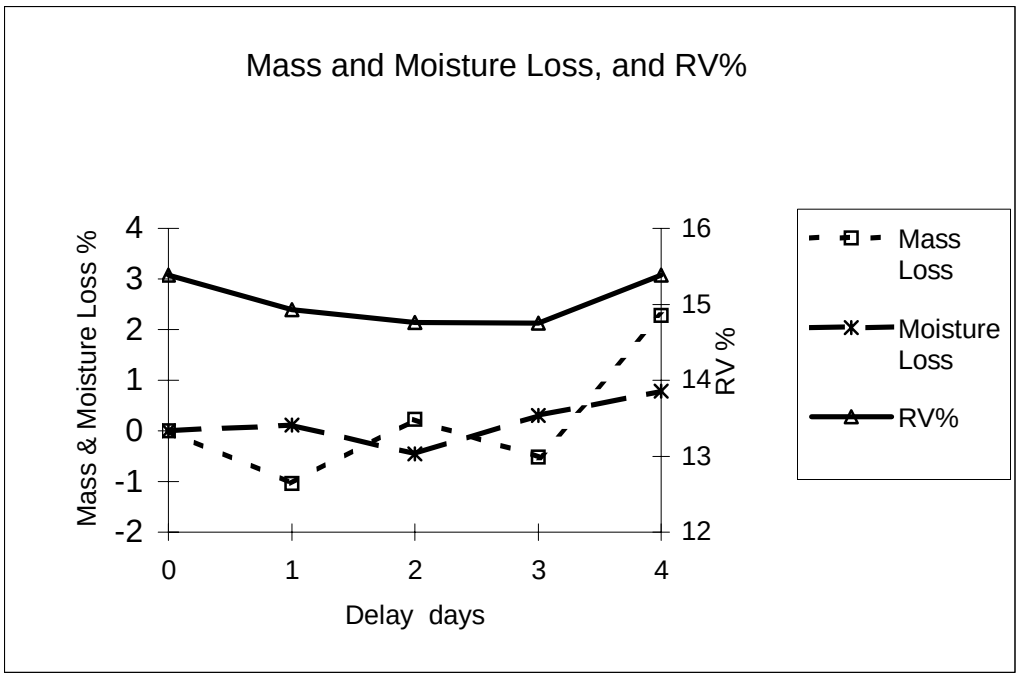

Figure 4. Mass loss, moisture loss and RV% over the four day period of the 'hot' trial in December 2004.

RV% as a proportion of the original mass

In all three cases, the RV% varied as the weather conditions changed and to get an overall impression of the impact of the mass loss on the RV% over the four days, RV% was expressed as a proportion of the original mass. It can be seen in Figure 5 that under the cold conditions in July the RV% increased slightly, whereas under the October and December conditions the RV% dropped by 2.3 and 1.1 percentage points respectively. This illustrates that, apart from the 'cold' portion of the experiment, the apparent increase in RV% was in fact a loss, but there is no way of determining the original mass in a commercial situation to provide a real estimate of RV%.

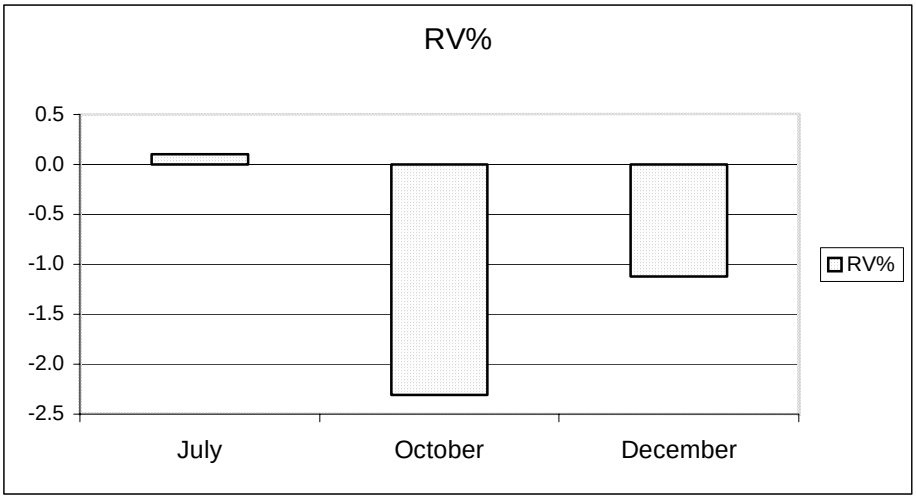

Figure 5. Average RV% expressed as a proportion of the original mass.

