Tile Drains and Tree Roots

Trees can grow on land in many useful and profitable ways. These include: windbreaks, treed fence rows, fruit and nut orchards, shelter for pastures, shelter for buildings, woodlots and reforested marginal land. Subdivisions, commercial developments, pastures and farm fields are often under-drained with tile to remove excess water. Some species of trees can aggressively plug drain tiles with roots while other tree species rarely plug drains. If conditions are favorable, it is believed that any tree species has the ability to plug drains with roots. Where crop production or development is to continue, tree planting projects on drained land must be designed to sustain the use of tile drains and not interfere with removal of excess surface water.

Figure 1. The section of plugged tile must be located and cut out from the system. These dense fibrous roots from a nearby tree entered through perforations in the tile and completely blocked water flow. The root wad grew so densely it filled the tile to the point the ribbings of the tile can be seen in the root wad that is being held.

What is a "tile"?

Drain tiles are underground pipes installed to drain away ground water. Historically, these pipes were made of vitrified clay – think red clay roofing tiles. Laid end to end, water could seep into the pipe between the joints. Today, these pipes are made of a variety of materials and strengths, from perforated plastic to reinforced concrete pipe.

Sustaining functional drains

A properly designed drainage system should quickly remove water from soil whenever an excess amount of water is present. Excess soil water can occur any time of year, however, it is typically most abundant from late winter to early spring, late summer to early winter and sporadically during the summer due to heavy or prolonged rains. The need for drainage can vary from season to season. Tiles that have remained fairly dry for several years may run water frequently or constantly during wet seasons if water tables become high. Tiles that drain natural springs will always run water. During most seasons, landowners realize the advantage of having drains in place.

Drain lines blocked by tree roots will disrupt proper water drainage. How can this problem affect landowners? Winter melt water and spring rains may not drain adequately, especially in heavy soils. Wet soils are cooler and can delay growth. Sporadic summer flooding can remain pooled too long in low spots, resulting in vegetation damage. In late summer and fall, soil may be too soft to permit equipment onto the land. It costs time and money to locate the plug and replace it with new pipe. Landowners depend on a functional drainage system to remove excess water.

Poor drainage can result in failed septic systems.

Drainage is an investment that is expensive. In order to establish trees and shrubs on one's property in beneficial ways without risk of plugging drain tiles with roots, recommendations on tile drain installation are outlined below. These recommendations have been established through experience and are recognized by drainage contractors. If questions on tile and tree root plugging arise, landowners should consult with the County Surveyor's Office or local entity, as not all drainage systems in subdivisions are county regulated drains.

Drain Management Problems

Drains that are within 50 feet of trees and which carry water for prolonged periods during the wet season may become plugged with tree roots. If possible, all water-loving trees, such as willow, soft maple, elm, and poplar, should be removed for a distance of 100 feet from the drain; other trees should have a clearance of 50 feet. If a tree cannot be removed or the drain rerouted, use continuous non-perforated pipe for a distance of 50 feet on either side of the tree.

Fruit trees are not included in these recommendations. However, a header drain should be located at the higher end of an orchard to intercept seepage water that might cause prolonged flow in lateral drains.

Figure 2. A lengthy section of 8 inch tile was plugged solid with roots. The roots originated from a large willow tree located more than 30 feet away from the buried drain. The plugged section, about 70 feet in length, was cut out and replaced with non-perforated pipe to prevent roots from entering again.

Precautions for stream (riparian) buffers

Where trees, shrubs and weeds associated with wet soils are established or are permitted to grow naturally along an unregulated open drain or stream, perforated tile that passes under the buffer to an outlet can quickly become plugged by roots. For tiles that drain into buffered streams, intermittent watercourses or ditches, a section of non-perforated tile should be installed. The non-perforated section of tile should extend from the outlet, pass under the vegetated buffer, and continue for at least 50 feet into the area to be drained, where it can then connect to standard perforated pipe. Typically roots will not penetrate non-perforated pipe if the pipe is installed properly. If sections of pipes are installed improperly, roots may enter through voids or other deficiencies in the pipe.

How tree roots grow in the soil

Roots of trees grow to new areas of soil to increase the root surface area. Nutrient uptake, water absorption and anchorage are key functions of roots. Roots grow proportionately in size 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 vegetation species can grow close to and within tile drains as they expand their ability to acquire water and nutrients.

Back-filled soil over drainage tiles provides easy access for roots to the tile due to the breakup of compacted soil layers and loosening of the back-filled soil by the drainage installation equipment. Roots do not actively search the soil for moisture and nutrients but grow more vigorously as they randomly encounter more favorable 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 favorable 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 easier 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 drain tiles

Drainage tiles that are perforated with holes (modern plastic pipe), have gaps (sectional clay tile) or are damaged by cracks can be plugged by roots. Non-perforated pipe cannot be plugged by roots since there are no entry points, as long as the pipe is installed properly and free of defects.

Roots are more likely to be found within tile after 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 the root does not encounter a water source.

Once running water or standing water becomes available inside a tile, tree roots that are present may proliferate and plug the tile.

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

How bad can it get?

Figure 3. An example of a 15 inch drain tile completely plugged by tree roots. Tile drains as large as 30 inches in diameter have been completely plugged by tree roots

Figure 4. The same 15 inch tile as in figure 3. Tree roots entered through the gaps between each tile. The roots are often fine and fibrous and packed very tight within the drain.

How do you know when drains are plugged?

