Farm Tile Drains and Tree Roots

T. Leuty

Factsheet

ORDER NO. 12-055 AGDEX 555 DECEMBER 2012

Trees grown on agricultural land can be both profitable and useful, whether in fruit and nut orchards, plantations and woodlots or as windbreaks, treed fence rows, stream buffers, shelter for pastures, farm buildings or reforested land.

When planting trees on farms with subsurface tile drainage systems, remember that tree roots can plug tile drains. Design your planting to sustain the use of tile drains without blocking them.

FARM TILE DRAINS

A properly designed subsurface drainage system should be able to remove excess moisture from the soil profile, providing suitable growing conditions for crop production. This can occur any time of the year but is typically most common from late winter to early spring, late summer to early winter and sporadically during the growing season, due to heavy or prolonged rains. The need for field drainage can vary from season to season. Field tiles that have remained fairly dry for several years may run water frequently or constantly during wet seasons if water tables become high. Some subsurface tile can run water constantly. During most seasons, farmers realize production advantages by having field drains in place.

Farmers depend on a functional drainage system to provide suitable soil conditions for crop production. Drain lines blocked by tree roots will disrupt proper water drainage and have a negative impact on crop production. Winter melt water and spring rains may not drain enough to allow early tilling and seeding, especially on heavy soils. Wet soils are cooler, which can delay crop germination and growth, reducing crop yields. Sporadic summer flooding can remain pooled too long in low spots, resulting in crop damage. In late summer and fall, soil may be too soft to permit heavy harvest equipment onto the land. Locating and replacing a plugged tile costs time and money.

Farm drainage is a major production investment. Tree plantings added to farmland can also be designed as production investments. OMAFRA Publication 29, *Drainage Guide for Ontario,* includes recommendations on how to install tile drains without risking plugging them with tree or shrub roots. These recommendations have been established through field experience and are recognized by drainage contractors. If any questions arise, consult with your drainage contractor or an OMAFRA agricultural engineer.

HOW TREE ROOTS GROW IN THE SOIL

Nutrient uptake, water absorption and anchorage are key functions of roots. Roots of trees grow to new areas of soil to increase the root surface area. Roots grow proportionately, in dry weight, with the above-ground tree and maintain a specific root-to-shoot ratio.

Roots of many species of trees, some weeds, and several shrub and crop species can grow close to and within tile drains as they expand their ability to acquire water and nutrients. Back-filled soil (Figure 1) loosened by the drainage installation equipment over drainage tiles provides the roots with easy access to the tile through the broken-up soil layers.

Figure 1. Parallel rows of back-filled soil show where tile was recently installed in this field.

Ministry of Agriculture, Food and Rural Affairs

Ontario

Figure 2. At first glance, this tile appears to be plugged by soil.

Figure 3. Rinsing soil away from the tile section shown in Figure 2 shows it is also plugged with dense fibrous roots, holding small soil particles flowing in the drainage water.

Roots do not actively search the soil for moisture and nutrients but grow more vigorously as they randomly encounter more favourable growing conditions, such as increased moisture and nutrient levels.

Root growth conditions can continue to improve until moisture becomes excessive or nutrients reach toxic levels, at which point root growth declines.

The ideal amount of soil moisture or the ideal amount of each nutrient is entirely dependent upon the tree species.

Physical soil properties can become more favourable for root growth with increasing moisture. Roots may develop more vigorously towards an increasing humidity gradient and moisture gradient. Roots can push their way through soil more easily towards an increasing moisture gradient as soil becomes more pliable due to increasing amounts of water.

Other soil factors, such as oxygen concentrations and soil particle size, also contribute to ease of root growth.

HOW TREE ROOTS PLUG DRAINAGE TILES

Roots can plug drainage tiles that are perforated (modern plastic pipe), have gaps (sectional clay tile) or are damaged by cracks. Non-perforated pipe cannot be plugged by roots as there are no entry points.

Roots are more likely to be found within tile after rain following a prolonged dry period, as root systems expand downward to increase their ability to absorb water.

A root will likely stop growing once it enters a dry tile but can remain alive. The root will not proliferate to plug the tile if it does not encounter a water source.

Once running water or standing water become available inside a tile, tree roots that are present may proliferate and plug the tile (Figures 2 and 3).

The rate of root growth and an ability to plug are dependent on the species of the root occupying the tile. Roots will plug tile more slowly if other sources of water are available outside the tile during the same period of time.

CONDITIONS THAT COULD CAUSE PLUGGING

Roots are drawn to tiles that run water constantly or for extended duration into the growing season. This water flow can usually be observed at the tile outlet.

Depth to the water table can vary from one season to the next and is dependent upon seasonal rainfall patterns. Tiles that are dry during average growing seasons may have late flow of water during wet seasons. A field location with wet tile will be a risky area to establish any tree species, since plugging by roots may eventually occur.

