THE PERFORMANCE OF CHOPPER HARVESTERS

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ABSTRACT

A review is given on the performance of chopper harvesters in various countries. Test procedures for sugarcane harvesters are considered by describing an experiment conducted during 1978 on an estate in Swaziland to determine the losses of a sugarcane crop incurred when harvesting mechanically with two different machines, in comparison with those incurred when harvesting conventionally by hand and transporting the cane on selfloading trailers. Of the estimated 118.9 tons cane per hectare standing in the field, it was determined that 116.4 tons/ha were recovered when hand harvesting, 110.8 tons/ha when using machine A, and 100.7 tons/ha when using machine B. Because the cane had been treated with a chemical ripener and an excellent burn was obtained, the amounts of extraneous matter tended to be low in all treatments. For hand cutting they were 3.1%; for machine A, 6.1%; and for machine B, 7.0%. Compared to hand harvesting, the use of machines A and B resulted in sucrose losses of 4.5% and 12.5%, respectively.

INTRODUCTION

Much more is known today about chopper harvester performance than was known ten years ago. Field personnel and researchers from various countries have reported on factors such as machine efficiency, quality of the sample, the effect of extraneous matter on mill output and sugar recovery, and on total field losses incurred by using these machines. A brief of some of the above findings is presented in this paper. Test procedures for chopper harvesters is discussed by describing a recent trial conducted by the S.A.S.A. Experiment Station on two harvesters in Swaziland. Current work in Australia (Foster et al., Fuelling et al., Mason et al.) where in-depth studies are being conducted on factors such as the effect of harvesting rates on billet quality and machine performance, will not be dwelt on, as these aspects will be covered fully in two other ISSCT papers titled “Review of cane harvester performance” by V. Mason et al. and “Recent studies on cane deterioration in Australia” by D.H. Foster, et al.

First reports on machine output received from countries other than Australia, 1011
presented a very poor picture. It was, however, soon appreciated that properly prepared fields were essential if acceptable performances were to be obtained from these machines. Papers published in Jamaica (Siriisa23) and Mauritius (Hoaran and dela Girodoy14) indicated that field efficiencies of about 40% could be expected. Twenty-five choppers in the French West Indies (Dutarte7) gave an average field efficiency of 45%. In South Africa (de Beer and Boevey6) it was established that while actual pour rates were 60 t/h or more, productivity averaged only 20 t/field hour. Even under ideal conditions, 10% of the total field time was lost when turning in the headlands. Of course, factors such as field layout and availability of infield cane transport will affect field efficiency. Under good field and management conditions, as they obtain in Australia, field efficiency can be as high as 60% (S.W. Boxter, personnel communication). Harvesting green cane in Texas in 1977 with eight different harvesters resulted in a reduction of 68% in pour rate compared to that for burnt cane at 66 t/h (Rio Valley Sugar Growers17).

Increased amounts of extraneous matter will adversely affect haulage payloads, mill throughput and sugar recovery. Clayton and Whitmore7 reported that each one percent of trash content resulted in a loss of 1.5% to 2.0% in the value of the sugar produced. South African tests (Scott19) at two mills showed that extraneous matter decreased the crushing rate by 2.2 to 3.0% for every additional 1% of trash (leaves) % cane. Tops did not adversely influence the rate of cane throughput. The effect of trash on sucrose % cane is illustrated by the fact that if clean cane contains 13% sucrose, additions of 5, 10 and 20% trash will reduce this value to 12.3%, 11.70 and 10.40%, respectively. This effect is further illustrated by the analysis of extraneous matter given Table 1. (Scott20). Data for this Table were obtained in a laboratory investigation, and it was concluded that both tops and leaves had pronounced adverse effects on juice purities and clear juice quality. In addition, trash (leaves) also reduces pectin extraction. All these effects were found to increase linearly with extraneous matter contents up to 30%.

