# Information Sheet

## 6. MECHANISATION

# *2.7 ~~6.7~~ Factors to consider when implementing a mechanised cane harvesting system

*** Note: The number of this information sheet has been changed to fit in with our new classification system. Contents will be reviewed in due course.***

Many factors have to be considered when implementing a change from manual to mechanised harvesting. These range from social and political issues to capital outlay and local tax implications. All aspects of cane production will be affected by the change and, where a chopper harvester is opted for, mill receiving facilities may also have to be adapted. Outlined below are some of the agricultural practices that will need to be adopted.

## *FIELD LAYOUT AND PREPARATION*

Successful mechanical harvesting depends primarily on field layout and proper land preparation.

**Land preparation**

The more sophisticated the mechanised harvesting system, the higher the standards of field preparation required. Once a harvesting system has been selected, fields must be prepared for maximum machine efficiency. Irrigation and drainage systems must also suit the system that has been chosen.

The successful establishment of an optimum yielding crop and the efficient use of mechanised equipment are largely depen-dent on accurate land levelling and smoothing. This will:

- allow for efficient use of irrigation water
- improve drainage and reduce costs, while pre-venting formation of water-logged areas
- provide conditions which will allow the highest possible economic speed of both harvesting and infield transport machinery.

During the tillage operations the land should be cleared of rocks as far as is economically possible. It is necessary to prepare a fine tilth before planting in order to obtain the desired row and interrow profile.

**Field layout**

The primary objective is to present the harvester and infield transport vehicles with straight, evenly spaced parallel rows. Harvesting equipment is not able to function efficiently in fields that are intersected by frequent deep irrigation or drainage ditches. Waterways and drains that cross the rows should be as shallow as possible. Open drains should run parallel to the cane rows at a distance of at least one full row width away from the nearest row.

Fields should be laid out in block form to give longer cane rows and reduce time lost in turning. Adequately wide headlands for the safe and speedy turning of the harvester and haulout equipment must be provided. Entry and exit from every row must be unhindered. This means that rows must not terminate in a bank or ditch, or in another row.

**Row spacing**

Wider row spacings are preferred for mechanisation and should be compatible with the wheel tracks of infield haulout vehicles to avoid cane stool damage.

***A fully mechanised green cane chopper harvester in operation.***

In most instances this would mean a row spacing of 1,4 to 1,6 m. Wider row spacings also assist crop lifters fitted to harvesting machines in lifting lodged cane.

Narrow row spacings require far greater skill and concentration on the part of the operator to ensure that the machine does not run into the next row. Any possible increase in cane yield due to narrower row spacing may be negated by stool damage and soil compaction caused by the wheels or tracks of harvesting and haulout equipment running on or close to the cane rows. Cane rows growing close together are also difficult to separate.

### Cane row profile

An important feature of good field preparation is providing the harvesting equipment with cane grown as uniformly as possible.

**Transverse windrowing and bundling harvesting machines** operate best on a flat culture where row and interrow are on the same level. Where it is necessary to grow cane on a ridge, ridge height and width must suit the harvesting and haulout equipment selected. However, soil type and climatic conditions also influence the height of the ridge.

**Chopper harvesters** generally prefer a slightly raised row (40-150 mm) with a smooth surface in the interrow, for effective base cutting and gathering of sprawled cane. Hilled up rows, apart from assisting the operator in steering the machine, also reduce the load and wear and tear on the base cutter assembly and blades. The ridge height should be constant to avoid poor base cutting and to reduce excessive soil being included in the cane. Row profile and base cutter angle are closely related. Matching these two factors will result in improved harvester output and better ratooning.

### Cane row length

Row length should suit both the harvester and transport equipment. Row lengths of 200 to 600 metres will result in acceptable performance from most types of mechanical harvesting and loading systems. Ideally, rows in adjacent blocks should be aligned so that the harvester can travel from one block to another without stopping. However, when laying out fields or blocks, consideration must be given to soil type and the method of irrigation to be used.

### Ratoon crop management

Mechanical cultivation is usually carried out after harvesting burnt cane, either to maintain or raise the row profile and to smooth the interrow space. Where cane is harvested green, specialised equipment is required to maintain row profiles. Mechanical or chemical stool pruning may have to be carried out in old ratoons where stool widths have become excessive.

## CANE VARIETIES

The main factors normally influencing variety selection include high sucrose yields, soil type, soil fertility, and disease and drought resistance. When harvesting mechanically, the variety should also have the following attributes:

- non-brittle cane to reduce losses
- resistance to lodging
- minimal tops and trash
- self-trashing or loose leafed to facilitate trash removal
- ratoonability.

Thin stalked, trashy varieties that are prone to lodging will result in high cane losses and high extraneous matter levels when harvested by combine harvester, particularly when harvested green.

## CANE QUALITY

### Soil in cane

A number of factors play important roles in levels of soil in cane, including soil type, cane variety, age of crop, farming practices, type of harvester, harvester component design, maintenance and adjustment of components, and harvester forward speed. Inappropriate or poorly adjusted cultivation equipment and a poorly maintained row profile will increase soil in cane. Factors that will reduce soil in cane include:

- effective land smoothing
- correctly shaped row profile
- correct harvester base cutter angle
- optimum number of cane rows placed in one windrow
- correct and neat placement of cane in the windrow
- high operator proficiency.

Push-pile loaders operate best where the cane rows are hilled up. Grab loaders operate best on a flat culture because this type of machine must turn across cane rows in order to place the cane in the infield transport.