Water may run through sections of field drainage later into the growing season without the farmer realizing. Tile can drain water from an up-slope, wet area or from a spring. However, as the water makes its way down the tile to drier areas, the water can leave the tile through perforations. The water can re-enter the soil in another area before reaching the drain outlet. In these situations, and unknown to a farmer, trees planted close to tiles that have standing or flowing water could cause root-plugging problems.

At a low field elevation, roots plugging a tile may encourage the proliferation of roots of other trees upstream in the line, since water remains in the tile upstream of the plug.

IDENTIFYING PLUGGED DRAINAGE TILES

Drainage problems are first noticeable by the farmer as a wet spot in a field that does not drain as fast as it did in previous seasons or as an area of unhealthy crop. Inspection of tile outlets may reveal water running later in the spring and early summer. If there have been no recent rains, the water may still be running due to a slow leak in the plug itself — water backed up in the tile system may simply be taking a much longer time to drain.

The root growth that created the plug could have progressed the previous season in early autumn and continued as late as December. The plug may have developed over several seasons. An old tile system may be losing the ability to effectively drain the land due to the accumulations of sediment or to pipe collapse. Plugged sections of tile must be located and cut out, and a new section of tile spliced into the line (Figure 4).

Figure 4. A large section of tile is plugged by roots from a large willow tree growing 30 m away. The plugged section must be dug up and replaced with a new section of tile. (*Photo credit:* Long Point Conservation Authority, Ontario.)

Root masses that form within tile can occasionally break free from the parent plant and travel downstream inside the tile, eventually blocking water flow at a different location. These shifting plugs have been found blocking drains of interconnected neighbouring farms, causing crop damage. Determining the origins of the root mass can sometimes be difficult.

AVOIDING PLUGGED DRAINAGE TILES

Trees

Drains that are within 15 m of trees and that carry water for prolonged periods during the growing season may become plugged with tree roots. If possible, remove all water-loving trees, such as willow, soft maple, elm and poplar, for a distance of 30 m from the drain. Give other trees a clearance of 15 m. If it is not possible to remove the tree or reroute the drain, use continuous non-perforated pipe for a distance of 15 m on either side of the tree.

Install a header drain at the higher end of an orchard to intercept seepage water that might cause prolonged flow in lateral drains.

Stream (riparian) buffers

Where trees, shrubs and weeds associated with wet soils are established or are permitted to grow naturally along a watercourse, perforated tile that passes under the buffer to an outlet can quickly become plugged by roots. For field tiles that drain into buffered streams, intermittent watercourses or ditches, install a section of non-perforated tile.

The non-perforated section of tile should extend from the outlet, pass under the vegetated buffer and continue for at least 15 m into the cultivated field where it can then connect to standard perforated pipe. Roots will not penetrate non-perforated pipe. This solution provides both worry-free drainage of field water and the added benefits of buffered vegetated watercourses.

TREES THAT CAN PLUG FARM DRAINS

Tree species that naturally tolerate or thrive in wet or flooded conditions and are shallow- to intermediate-rooted can proliferate and plug wet drainage tiles. Plugging may occur quickly or may require several seasons of repeated wet conditions.

Shallow-rooted trees have roots that grow laterally for long distances (30 m or more have been observed) and develop primarily within 1 m of the soil surface. They have many fibrous roots that can form very dense root systems, causing thick blockage of drainage lines.

Most roots of intermediate-rooted trees have uniform thickness and grow outwards and downwards from the tree in a semi-circular pattern. They have some deeper lateral roots but are fairly wide-spreading in growth. They can completely block field tile with many small-diameter roots.

Deep-rooted trees usually consist of one or more deep taproots that extend straight down deep into the soil for many metres with a portion of shallow roots that take up nutrients near the soil surface. The taproots do not tend to spread out laterally and are least likely to plug wet drain lines unless planted within 1 or 2 m of the underlying drain.

The following list of tree species can tolerate and grow in saturated soil or free water and should not be planted near perforated field drains:

Shallow-rooted trees

Poplar

- balsam poplar (*Populus balsamifera*)
- Eastern cottonwood (*Populus deltoides* ssp. *Deltoides*)
- trembling aspen (*Populus tremuloides*)
- largetooth aspen (*Populus grandidentata*)
- Carolina or hybrid poplar (*Populus nigra* x *Populus deltoides*)

Willow

- golden weeping willow (*Salix alba*)
- black willow (*Salix nigra*)
- peachleaf willow (*Salix amygdaloides*)
- Bebb willow (*Salix bebbiana*)
- pussy willow (*Salix discolor*)
- balsam willow (*Salix pyrifolia*)
- all other willows

Other

- speckled alder, grey alder (*Alnus incana* ssp. *rugosa*)
- European black alder (*Alnus glutinosa*)
- flowering dogwood (*Cornus florida*)
- black maple (*Acer nigrum*)
- Manitoba maple (*Acer negundo*)
- red maple (*Acer rubrum*)
- silver maple (*Acer saccharinum*)
- Eastern larch, tamarack (*Larix laricina*)
- Eastern white cedar (*Thuja occidentalis*)
- black spruce (*Picea mariana*)