Various studies (Clayton et al2, Cruz4, EEA8, Fernandez et al9, Humbert15, Tambosco et al24) have shown extraneous matter contents of chopper-harvested cane to vary from 6 to 17%, compared to those of handharvested cane of 3 to 7%. Compared to manual cutting and push-pole loading, chopper harvesters do, however, substantially reduce the quantity of soil delivered with the cane. (Smith27). In Brazil a reduction in mineral matter of three times to 0.8%, was recorded in one study (Fernandez et al9) while in another (Tambosco et al24) soil content ranged from 0.1 to 0.3% for chopped cane as compared to 0.5 to 3.1% for mechanically-loaded cane.

The Bureau of Sugar Experiment Stations, Australia, had developed a convenient method to sample the cane delivered by a chopper harvester (Fueling et al17).
A portable light-weight chute is attached to the back of the haulout bin or trailer. Samples are taken by signalling the haulout driver to move forward briefly so that the harvester discharges directly into the chute. A bag attached to the bottom of the chute then catches the sample. This sample is likely to be quite representative.

Field losses of sugarcane due to chopper harvesting consist of cane left behind in the field and losses of juice and cane fragments so small that they cannot be gleaned (invisible losses). Cane left behind can be easily determined by careful gleaning of marked-off plots immediately following harvesting. Typical values for this part of the cane loss vary from 2 to 10% (de Beer and Boevey, Mason et al., Smith, Zepp and Clayton).

Invisible losses are more difficult to determine, especially under actual operating conditions. A survey of invisible losses was made when using six chopper harvesters in Florida in 1974 (Joe E. Clayton, personal communication). This followed on reports from Australia (Vaillancourt) that losses were 19% and up to 30% when pre-weighed cane was fed through harvesters. In the Florida study, harvesting mechanisms and extractor fans were operated at normal speeds and pre-weighed cane was fed through the machines. After the test, all cane found inside the machine was added to that which dropped out of the harvester. There was still a shortfall of 3.2%, which was regarded as an invisible loss, probably due to the disintegration of billets and lost juice. According to a Mexican study carried out in 1975 (CNIA) two chopper harvesters delivered 78% of available millable cane as compared to 94% from manual cutters. Both “cane left behind” and “invisible losses” were probably included in these figures.

A 1976 study at Rio Grande Valley Sugar Growers, (Rozeff and Tucker) comparing hand cutting with a chopper harvester, indicated that little, if any, juice was lost in the mechanical harvesting operation. However, when testing eight different models of chopper harvesters in 1977 (RGVSG) in a field averaging 133 t/ha, it was found that 15% of the pol available after burning was lost during the harvesting operation. This loss was made up of 1% pol recovered with the trash, 10% lost in scrap left behind in the field and 4% on undetermined or invisible loss. These values were determined by comparing the pol % cane and fiber, of hand cut samples and the net cane component of the gross cane delivered by the machines.

During 1976 it was reported in Hawaii (Gibson et al.) that the extraction fans of a specially-built chopper harvester removed 2.0 tons recoverable pol/ha from 261 tons of sugarcane/ha. South African test (de Beer and Boevey, SASAES) based on direct comparisons of millable cane delivered by machine or following manual cutting, gave invisible losses due to chopper harvesting of 4 to 15%. The lower values were found with well-maintained machines, while the higher values were for machines obviously in need of attention.

In the final analysis, machine efficiency, trash content, sample quality and
cane losses will be determined not only by the machine and its inherent design, (Hackett) but also by factors such as cane variety, burn quality, moisture content of the soil, base cutting height, topper height setting, blade sharpness, production rate and erectness of the cane.

During 1978 the Experiment Station of the South African Sugar Association had the opportunity to compare two makes of chopper harvesters with hand cutting. This enabled the Experiment Station to further evaluate test procedures for these machines, one of the objectives set by the ISSCT Standing Committee on Mechanical Harvesting and Cane Quality.

The 1978 tests were performed at Mhlume Sugar Company, Swaziland, on two makes of sugarcane chopper harvesters. The aim of the tests was to observe the field losses incurred when each of the machines was used, in comparison with those incurred when the normal standard of hand cutting was practiced by Mhlume Sugar Company.

TEST PARTICULARS

The rest was done on 39 sprinkle lateral blocks, with an average size of 0.37 ha, on the Ematsheni Section from 7 to 11 August 1978. The three treatments, Chopper A, Chopper B and hand-cut, were randomly assigned to each group of three lateral blocks, with thirteen replications per treatment.