Grower revenue

If one calculates the revenue, including the transport cost for a lead distance of 25 km, the average losses in the October and December portions of the experiment were 1.5 and 3.0% respectively. Even where a transport distance of 100 km was used, the loss decreased only very slightly.

Respiration

A factor that has not been accounted for in previous studies is the respiration process that takes place after the cane has been cut. The mass loss that occurs has been ascribed to dehydration and although this does occur, the rate of mass loss due to respiration is at a far higher rate. Figure 6 shows how the respiration rate of N19 varies with temperature (personal communication[1]), and it is this process that accounts for the major proportion of the mass loss in harvested cane.

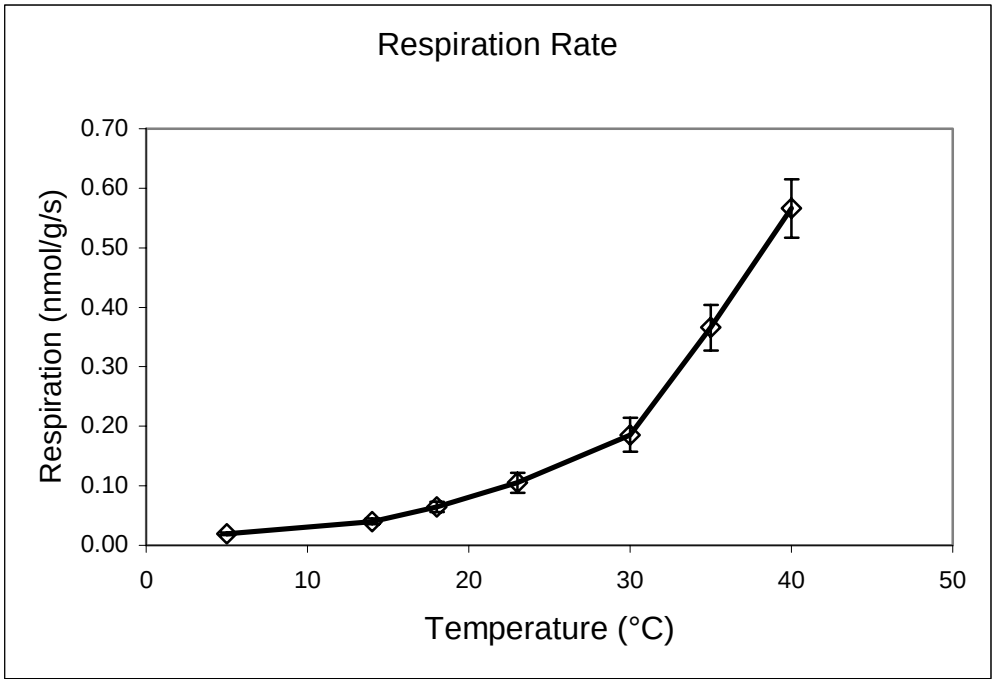

Figure 6. Respiration rate of N19 at temperatures between 5 and 40ºC (after Cramer 2004 – see footnote).

Conclusions

The results showed that, although there was an increase in RV% with a four day HTCD, there was also a significant mass loss and no improvement in overall revenue, even where the transport cost was included. An interesting phenomenon was observed; the moisture loss of the cane as measured by moisture content over the delay period was approximately one third of the mass loss, the other being respiration losses made up of water and CO_2. This means that one cannot use moisture content as an indicator of mass loss.

[1] M Cramer (2004), Dept of Botany, University of Cape Town, South Africa. mcramer@botzoo.uct.ac.za

There was no evidence to suggest that a grower would benefit from delaying delivery to the mill. On the contrary, the evidence showed a loss in revenue which increased with temperature. The increase in RV% with delay was due to the concentration of RV because of mass loss and gave a false indication of increased cane quality. In reality as delays increase, particularly in hot conditions, the loss of tons RV causes grower revenue to decline.

The results showed that over four days and in very cold conditions, which are not likely to occur very often in South Africa, there was no significant change in revenue. In warm spring conditions in Barberton there was a 1.5% loss in revenue, and in warm, wet summer conditions there was a 3.0% loss in revenue. These results are a best-case scenario. All three burns were cool and did not damage the cane at all, and the cane stalks were correctly topped and individually cleaned. In a commercial situation where these processes are carried out with less precision, deterioration would occur at a faster rate.

It can only be concluded that, to reduce losses, every effort should be made to reduce the harvest to crush delay to a minimum.

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