Information Sheet

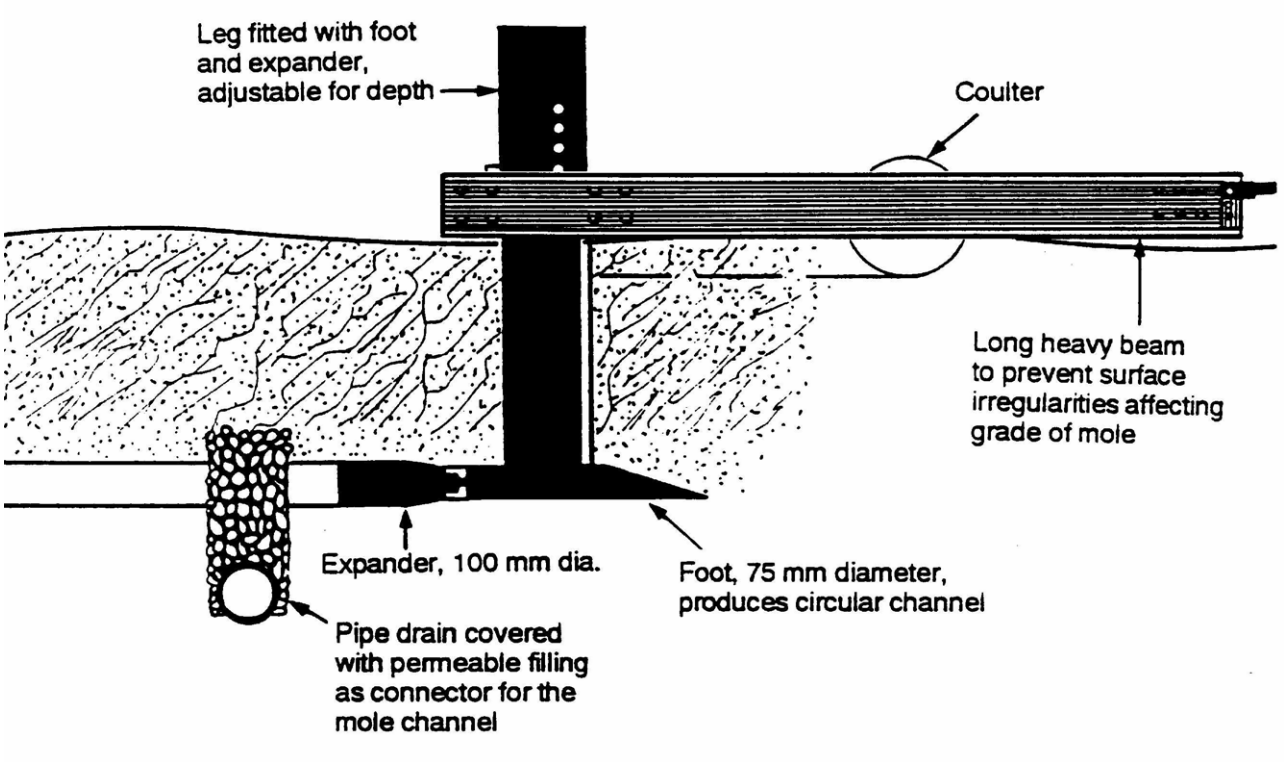
6.16 Mole drainage

For soils with poor drainage, it may be necessary to install subsurface drains to prevent water logging and improve drainage. This can be costly and requires extensive earthworks to undertake using conventional designs. Mole channels or mole drains can be used as an alternative for, or a supplement to, conventional subsurface drains. Mole drainage is the creation of open "tubes" or channels below the soil surface that can improve subsurface drainage (Figure 1). They provide an inexpensive and easy way to deal with perched water tables and excess surface water and facilitate improved water infiltration into poorly drained soils. There are, however, several key considerations for their successful implementation.

▲ Figure 1: A mole drain at a depth of 450 mm in the gley horizon of a Rensburg soil form.

Equipment

A mole plough is a modification of the conventional ripper to create a channel with the tip of the tine followed by an expander (mole) to stabilise the channel. Typical dimensions of a mole plough are: foot 75 mm diameter by ±350 mm; expander (mole) 85-100 mm diameter by ±200 mm; tine thickness 25 mm; tine width 200 mm; tine length ±1000 mm; beam length 4-5 m and the implement is carried on two wheels which are hydraulically lifted to act as stabilisers when in operation.



The mole-plough is drawn through the soil by tractor. The tractor used must be of sufficient size and power (minimum size 40 kW) to draw the mole channel evenly and continuously at the specified depth.