The whole field was burned at one time and harvesting commenced with five replications being hand-cut on August 7. This cane was hand-stacked for self-loading trailers to deliver the bundles to a transloading zone for further transport by road vehicle to the mill. Hand-cut cane was crushed on the day following cutting. Five additional replications were cut on August 8 and 9, respectively.

Both chopper harvesters were practically new, having only been used for demonstration purposes before the tests. Machine A was in excellent condition, being under the supervision of and being maintained and adjusted by the manufacturer's representative. Machine B did not receive the same attention, being operated without the agent's presence. Two local chopper harvester operators, used to another make of machine, operated the harvesters but both had adequate practice on the two machines in question before the test began.

The chopper harvesters started cutting on August 8, with the cane delivered directly from the field to the mill in 10-ton containers. Chopper-harvested cane was crushed within two hours of cutting. Only one machine operated at any particular time, allowing about 40 tons from each lateral to accumulate on the mill carrier for continuous crushing. Four replications were cut by each machine on the 8th, seven by machine A and one by machine B on the 9th, and the last two were harvested by machine A on August 10.
It soon became obvious that machine B was performing very badly and erratically. This was apparently due to a lack of proper setting and maintenance. This harvester was therefore withdrawn from the test after cutting only five replications.

Choppers A and B cut at average rates of 40.5 and 27.1 tons per field hour, respectively. The cane was a fourth ratoon NCo 376 which was 12.7 months old. Because a cane ripener had been used, the quality of the burn was excellent. Recumbency was judged to be 25% occurring in patches in the field. Field conditions were dry, and the average daily maximum and minimum temperatures were 28°C and 13°C, respectively. Average relative humidities at 08h00 and 14h00 were 83 and 31%, respectively. The cane rows were 216 m long, spaced 1.5 m apart, with the cane grown on a ridge of about 100 mm. Each lateral block consisted of 11 cane rows, yielding about 44 tons each. Average yield for the field was 108.1 tons/hectare at 14.24% sucrose.

EXPERIMENTAL PROCEDURES

To be relevant, the tests had to be done under infield harvesting conditions, but they could not be allowed to disrupt normal harvesting schedules to a significant extent. It was also realized that the testing procedures should not require unrealistic resources as far as manpower, testing equipment and time were concerned.

Cane sample

The first factor considered in determining field losses was the amount of extraneous matter delivered to the mill with the harvested cane.

Hand-harvested cane was placed in windrows, stacked manually and the stacks were then picked up by self-loading trailers. Eleven random samples of 15 to 25 kg were taken to represent each treatment block from the windrowed cane before it was stacked. Samples were taken by removing stalks from all levels of the windrow to ensure that cane from all the rows included in that windrow were represented. The samples of stalks were weighed as they were taken from the windrow. All tops and other trash still adhering to the stalks were then carefully removed and the cleaned stalks were weighed again. This gave a measure of the extraneous matter content, which was then expressed as a percentage of the total sample. Extraneous matter is defined as all materials other than millable cane. With this handling method, it was not possible that the commercial cane could be contaminated by additional extraneous matter (such as soil) subsequent to sampling.

Samples from chopper-harvested cane were taken directly from the machines. On a signal, the harvester operator stopped the elevator and the harvester, and the bin trailer was moved slightly forward to be out of the way. A canvas sheet was then held in position below the elevator and the operator started the elevator again.
Between 15 and 25 kg of cane were caught on the sheet. During this operation all fans were kept going at normal operating speeds. The canvas sheet was large enough to catch all cane and extraneous matter delivered from the elevator. Care was taken, however, to ensure that trash did not get blown away. The machine then caught up with the trailer and continued to harvest normally. This procedure resulted in a minimum of delay to the harvester. Each sample was immediately analyzed for cane and extraneous matter, the latter again being expressed as a percentage of the total. One sample was taken at random per row or cane in each test block, resulting in eleven samples per treatment block.

**Net cane delivered**

The quality of net cane delivered at the mill was found by subtracting the estimated amount of extraneous matter determined by means of the cane sample hired from the gross mass of cane as determined on the weighbridge.

