Agriculture Notes

Managing wet soils: mole drainage

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Mole drainage, on the right soil type and done properly can help reduce waterlogging problems. This Note aims to help farmers construct effective mole drains.

Winter wet soils are a common problem in southern Victoria. Surface drainage can improve the situation by removing excess surface water, but in most cases the soil profile itself needs to be drained so that pastures and crops can reach their potential and stock damage by treading and compaction can be reduced.

Mole drainage is widely used in New Zealand and England on heavy soils to improve productivity of pastures and crops. Mole drainage was popular with dairyfarmers in the 1960's but often failed due to reasons now more fully understood. Recommendations from recent research now mean that we can install more successful and longer lasting mole drains with a greatly reduced failure rate.

What is a mole drain?

Mole drains are unlined channels formed in a clay subsoil with a ripper blade with a cylindrical foot, often with an expander which helps compact the channel wall.

Mole drains are used when natural drainage needs improving due to lack of slope or a heavy clay subsoil prevents downward drainage. They are a more sophisticated drainage system than open drains.

Mole drains do not drain groundwater but only water that enters from above.

Soils

Soils should have a minimum of 35% clay for best results. Clay gives the soil the ability to hold together and reduce the chances of collapsing after the mole is pulled. Sand content should be less than 30%. The soil should be free of stones at the mole drain depth.

Testing for suitability for mole draining

Two simple tests can indicate a soil's suitability for mole drainage:

1. Test soil at mole draining depth by rolling out a pencil thick rod and try to form a 40 to 50 mm diameter circle. If this can be done without crumbling or cracking then it may be suitable for mole draining.
2. Another test is to find out if the soil at mole drain depth will slake or disperse. Small golf ball size balls of the soil are placed in distilled or rain water and observed over a day or two. If the water becomes cloudy and the ball soft, then this indicates a dispersive soil. These soils are prone to tunnel erosion and should not be mole drained. If these ball falls apart quickly it is has a tendency to slake.

Soils which tend to slake may be successfully gravel mole drained (actually a gravel slot) albeit expensively. Gypsum may be useful in dispersive soils to suppress clay dispersal, but it can be difficult to get the gypsum into the subsoil.

When to mole drain

To achieve satisfactory results, the soil in the vicinity of the mole channel needs to be moist enough to form a channel, but not dry enough to crack and break up, and not soft enough to slough off and form a slurry. These conditions usually occur on the drying cycle in late spring or early summer. Big tractors (100kW) can pull moles satisfactorily in the Western district and Gippsland dairy areas in January and February, whereas smaller tractors (60 kW) are limited to November and early December in most years.

The surface soil needs to be dry enough to form cracks at the time of mole draining and allow traction. If too moist then the cracks can heal over and reduce water intake. It is preferable for a drying period with no rain to allow the cracks to dry and the mole channel to harden.

Usually when the clay at mole draining depth has a moisture content of 20-25%, conditions are satisfactory. Test the soil by kneading between the fingers. If you can roll out a ribbon without it sticking to your fingers the moisture content is right.

Mole draining in autumn is not recommended, as the topsoil is wet and subsoil is too dry. The subsoil is difficult to mole and to dry out and it's difficult to achieve the desirable depth.

Gradient

Recommended gradients for moles generally fall between 0.4% and 4%. A good gradient to aim for is 3%. This should enable relatively trouble free moles in that minor surface undulations won't block with negative gradients, and the risk from erosion is reduced. The flatter the gradient, the more even the soil surface has to be and more interceptor drains needed to achieve good results. At the

other extreme, erosion is more likely particularly if the soil has dispersible clay content.

Depth

Optimum mole depth depends on soil type, and the conditions when moles are installed. Generally moles are pulled at 400–600 mm depth. Often when first mole draining, the shallow depth is used due to tractor limitations in tight soils. As the soil structure improves over time they can often be pulled deeper. Moles less than 400 mm deep are liable to be damaged by tractors and animals during or immediately after rain.

A rule of thumb is that the expander to mole draining depth ratio is 1:7 ie a 70 mm diameter expander should have mole depth 490 mm.

Spacing

In dairy areas spacing between moles is usually about 2 m. In grazing or less intensely used areas spacing may be up to 5 m apart but performance falls off with wider spacings.

Length

The generally accepted maximum effective length of moles is about 200 m. However moles up to 400m pulled at Cooriemungle in south west Victoria have performed satisfactorily for a number of years. However shorter (80-100 m) moles should last longer, because they empty out quicker and are not likely to be overloaded.

Outfall

The drain outfall or outlet is the most important part of the system. If this fails the whole system fails.

Mole drains can discharge to open drains or into interceptor drains filled with gravel. This latter system protects the mole outlets and the only maintenance is required at the tile outlet, but does cost more to install. (see agnote AG0948 *Managing wet soils: pipe drainage*)

Open drain outlets should be fenced off from stock and kept clean so the outfall is above the drain water level. This prevents water backing up into the mole outlets and causing them to collapse. Short lengths of plastic pipe inserted in the ends can protect them better.

Another advantage of gravel filled interceptor drains is that moles can be pulled both ways, instead of the one way trip from open drains. This speeds up the job.

Effective life

The effective life of a mole can be from hours (if done in the wrong conditions) to years. Even some soils that in theory shouldn't support moles are still operating after 5 years.

Types of mole ploughs:

Linkage mounted.

These produce more uneven grades than the trailed ploughs because of the short beam. Ideally they should be allowed to float with no pressure control used to make them go deeper. They are better suited for smaller tractors and areas. They are easier to turn and reverse to start runs.

The longer the beam, coupled with a chain to have floating top link, allows a more even mole channel to be made.

Trailed

These require more horsepower because they scrub the ground when working. However they produce more even grades than linkage ploughs because of the longer beam. More difficult to manoeuvre compared to the linkage plough.

Other ploughs

The trailed floating plough is even better at evening out ground variation. This plough has been used experimentally in Victorian trials but none are available commercially. They are much dearer to build than the other types.

Gravel mole plough incorporates a hopper to allow gravel to fall into the mole channel. These ploughs have been successful in England and Ireland in heavy soils that can't hold normal moles. Experimental results from north east Victoria and Gippsland show they have promise on unstable clay soils but are expensive because of the amount of gravel needed.

Grazing the drained paddocks while still soft from recent rain will cause pugging damage and reduce the life of mole drains. (see Agriculture Note AG0943*: Managing wet soils: grazing techniques*)

Other factors.

1. Improved drainage not only takes away surplus water but takes away some nutrients as well. Fertiliser should not be applied immediately before rain events when run off is likely. Good management practices such as not applying fertiliser within 4 days of predicted rain should reduce nutrient run-off to a minimum.
2. Consider changing paddock layout to make mole draining easier. Water pipes often have to be relaid.
3. Drainage trenches can outfall to dams so that more water can be harvested.
4. Moles should be pulled at 2-3 km/hr. At faster speeds, there is more disruption (tearing) of mole channels, which reduces mole life.

The 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 for advice, as a permit may be required.