

**BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA**

**THE CONTRIBUTION OF MECHANICAL
CANE HARVESTING TO THE
PRODUCTIVITY PLATEAU**

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THE CONTRIBUTION OF MECHANICAL CANE HARVESTING TO THE PRODUCTIVITY PLATEAU

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SUMMARY

The invention of mechanical cane harvesters has been important in the development of the Australian sugar industry. Mechanisation of the harvest has brought many benefits. However associated with mechanical cane harvesting there are aspects which impact on crop productivity matters and hence on industry profitability. These issues are being addressed in BSES research and extension programs.

INTRODUCTION

The period 1964 to 1970 saw a transition from wholestalk to chopper harvesting. Since 1970 there has been gradual refinement of chopper harvesters to give a stronger cleaning system, more capacity, the ability to handle lodged cane and more recently the ability to cut green cane. The changes to mechanical cane harvesting have had an important impact on productivity and thus is one of the factors contributing to the productivity plateau discussed at a previous meeting of the Sugar Industry Policy Council.

The main effects of mechanical harvesting on production occur through:

- losses of cane during harvesting
- extraneous matter levels
- dirt in the cane supply

- soil compaction during harvesting
- damage to cane stubble during harvesting

CANE LOSSES DURING HARVESTING

No estimates of cane losses during the wholestalk harvesting era are available for Australia but recent research overseas places these in the order 1-2.5 per cent. In contrast BSES research has demonstrated substantial losses for chopper harvested cane. These are made up of wholestalks and stubble not gathered by the harvester and losses during the cleaning process.

Losses during gathering of cane vary between 0 and 10 per cent depending on crop and field conditions. Losses in the cleaning process vary from 2 - 10 per cent in burnt cane and 3 - 15 per cent in green cane. These are substantial losses to the industry as a one per cent increase

in cane loss is estimated to be worth \$10 million annually.

BSES harvester research has shown that gathering losses are higher in lodged cane, particularly where row profiles are unsuitable for mechanical harvesting. Recent BSES research has identified several factors which contribute to high losses during cleaning:

- varietal characteristics - losses are highest in thin stalked, trashy varieties with low stalk densities.
- lodged cane - topping is the most effective way of reducing extraneous matter levels with minimal cane loss.
- green cane harvesting - losses are significantly higher in green cane than burnt cane due to the large bulk of extraneous matter which must be removed by the harvester cleaning system.
- poorly designed harvester cleaning systems with high air velocities and poor presentation of cane for cleaning.

Several recent industry trends may accentuate cane losses:

- the production of more vigorous varieties with a greater propensity for lodging.
- growth of older ratoons which tend to be thin stalked and trashy and susceptible to cane loss.

- the expansion of green cane harvesting (Figure 1; Table 2).

Table 1: Trends in green cane harvesting

Region	% green cane harvesting				
	1986	1987	1988	1989	1990
Ingham	47.7	69.6	87.0	95.0	96.0
Nth Qld	33.6	44.9	60.0	71.4	74.8
Qld	11.6	19.4	30.0	30.7	33.6

BSES conjunction with Agridry-Remik has developed an electronic device known as a Cane Loss Monitor which assists the harvester operator in reducing cane loss. The device records impacts of billets on the extractor shroud. By adjusting fan speed in relation to readings on the Cane Loss Monitor, cane losses can be reduced.

EXTRANEOUS MATTER LEVELS

In the early stages of mechanical harvesting there was an increase in extraneous matter levels entering mills, particularly in north Queensland (Figure 2). No recent data is available for extraneous matter levels. Research by BSES and others has shown that ccs is reduced by approximately 0.13 unit for each percentage increase in extraneous matter levels. Extraneous matter is therefore an important productivity issue and in addition it reduces processing efficiency and sugar recovery in mills.

The same industry trends which affect cane losses also impact on extraneous matter levels: growth of more vigorous varieties prone to lodging and suckering,

more older ratoons with high field extraneous levels and the move to green cane. While extraneous matter levels are generally only marginally higher in green cane than burnt cane the difference is comprised mainly of leaf and trash material which has an adverse effect on bin weights and mill crushing rates. These factors in combination may be causing a gradual increase in extraneous matter levels and a corresponding drop in ccs.