**Gleaning after harvest**

Hand-cut blocks were gleaned by the team of laborers normally hired for this task. Gleaned cane was weighed in the field by a tractor-mounted grab fitted with a load cell. No gleaning of machine-cut cane occurred after harvest, but two field laborers worked with each chopper harvester and placed some left-over cane in the next row to be cut. These gleaning procedures correspond to those normally used by Mhlume Sugar Company.

**Cane left in field**

After all harvesting operations had been completed in each lateral, three random sample plots were marked out per lateral by means of pegs and strings. These plots were 3 m square, i.e. 9 m² each. All “millable” cane inside the demarcated sample plots was gathered and the weight determined. Millable cane consisted of all pieces of cane recognizable as such. Where topping was too low, that part of the top regarded as “millable cane” was broken off at the natural breaking point. Where base-cutting was obviously too high, the stubble was cut by hand. Any piece of millable cane lying across the plot demarcation line was cut at the line and the part left on the inside was collected. The millable cane collected from each sample plot was expressed in terms of tons per hectare. In the case of chopper-harvested cane, care was taken to ensure that sample plots were marked out only on that part of the field traversed by both the harvester and the bin-carrying trailer.

**Mill analysis**

Approximately 40 tons of sugarcane were cut from each treatment block and delivered in one batch to the mill. This quantity of cane was adequate for mill sampling for sucrose and purity determinations.
Billet quality

Seven samples for machine A and six for machine B, each approximately 20 kg. were taken from the cane delivered by the chopper elevator and analyzed for extraneous matter content and billet quality based on procedures developed by Australian researchers. (Foster et al\textsuperscript{10}, Fuelling et al\textsuperscript{11}, Mason et al\textsuperscript{16})

**TABLE 1. Typical analysis of clean cane and extraneous matter**

<table>
<thead>
<tr>
<th>Brix %</th>
<th>Pol %</th>
<th>Purity</th>
<th>Fiber %</th>
<th>Moisture %</th>
<th>Non-pol %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean cane</td>
<td>16.7</td>
<td>14.8</td>
<td>89</td>
<td>12.8</td>
<td>70.5</td>
</tr>
<tr>
<td>Tops</td>
<td>6.7</td>
<td>1.4</td>
<td>21</td>
<td>16.6</td>
<td>77.7</td>
</tr>
<tr>
<td>Trash (leaves)</td>
<td>7.8</td>
<td>1.5</td>
<td>19</td>
<td>58.6</td>
<td>33.6</td>
</tr>
</tbody>
</table>

**RESULTS AND DISCUSSION**

The results of the tests are summarized in Table 2.

**TABLE 2. Summary of results**

<table>
<thead>
<tr>
<th></th>
<th>Hand</th>
<th>Chopper A</th>
<th>Chopper B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross cane delivered (t/ha)</td>
<td>120.10</td>
<td>117.94</td>
<td>108.36</td>
</tr>
<tr>
<td>Extraneous matter (%)</td>
<td>3.10</td>
<td>6.05</td>
<td>7.00</td>
</tr>
<tr>
<td>Net cane delivered (t/ha) (including gleaning)</td>
<td>116.37</td>
<td>110.78</td>
<td>100.66</td>
</tr>
<tr>
<td>Left behind in field (t/ha)</td>
<td>2.53</td>
<td>3.04</td>
<td>6.08</td>
</tr>
<tr>
<td>Loss vs total millable cane (118,90t/ha) (%)</td>
<td>2.13</td>
<td>6.83</td>
<td>15.34</td>
</tr>
<tr>
<td>Loss vs hand-cut + gleaning (%)</td>
<td>–</td>
<td>4.80**</td>
<td>13.50*</td>
</tr>
<tr>
<td>Sucrose % cane</td>
<td>14.35</td>
<td>13.95*</td>
<td>13.95*</td>
</tr>
<tr>
<td>Purity %</td>
<td>88.48</td>
<td>87.35**</td>
<td>87.54**</td>
</tr>
<tr>
<td>Sucrose (t/ha)</td>
<td>17.22</td>
<td>16.44*</td>
<td>15.07*</td>
</tr>
<tr>
<td>Loss in sucrose vs hand-cut + gleaning (%)</td>
<td>–</td>
<td>4.50</td>
<td>12.50</td>
</tr>
</tbody>
</table>

