DEPARTMENT OF
PRIMARY INDUSTRIES

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Managing Wet Soils: Types of Subsurface Drainage Systems

This Agnote explains the options available for draining excess subsurface water to a specific depth from the soil profile. The most suited drainage system is influenced by topography, rainfall, outfall type and location and especially soil type. More detailed explanations of each drainage type and how to determine which drainage system to use are covered in greater detail in other Agnotes in the "Managing Wet Soils" series.

Introduction

Many soils in southern Victoria used for dairy farming have had their drainage characteristics assessed. Many of these soils are subjected to waterlogging for several weeks or months each year, in wetter years.

Many farmers are unsure of their soil types and what type of drainage method is best suited to their soils. It is important to select the right method because soils have different characteristics requiring different drainage methods. Drainage systems are very expensive to install but their short and long term benefits generally outweigh their initial cost, provided they are well maintained.

Most wet soils problems are the result of waterlogged soil profiles not just surface water. However, surface drains should be installed to drain excess surface water off paddocks before installing subsurface drains (See Agriculture note AGO946: M*anaging wet soils: surface drainage).* This will reduce the load on the underground drainage system thereby reducing its cost as a smaller system can be installed.

Benefits of a subsurface drainage system

Costing of drainage systems has shown that both increased pasture utilisation and extra pasture growth from drainage can be very competitive with other feed sources. However to take advantage of this extra growth, more cows, and farm improvements (including a feed pad) may be necessary.

However, subsurface drainage provides many intangible benefits such as improvement in soil health due to the increased aeration of the soil, increased responses to fertiliser use, reduced mineral imbalances in the soil and sometimes in the plants as well, are long term sustainability benefits. Salinity can be prevented or greatly reduced if in its early stages.

Drained soils enables fodder conservation of silage/hay to occur several weeks earlier than on undrained soils. Therefore the resultant fodder has the potential to be of much higher quality producing improved animal production.

Drainage, by reducing pugging and creating favourable soil environments results in the retainment of the improved pasture species versus the influx of plants suited to waterlogged conditions such as rushes, fog grass, *glyceria* species, water couch, etc.

Most importantly, reduced stress in managing stock and pastures during the wetter months of winter or spring has very large benefits for the farm operator.

Types of subsurface drainage systems

There are four main types of subsurface drainage systems. These are:

- Subsurface pipes
- Mole drainage including:
  - Mole drains
  - Mole drains over collector pipe systems
  - Gravel mole drains
- Interceptor drains
- Ground water pumps

Subsurface pipes

Subsurface pipe drainage is best used in deep permeable (free draining) soils that may or may not have an impeding layer at depth (eg clay) .

Subsurface pipes can be used to drain heavy (clay) poorly drained soils successfully but need to be installed so close

ogether to do so, that they are uneconomic in extensive farmland systems.

Subsurface pipe drainage was referred to as 'tile drainage' in the past due to the use of short clay pipes. Clay was expensive and difficult to lay and has now been replaced by slotted PVC or flexible corrugated plastic pipes.

Specifically designed drainage trenchers (Figure 1), usually fitted with laser guidance equipment, dig the trench, lay the slotted pipe and place permeable backfill into the trench on top of the laid pipe. This backfill is delivered by trucks or trailers fitted with conveyor belts which feed the backfill into the hopper. The forward speed, hopper channel opening size, material size, etc. determine the depth and amount of material laid on top of the pipe.

In very permeable soils, very little backfill is needed but in less permeable soils, or where moles are to be pulled through above a pipe, the backfill depth reaches to near the ground surface.

Figure 1. Drainage trencher installing subsurface pipe drains and depositing permeable backfill on top

Mole drainage

Mole drainage can be classified as mole drains, mole drains over a collector pipe system or gravel mole drains. The suitability of each type will depend on the clay content and type, sand and/or stone in the profile, gradient and outfall location.

The action of the mole plough forms a mole channel in the area of the soil profile with specific clay content. The plough also cracks the soil profile immediately above the mole channel allowing water to flow into it.

Mole drains

Mole drains are used in heavy soils where clay subsoil near moling depth (400 to 600cm) prevents downward movement of ground water.

The success and longevity of mole drains is dependent on soils having a high clay content so that once a mole channel is formed, it will maintain the channel for many years. Mole drains are not suited to soils with clay types which have dispersive or slaking characteristics. Mole drains are also not suited to permeable soils due to their high sand and/or loam contents.

A mole plough (Figure 2) is used to form mole drains. Simply, a mole plough contains a leg (or blade) to which a torpedo (or foot) is attached to its bottom. Sometimes a plug (or expander) and having a slightly larger diameter, is attached to the rear of the torpedo, and ensures the mole channel is left with the correct shape.

Figure 2. Mole plough

Mole drains over collector pipe systems

This system is used in soils where it is not possible to form moles that reach the outfall. This includes the presence of stones, sandy pockets, uneven surfaces or excessive distances to the outfall.

In heavy soils where mole drains would need to be very long (over 80 m) before they reach an outfall, installing subsurface pipes at approximately 60 to 100 m, over which mole drains are pulled, can be very successful. Washed sand or small diameter gravel is backfilled into the pipe trench to near the ground surface at installation.