Drainage problems are first noticed by the landowner as a wet spot in an area that does not drain as fast as it did in previous seasons or as an area of unhealthy vegetation. Upon inspection of tile outlets water may be observed running later in the spring and early summer. The late water flow may not be due to 'late flowing water' but can be due to a slow leak in the plug itself. A backup of water up the tile system may simply be taking a much longer time to drain.

The root growth which 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 accumulations of sediment or pipe collapse. Plugged sections of tile will need to be located, cut out and a new section of tile spliced into the line.

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 neighboring landowners causing vegetation damage. Determining where the root mass originated from can sometimes be difficult.

Conditions that could cause plugging

Water can run through tile constantly or it can flow for an extended duration into the growing season due to drainage of natural springs or drainage of areas in which the water table meets a tile. Indication of 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. Locations having wet tile will be a risky area to establish any tree species since plugging by roots may eventually occur.

Water may be running through sections of tile later into the season but may not be realized by the landowner. 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 landowner, trees planted close to tiles that have standing or flowing water could cause root-plugging problems.

In low areas plugging of tile by roots may encourage proliferation of roots of other trees upstream in the line since water remains present until the plug is noticed and subsequently released.

Since trees take up soil water, could trees be used to drain land naturally?

By transpiration, trees, like vegetation, can remove significant amounts of water from soil. If planted dense enough, could trees act as an effective natural substitute for tile drainage on land? Trees remove little soil water. In order to remove soil water through transpiration, water must evaporate through photosynthesizing deciduous leaves or needles of conifers. Trees remove water from soil from mid-spring to early autumn. At other times of the year, trees transpire very little water out of the soil. Although some moisture evaporates from trees during winter dormancy, the amount is small. Trees remove very little water from soil before early spring and after mid-autumn since leaves are absent or are no longer functional, and for most conifers, needles are either ending or beginning their winter dormant period. Early spring and fall are critical times when land needs to be drained to allow access by equipment. Tile will adequately drain water at these important times.

During heavy summer rains and occasional flooding, soil oxygen levels can be depleted enough to cause many tree species to stop water uptake altogether, especially dry-site trees. Tree species that tolerate wet soil and are able to continue absorbing water during floods would not remove water fast enough to enable nearby vegetation to survive the prolonged saturated conditions. Trees will not function as a natural substitute for tile drainage during sporadic saturation of soil during the growing season.

Trees that can plug drains

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

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

Shallow rooted trees - Have roots that grow laterally for long distances (100 feet or more have been observed) and develop primarily within 3 feet of the soil surface, have many fibrous roots that can form very dense root systems causing thick blockage of drainage lines.

Poplar:
Balsam poplar *(Populus balsamifera)*
Eastern cottonwood *(Populus deltoides ssp. Deltoides)*
Quaking aspen *(Populus tremuloides)*
Bigtooth aspen *(Populus grandidentata)*
Eastern Cottonwood *(Populus deltoides)*

Willow:
Black willow *(Salix nigra)*
Peachleaf willow *(Salix amygdaloides)*
Pussy willow *(Salix discolor)*
All other willows

Other:
Flowering dogwood *(Cornus florida)*
Black maple *(Acer nigrum)*
Boxelder *(Acer negundo)*
Red maple *(Acer rubrum)*
Silver maple *(Acer saccharinum)*
Eastern larch, tamarack *(Larix laricina)*
Eastern white cedar *(Thuja occidentalis)*

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

American elm (*Ulmus americana)*
Black ash *(Fraxinus nigra)*
Green ash *(Fraxinus pennsylvanica)*
White ash *(Fraxinus americana)*
Black locust *(Gleditsia triacanthos)*
Manitoba maple *(Acer negundo)*
Pin oak, swamp oak *(Quercus palustris)*
Swamp white oak (Quercus bicolor)
Sycamore, American plane-tree *(Platanus occidentalis)*
Red mulberry *(Morus rubra*)

Deep rooted trees- Usually consist of one or two deep taproots that extend straight down deep into the soil for many meters. The roots do not tend to spread out laterally and are least likely to plug wet drain lines unless planted within 15 to 20 feet of the underlying drain.

Bur oak *(Quercus macrocarpa)*
Black walnut *(Juglans nigra)*
Common hackberry *(Celtis occidentalis)*
Bitternut hickory, swamp hickory *(Carya cordiformis)*
Shellbark hickory *(Carya laciniosa)*
Shagbark hickory (Carya ovata)

Other plants - Field horsetail (Equisetum arvense) is a common weed that can plug perforated drainage tile. Rhizome roots of horsetail can penetrate to more than 3 feet below ground forming thick mats of root. Other species reported to have plugged drains include canola, sugar beet, kale, rape, brambles, watercress, hawthorn, nettles, dandelion, meadow grass, dock, buttercup, fleabane and rushes.

Trees that rarely plug drains

Roots of tree species that prefer dry or well-drained soil are least likely to plug drains especially when grown on fast draining soils. Roots may encounter conditions within tiles that are 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 tile and both are dry-site species. Therefore, great care must still be taken when planting these. It's recommended that these species should be planted at least 10-15 feet away from tile drains.

The following list of tree species do not tolerate wet soils for extended periods of time and are least likely to plug drains:

Shallow rooted trees:
American beech *(Fagus grandifolia)*
Black cherry *(Prunus serotina)*
Black locust *(Robinia pseudoacacia)*
Paper birch *(Betula papyrifera)*
Eastern white pine *(Pinus strobus)*
Jack pine *(Pinus banksiana)*
Virginia pine *(Pinus virginiaiana)*

Intermediately 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)*)
Pecan, northern *(Carya illinoensis)*
Shagbark hickory *(Carya ovata)*
Tuliptree *(Liriodendron tulipifera)*