Requirements for mole-drains

Slope, soil water content, soil bulk density, sodicity and soil texture are important factors when considering mole drainage. The following are recommended standards for the installation of mole drains:

- **Depth**
  Mole drains should be drawn at a depth between 450 and 600 mm, penetrating the clay layer in the subsoil. Uniformity of depth is important with appropriate gradients to ensure water can flow readily from the field.

- **Clay content**
  Moles drains are well suited for use in soils with high clay content (45% or higher) in the subsoil. Mole drains in soils with less than 45% clay tend to collapse readily. Beware of soils with strong swell and shrink properties, particularly in the subsoil – the mole drains will collapse due to movement of the clay and will thus not last long. Non-uniform soils containing sand or silt pockets are also prone to channel collapse in places, causing blockages.

- **Soil water content**
  Water content of the subsoil layer where the mole drain will be installed must be within the plastic range, or just below field capacity (very wet). This condition can be estimated in the field by taking a soil sample at the depth of the mole drain and attempting to roll it into a thread about two millimetres in diameter. If this is possible, the soil is within the plastic range. The drier the soil above the depth of the mole drain, the greater the cracking produced in the upper soil, thus promoting more efficient water removal.

- **Sodium salts**
  Sodicity can lead to the collapse of mole drains. To ensure longevity and to prevent a collapse of mole drains, the sodium adsorption ratio (SAR) values should be less than 6.

- **Drain gradient**
  The ideal gradient for mole drains is about 2%. In practice, it means that the surface of the site must have a slope of between 2 and 5% since the mole channel will be created parallel to the surface with the equipment described here. Equipment that is GPS enabled could be used to create mole gradients that are different from the surface slope. If the gradient is less than 2%, the drains are likely to be unreliable. A gradient of more than 5% will result in drainage water with a high velocity, causing erosion of the walls and premature collapse of the drains.

- **Spacing**
  The maximum spacing between mole drains should be about three metres. Beyond this, the mole channel is unlikely to drain the soil profile adequately. For convenience, mole drains are usually drawn in every other interrow.

▲ The mole plough in the start position in a ditch.

- **Length**
  The length of a mole drain will depend on the stability of the soil and will vary from 80 m in very stable soils to 20 m in the less stable soils. Length may have to be reduced on steep gradients to avoid channel erosion.

The Table below provides an overview of the suitability of different soil types for installing mole drains. Category 1 soils are considered most suited and category 3 should be avoided.

Soil suitability guide

Very suitable Category I	Suitable Category II	Unsuitable Category III
Arcadia Rensburg Willowbrook	Katspruit Valsrivier Sterkspruit Bonheim Swartland	All sandy soils and soils with an E horizon

Practical tips

- Soil form should be used as a guide to the suitability of a field for mole drainage.
- The mole plough must be designed and adjusted so that the foot travels parallel to the general surface slope, otherwise, a distorted and weak channel will result.
- Always start the moles from a ditch and draw them in a direction away from the ditch.
- Ditch maintenance is essential to ensure that the pipe drain outfalls are always clear, and submergence of the mole channels is avoided.
- Where mole drains are used in conjunction with subsurface drainage, care should be taken to draw the mole channels through the permeable sand envelope over the pipe.
- Support mole channel outlets by inserting short pieces of pipe (about 800 mm long) with the same outside diameter as the inside diameter of the mole channel.
- All mole channels deteriorate with time and eventually collapse. Plan remoling on a systematic basis after each crop, when moisture conditions are suitable. Mole channel outlets should also be checked during the rainy season.
- Keep remoling in the same direction as previous moling operations, but not in the same interrow.
- The mole drains can be back-filled with river sand as they are drawn, to ensure longevity.
- Keep drainage record plans in a prominent position and record moling dates.

Economics

The cost of mole drainage will depend on the draught of the moling implements and the type of tractor used for the installation, but it is typically less than 5% of the cost of subsurface drainage. It is important to redraw mole drains before the established system breaks down completely. However, following mole channel inspection, selective remoling of failed mole channels could be considered as a means of reducing costs. It is also likely that in soils with a G-horizon in the subsoil (i.e. Rensburg, Willowbrook and Katspruit), the frequency of remoling may be reduced after the second ratoon crop, to every other ratoon.

Notes

- Because soil characteristics determine the applicability, depth, spacing and length of mole drains, growers should obtain specialised advice through their Extension Specialist before using them as a means of draining sugarcane land.
- A copy of the plan of a mole drain plough can be obtained from the South African Sugarcane Research Institute at Mount Edgecombe through your local Extension Specialist.

▲ The rear view of a mole plough.

▲ A mole plough in the operational position – note the long heavy drawbar for stability and evenness of the channel.

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