Mole drains are then installed at or close to a right angle to the direction of the pipes. Excess ground water flows into and along the mole drains, then drains into the porous backfill above the pipes, and then is quickly removed to outfalls via the subsurface collector pipes.

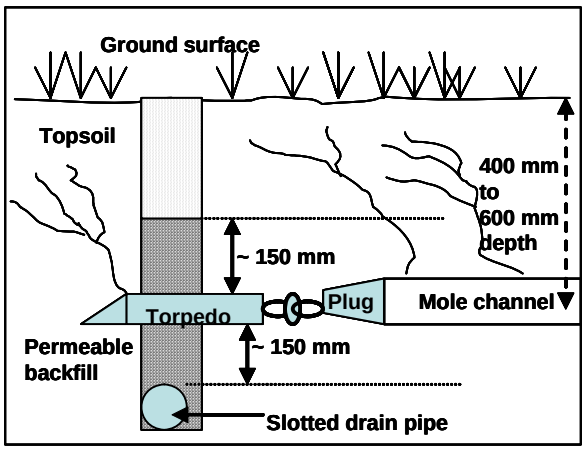

Figure 3. Mole drain over collector pipe system

Gravel mole drains

Gravel mole drains are best suited to soils and situations where subsurface pipes are unsuitable, where mole drains have a very short life span, or in slaking soils so the mole channel will maintain its shape at or soon after moling.

A gravel mole drain (Figure 4) is an unlined channel and/or leg slot filled with small diameter gravel or washed sand. Unfortunately there are very few gravel mole drainage machines (Figure 5) available in Australia. Also gravel mole drains are expensive due to the amount of backfill and the close spacing required.

Figure 4. Gravel mole drain (slot filled with gravel)

However, they do offer an alternative in some "difficult to drain" situations. They may be useful in slaking and dispersive soil types but expert opinion should be sought if considering their use in these situations.

Figure 5. Gravel mole drain machine

Interceptor drains

These drains are installed at the base of slopes at the change of gradient, usually where a steeper slope meets the flats to intercept the downhill flow of subsurface water (Figure 6). Often the soil type on the slope is more permeable than those of the flats and this forces the water to come to the surface, usually at the change of slope.

Interceptor drains can also be installed below springs and spring lines to intercept spring water. Grazing animals severely pug the areas surrounding springs and damage is usually more concentrated down slope. This affected area increases over time as the 'soak' area spreads outward and down slope. Drainage reduces stock damage, or pugging as the soil maintains its structure.

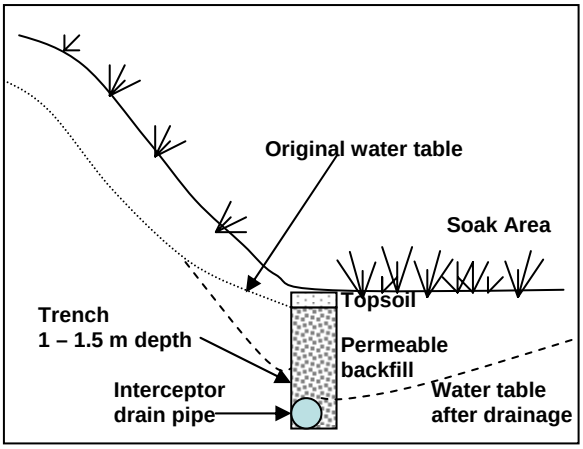

Figure 6 Interceptor drain

Ground water pumps

These remove water from aquifers so that the water table will fall or be maintained at a suitable level below the ground surface.

The act of pumping causes a drawdown of ground water leading out from the pump's location with its effect being much less at depth. The extent of effect will depend on aquifer depth, soil type, height of water table, etc.

The cost, benefits, disadvantages, and most importantly, whether they can be used or not and the need for a permit must be discussed with the Regional Rural Water authorities. Ground water pumping will not be discussed further in this Wet Soils Management series.

Assessing which drainage system to install.

To decide which drainage system to install, the soil's characteristics, its permeability(speed at which water can move through the soil), and suitability for mole drainage (clay type and content) must first be determined.

Farmers and drainage contractors can often decide which drainage option to use based on some simple on-farm tests. However, if there is any indecision from these on-farm tests, decisions should be backed up by soil tests and/or consultation with a subsurface drainage expert. For a detailed explanation of these tests, see Agriculture note: AG1355 *Managing wet soils: determining which subsurface drainage system to use.)*

Water Act

The Water Act (1989) provides guidance for the management of waterways and swamps. Before considering draining a wet area you should contact your local Catchment Management Authority and Regional Water authority for advice, as a permit may be required.

Further References

See other Agriculture Notes in *Managing Wet Soils* series.

AG0948: *Managing wet soils: pipe drainage*

AG0949: *Managing wet soils: mole drainage*

AG1355: *Managing wet soils: determining which subsurface drainage system to use*

Contact/Services available from DPI

For further information contact the dairy extension team at Colac, Ellinbank or Warrnambool.

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