* Difference from the hand-cut treatment is significant at 5% level.
** Difference from the hand-cut treatment is significant at 2% level.
Total millable cane

A measure of the total tons of millable cane on the field before harvest can be found by subtracting the extraneous matter from the hand-cut cane delivered to the mill, then adding what was gleaned and what was found to be left behind. The average for the 13 replications was 118.9 t/ha.

Net cane harvested

The amount of net cane normally harvested by Mhulme, when hand cutting is practised, can be estimated as the total millable cane less that portion left behind in the field after gleaning i.e. 116.4 t/ha. For the chopper harvesters it would be the gross tons cane delivered at the mill less the extraneous matter. This was calculated to be 110.8 and 100.7 t/ha for machines A and B, respectively.

Gleaning after harvest

By gleaning the hand-cut blocks, 0.9 t/ha of cane was retrieved. Gleaning of chopper harvested blocks was not deemed to be worthwhile.

Cane left in the field

Even after gleaning, 2.5 t of cane per ha was still left behind in hand-cut blocks. Chopper A and chopper B left behind 3.0 and 6.1 t/ha, respectively. Chopper A was clearly harvesting more cleanly and its base cutting was lower than that of chopper B.

Mill analyses

Sucrose % cane was 14.35, 13.95 for cane cut by hand, by machine A and by machine B, with juice purities of 88.5, 87.4 and 87.5, respectively.

Billet quality and extraneous matter

The low extraneous matter content of both hand-cut (3.1%) and chopper-cut cane (6.1% for A, 7.0% for B) must be ascribed to the excellent burn resulting from the prior use of chemical ripeners and the dryness of the weather.

Table 3 provides further evidence that machine A was cutting lower than machine B. This resulted in higher dirt and root percentages for machine A, but for both machines these values were negligibly small. Billet quality did not differ much between the two machines but machine A did show a marked improvement in sound cane (64.8%) after sharpening of blades. The lengths of the billets differed considerably, with machine A delivering shorter billets of more consistent length than those delivered by machine B (Fig. 1). In the case of Mhulme Sugar Company,
the amounts of damaged and mutilated billets are probably not important because chopped cane is usually crushed with two hours of cutting.

Field losses

Of the total amount of millable cane (118.9 t/ha), hand cutting resulted in a loss of 2.13%, chopper A caused a loss of 6.63% and chopper B a loss of 15.34%.

Compared to hand cutting with gleaning, as normally practiced by Mhlume, mechanical harvesting resulted in a millable cane loss of 4.80% and 13.50% for choppers A and B, respectively. Mechanical harvesting resulted in a loss in sucrose of 4.50% and 12.50% for choppers A and B, respectively, when compared with hand-cutting as practiced at Mhlume. Juice purities were also significantly lower when mechanical harvesting was practiced.

The results obtained with chopper A, taking into account its high cutting rate, are nevertheless as good as those found previously by the Experiment Station for other machines. The results obtained using this machine are indicative of what can be expected with a chopper harvester when it is in good repair and with proper settings and maintenance.

The poor results obtained with chopper B should not be taken as typical for the make of harvester, but should rather serve as a warning of the deterioration in performance to be expected when a machine is neglected.

CONCLUSIONS

Considering the results of the 1978 Swaziland tests as well as those reviewed in the introduction to this paper, the performance of chopper harvesters can be summarized as follows:

1. Field efficiency will be about 40% under field conditions which are normally to be found in most countries. Under excellent field conditions, the efficiency could increase to 60%.

2. The harvesting rate can exceed 60 t per operating hour (pour rate), but in practice this will usually decrease to 10 to 30 t per field hour. In green cane, the pour rate of existing harvesters will be reduced to 20 to 30 t per hour.