DIRT IN THE CANE SUPPLY

In the changeover period from wholestalk to chopper harvesting (1964 - 1970) dirt levels were relatively low in mills but since that time there has been a gradual increase in dirt levels (Figure 3). This has been particularly pronounced in north Queensland where there is a higher incidence of lodging, stool tipping and wetter harvest conditions.

Higher dirt levels reduce mill efficiency through increased maintenance and operating costs and also impact on grower returns by reducing ccs. Any trend upwards in dirt levels is thus of industry wide concern.

SOIL COMPACTION

The effects of soil compaction are insidious and there is no clear evidence that it affects productivity. However there are some worrying trends in harvesting practices which could be accentuating compaction effects: harvesting in wetter conditions; the increase in weight of harvesters and haulout equipment; and the poor

matching of row spacings to the wheel track of harvesting equipment. The latter problem is being accentuated by the use of wide, high flotation tyres on both harvesters and haulout equipment so that traffic passes closer to the cane rows.

BSES research to date has been inconclusive regarding the long-term effect of compaction on yield. It has demonstrated serious soil compaction, which under reduced tillage is not alleviated by cultivation.

STUBBLE DAMAGE

Mechanical cutting of cane has a more severe effect on ratoon stubble than hand cutting. There has been concern about possible effects of stubble damage on yield since the introduction of mechanical harvesters. BSES research has shown that stubble damage is enhanced by cutting above ground level and by high harvester ground speed. Damage can be particularly severe in lodged cane where stubble shattering is combined with pulling out of the cane stool.

Despite observed differences in physical damage to cane stubble, comparative trials between hand and machine cutting and high and low ground speeds have not shown consistent yield losses. There is a strong interaction between stubble damage and conditions for ratooning, with increased yield losses under adverse conditions for crop growth.

There are two industry trends which may increase stubble damage at harvesting:

the use of more vigorous varieties which are prone to lodging, and the increase in group sizes leading to higher ground speeds for harvesters.

RESEARCH NEEDS

In the earlier discussion five priority areas for harvesting research were highlighted and the BSES is addressing each of these areas.

Cane loss and extraneous matter

Recent research has shown that there is a trade off between cane loss and extraneous matter with current harvester cleaning systems. Cane loss can be reduced significantly eg by slowing extractor speed, but this results in a significant increase in extraneous matter levels. The extra material is mainly leaf and trash and this has an adverse effect on bin weights and mill crushing rates.

The current BSES research program is addressing the cleaning problem from three directions:

- development of a cane loss monitor to allow testing of extractor performance in the field.
- improvement in the extractor chamber design to reduce cane loss without a penalty of increased extraneous matter levels.
- evaluation of the potential of the chop/throw system in harvesters for improving cleaning efficiency.

In conjunction with the research program an industry wide extension program is planned to explain the issues involved in minimising cane loss/extraneous matter

and possible improvements already available to the industry.

Dirt in cane

Over the last four years the BSES has conducted an intensive research program aimed at reducing dirt levels in the cane supply. This has addressed field practices required for reducing dirt intake by harvesters and modifications to reduce dirt intake and increase dirt rejection by the harvester. Results of the research are being reported to the industry and testing of refinements to the harvester will be continued.

Soil compaction

Research on soil compaction is addressing three issues:

- measuring yield losses associated with compaction on or close to the cane row during harvesting.
- development of the controlled traffic concept for minimising compaction close to cane rows.
- study of the decline in soil structure in old caneland which may render it more susceptible to compaction.

Stubble damage

The research on field practices affecting dirt levels in the cane supply highlighted practices which accentuate stubble damage such as poor filling of the plant cane drill. More research is needed to determine the factors leading to yield loss as a result of stubble damage. Research is also required to improve the performance of the harvester basecutter so that damage is minimised. Both

aspects of 'basecutter damage' are the subject of recent proposals for SRDC research funding.

ENCOURAGEMENT OF INNOVATIONS IN HARVESTER DESIGN

BSES is facilitating innovations in harvester design which will improve the

operational efficiency. BSES has projects with Austoft on primary extractor and cabin design.

BSES has also formed a group comprising inventors and harvester operators to discuss ways to improve harvester efficiency and design.