**Cane losses**

Cane losses in manually harvested burnt cane (cut and windrowed followed by mechanical loading) are 3-5% pre-gleaned and 1-2% post-gleaned. Because of the host of factors that affect this operation, cane losses vary enormously when mechanical harvesting is practised, and will generally be higher than that of manually harvested cane.

**Cane deterioration**

Green cane deterioration for both whole stalk and chopped cane is slower than that of burnt cane. Whole stalk cane can be stored for longer than chopped cane, which should be crushed within 14 hours of harvest.

## SOIL COMPACTION

In many mechanised systems, the harvester and haulout equipment pass over the same interrow at least twice. With single row chopper harvesting systems, a total of four passes per cane row are made (two by the harvester and two by the following infield transport). The risk of soil compaction and cane stool damage from mechanised harvesting is therefore considerable. A system of tramline planting will assist in reducing this risk. It is also essential that row spacing and stool widths are compatible with harvester and infield haulout machinery track widths.

The option of not burning before harvesting, apart from having nutritional, agronomic and environmental advantages, also reduces the risk of soil compaction due to the cushioning effect of the trash blanket. Other factors which reduce soil compaction include:

- harvesting susceptible fields during the dry period
- incorporation of organic matter
- avoiding over-irrigation
- proper drying off after irrigation.

Information Sheet 6.2 deals in depth with the different types of compaction and corrective measures that can be taken.

## PAYLOAD DENSITY

Payload densities for whole stalk and chopped cane are influenced by the following:

- Cane age and variety
- Time of year
- Lodged or erect cane
- Length of cane stalk or billet
- Burnt or green cane
- Extraneous matter content
- Transport vehicle design
- Infield loading method
- Transloading method.

## HAULOUT DISTANCE

An important factor affecting chopper harvester performance is the number and capacity of the infield haulage units, and the distance that these units have to travel to the transfer station or transloading site. Optimum harvester performance can only be achieved when the harvester is not held up by a lack of infield transport. This means that an adequate number of infield haulage units should be available when required and that infield haulage distances must be kept as short as possible.

*A chopper harvester operating under ideal field conditions.*

## GENERAL

1. For mechanised harvesting to be successful in the sugar industry, several factors will have to receive urgent attention. These include mill receiving facilities, the cane payment system and the breeding of cane varieties suitable for mechanised harvesting operations.
2. The development and adoption of mechanised harvesting systems in sugar producing countries such as Australia, Florida and Louisiana was driven by a shortage of manual labour and not by the prospect of lower production costs.
3. A change to a fully mechanised harvesting system involves many disciplines and affects all aspects of cane production. Growers, managers and millers should all be involved from the outset to plan, implement and monitor the operation.

4. The successful implementation of a fully mechanised harvesting system is directly related to the pre-planning, level of commitment and level of supervision afforded the project. The level of efficiency required may only be reached after the second or third season. This is so because it takes time to alter field layouts and field practices to optimise machine performance. Machinery operators also need time to acquire the skills and techniques necessary to maximise machinery performance.

5. The formation of harvesting syndicates or contracting groups may improve the viability of the relatively more sophisticated and expensive mechanised harvesting machinery. However, it may never be economically viable to mechanically harvest cane on steep slopes.

## *WHAT ARE THE DIFFERENCES BETWEEN WHOLE STALK AND CHOPPED CANE HARVESTING SYSTEMS?*

### WHOLE STALK HARVESTERS

**Advantages**

- Generally cheaper to purchase and to operate.
- Whole stalk cane deteriorates more slowly than chopped cane and can be stockpiled for considerably longer periods.
- Under good field and crop conditions, whole stalk harvesting systems will result in less cane loss and better cane quality than chopper harvesting.
- As the cutting and loading operations are conducted separately, there is more flexibility around breakdowns.
- Whole stalk cutters are fairly simple machines that are easy to operate and require relatively unsophisticated maintenance staff and facilities.
- Whole stalk harvesting systems permit the continued use of whole stalk loading, transport, mill receiving equipment, vehicles and facilities.

**Disadvantages**

- Whole stalk harvesters often have difficulty in harvesting heavy crops, and green or recumbent cane.
- Separate infield loading equipment is required.
- Mechanical loading of whole stalk cane could increase soil content in the cane.
- Some whole stalk machines have a high centre of gravity and are unstable on steep slopes.
- Transport load densities are usually lower for whole stalk than for chopped cane.

### COMBINE CHOPPER HARVESTERS

**Advantages**

- Chopper harvesters are complete combines and do not require separate infield loading equipment.
- Modern combine harvesters are able to handle both green and burnt cane in a wide range of weather and crop conditions, including badly lodged cane.
- In pollution sensitive areas chopper harvesters have a distinct advantages because of their ability to handle green cane. Chopper combine harvesting rates in green cane are about 40-60% of those obtained in burnt cane.
- The harvest-to-crush delay is minimal (provided cane transport is well scheduled), resulting in higher sugar recoveries.
- Chopped cane feeds into the mill more easily and consistently.
- Chopped cane spillage en route to mills is usually lower than whole stalk cane.
- Labour requirement is reduced.

**Disadvantages**

- High capital outlay of equipment.
- Because harvesting, transport and milling operations are indelibly linked, communication and transport scheduling are vital in obtaining optimum harvester utilisation.
- Receiving facilities at mills usually handling whole stalks would have to be adapted to accept chopped cane.
- Cane losses are generally higher compared with whole stick harvesting systems.
- Chopped cane deteriorates more quickly than whole stalk cane.
- A high level of managerial and operator skills and technical support is required.

**A comprehensive report entitled, *Factors to consider when implementing a fully mechanised harvesting system* is available free of charge through your local Extension Officer.**

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