3. Chopper harvesting will result in increased amounts of tops and leaves in the sample. The amount of extraneous will be affected by field conditions but will generally be 6% under good field conditions and up to 17% under poor conditions. Increased extraneous matter contents will have a detrimental effect on mill performance and sugar produced, in direct proportion to the amount of extraneous matter in the sample.
4. Chopper harvesters, compared to mechanical loading, will substantially reduce the amount of soil delivered with the cane. Soil % cane can be expected to be less than 0.3%.

5. Chopper harvesting will lead to a loss of millable cane. For well maintained machines these losses will be in the order of:

Cane left behind in the field : 2 to 10%
Invisible losses : 3 to 6%

<table>
<thead>
<tr>
<th>TABLE 3. Sample analysis and billet quality</th>
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<table>
<thead>
<tr>
<th>Sample Tons cut size (kg)</th>
<th>Sample Roots %</th>
<th>Dirt %</th>
<th>Tops %</th>
<th>Trash %</th>
<th>Damaged %</th>
<th>Mutilated %</th>
<th>Sound %</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACHINE A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1 20 12.78 0.1 0.1 2.6 0.2</td>
<td>21.0 24.1 51.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 40 16.85 0.3 0.2 2.9 —</td>
<td>30.3 21.6 44.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 140 17.28 — 0.1 3.5 —</td>
<td>25.9 26.3 44.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 160 19.74 2.2 0.2 5.2 —</td>
<td>29.3 23.2 42.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 10 14.85 2.2 0.6 3.6 —</td>
<td>10.0 18.9 64.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 160 17.74 — 0.2 3.0 —</td>
<td>19.7 23.3 53.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 250 21.41 — 0.5 3.5 —</td>
<td>14.4 32.4 49.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Av 0.4 0.3 3.5 —</td>
<td>21.5 24.3 50.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

| MACHINE B                |                |        |        |         |           |             |         |
| 1 20 24.98 0.1 0.1 3.3 0.5 | 22.3 30.6 42.0 |        |        |         |           |             |         |
| 2 40 16.57 0.1 0.1 3.9 — | 26.3 36.0 33.6 |        |        |         |           |             |         |
| 3 125 27.66 — 0.1 3.0 — | 30.4 18.7 47.8 |        |        |         |           |             |         |
| 4 150 24.82 — 0.1 4.4 — | 26.7 19.4 49.5 |        |        |         |           |             |         |
| 5 155 24.18 — 0.1 3.4 — | 25.4 26.3 44.8 |        |        |         |           |             |         |
| 6 184 17.94 — — 4.3 — | 18.3 22.6 54.7 |        |        |         |           |             |         |
| Av — 0.1 3.7 0.1 | 24.9 26.6 45.4 |        |        |         |           |             |         |

* The number of tons cut after setting of machine, sharpening blades, etc.
FIGURE 1. Distribution of billet lengths
For neglected machines, these losses will be much higher.

One aspect on which very little data has been published is the cost of chopper harvesting. Life expectancies of mechanical harvesters under defined conditions are also unknown.

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RENDIMIENTO DE COSECHADORAS TROZADORAS

A. G. de Beer

RESUMEN

A continuación damos una reseña de los resultados obtenidos en varios países con el uso de cosechadoras trozadoras. Los procedimientos de pruebas para cosechadoras de caña se consederan mediante la descripción de un experimento llevado a cabo en 1978 en una hacienda en Swazilandia con el fin de determinar las pérdidas durante una cosecha de caña al usar dos cosechadoras distintas, en comparación con las pérdidas cuando la cosecha se llevo a cabo por el medio convencional de mano de obra y la caña fue transportada en carretas autocargables. De un estimado de 118.9 toneladas de caña por hectárea en un campo, se determino que 116.4 tons/ha fueron recobradas al usar mano de obra, 110.8 tons/ha usando la maquina A y 100.7 tons/ha usando la maquina B. Como la caña habia sido tratada quimicamente para su maduración, y la quema obtenida fue excelente, la cantidad de materia extraña fue muy poca en todos los casos. Para caña cortada a mano fue 3.1%, la maquina A 6.1% y la maquina B 7.0%. Comparadas con el corte a mano, el uso de las maquinas A y B resulto en una perdida de sucrosa de 4.5% y 12.5% respectivamente.