Intermediate-rooted trees

- American elm (*Ulmus americana*)
- black ash (*Fraxinus nigra*)
- green ash (*Fraxinus pennsylvanica*)
- white ash (*Fraxinus americana*)
- honey locust (*Gleditsia triacanthos*)
- pin oak, swamp oak (*Quercus palustris*)
- swamp white oak (*Quercus bicolor*)
- sycamore, American plane-tree (*Platanus occidentalis*)
- red mulberry (*Morus rubra*)
- white mulberry (*Morus alba*)

Deep-rooted trees

- bur oak (*Quercus macrocarpa*)
- English oak (*Quercus robur*)
- black walnut (*Juglans nigra*)
- black walnut rootstock (*Juglans nigra*) with Persian walnut grafts (*Juglans regia*)
- common hackberry (*Celtis occidentalis*)
- bitternut hickory, swamp hickory (*Carya cordiformis*)
- shellbark hickory (*Carya laciniosa*)

Other plants that can plug farm drains

Field horsetail (*Equisetum arvense*) is a common weed that can plug perforated drainage tile. Rhizome roots of horsetail can penetrate to more than 1 m below ground, forming thick mats of root. Other species reported to have plugged farm field drains include canola, sugar beet, kale, brambles, watercress, hawthorn, nettles, dandelion, meadow grass, dock, buttercup, fleabane and rushes.

Figure 5. Masses of root pulled from the plugged tile are from nearby peach trees. While it is rare, roots of dry-site trees, such as peach, can also plug tiles, as shown here.

TREES THAT RARELY PLUG FARM DRAINS

Roots of tree species that prefer dry or well-drained soil are least likely to plug farm drains, especially when grown on fast-draining soils. Conditions within tiles may be too wet for the roots to survive.

It is important to know that drain plugging by dry-site trees is rare but can still occur, depending on the situation. For example, roots of peach and black locust have been observed plugging farm tile, and both are dry-site species (Figure 5).The following tree species do not tolerate wet soils for extended periods of time and are least likely to plug farm field drains:

Shallow-rooted trees

- American beech (*Fagus grandifolia*)
- European beech (*Fagus sylvatica*)
- black cherry (*Prunus serotina*)
- black locust (*Robinia pseudoacacia*)
- European white birch, weeping or silver birch (*Betula pendula*)
- paper birch (*Betula papyrifera*)
- Norway maple (*Acer platanoides*)
- staghorn sumac (*Rhus typhina*)
- Eastern hemlock (*Tsuga canadensis*)
- Eastern white pine (*Pinus strobus*)
- jack pine (*Pinus banksiana*)
- red pine (*Pinus resinosa*)
- Scots pine (*Pinus sylvestris*)
- Norway spruce (*Picea abies*)
- white spruce (*Picea glauca*)
- Colorado spruce (*Picea pungens*)

Intermediate-rooted trees

- apple (*Malus sylvestris*)
- sweet cherry (*Prunus avium*)
- sour cherry (*Prunus cerasus*)
- peach (*Prunus persica*)
- pear (*Pyrus*)
- plum (*Prunus americana*)
- grape, wine and fresh (*Vitis labrusca* and *Vitis vinifera*)
- American chestnut (*Castanea dentata*)
- Chinese chestnut (*Castanea mollissima*)
- sugar maple (*Acer saccharum*)

Deep-rooted trees

- red oak (*Quercus rubra*)
- white oak (*Quercus alba*)
- butternut (*Juglans cinerea*)
- heartnut (*Juglans ailantifolia* var. *cordiformis*)
- pecan, Northern (*Carya illinoensis*)
- shagbark hickory (*Carya ovata*)
- tuliptree (*Liriodendron tulipifera*)

This Factsheet was authored by Todd Leuty, Agroforestry Specialist, OMAFRA, Guelph. It was reviewed by Sid Vanderveen, Drainage Coordinator, OMAFRA, Guelph. This Factsheet is a revision of an infosheet originally authored by Todd Leuty, Agroforestry Specialist, OMAFRA, Guelph, and Jim Myslik, former Agricultural Engineer, OMAFRA, and reviewed by Christoph Kessel, Nutrition – Horticulture Program Lead, OMAFRA, Guelph, and Hugh Fraser, Engineer, Horticultural Crop Protection & Post Harvest, OMAFRA, Vineland.

FOR YOUR NOTES

FOR YOUR NOTES

Agricultural Information Contact Centre:
1-877-424-1300
E-mail: ag.info.omafra@ontario.ca
Northern Ontario Regional Office:
1-800-461-6132

www.ontario.ca/omafra

POD
ISSN 1198-712X
Également disponible en français
(Commande nº 12-056)