Tile Drainage in Vermont: Benefits and Risks

Factsheet No. 2

Introduction

Tile or subsurface drainage can enhance agricultural systems by removing excess water that may accumulate due to the soil's texture, seasonally high water tables, and/or depressions in the field that are subject to ponding. In Vermont, tile drainage can be a useful agricultural practice due to our soil types and high yearly precipitation. However, there can be some environmental risks with tile drainage. Refer to the Required Agricultural practices for tile drainage management state laws: https://agriculture.vermont.gov/rap

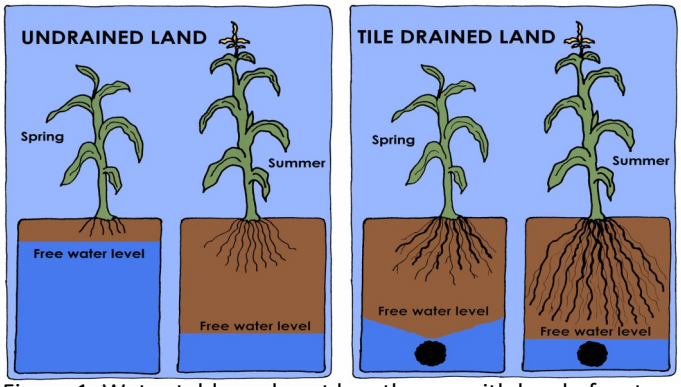

Figure 1. Water table and root length vary with level of water table. Drainage helps lower the water table. (Illustration courtesy of Amanda Gervais)

Benefits

Tile allows water to infiltrate and percolate through the soil profile which means less potential for water to move across the soil causing erosion and nutrient loss through run-off. Helping to drain excess water, tile improves soil conditions for field operations and crop growth. As a result, field operations can often be implemented in a more timely manner. Generally, the soil is drier when field operations occur leading to less compaction and overall better soil structure. Soil that is able to maintain adequate but not excess moisture allows for higher biological activity that improves nutrient cycling. All of these attributes ultimately lead to more reliable crop yields. Lastly, tile can allow farmers to reduce costs by minimizing pest damage and nutrient loss.

Risks

However, with a reduction in surface runoff, more water infiltrates into the soil and percolates through the soil profile (Figure 2).

Nitrogen (N) and phosphorus (P) have the potential to enter the waterways either through surface runoff, leaching, and tile drains. Nitrogen and P can leave the system either attached to soil, or dissolved in water. Hence nutrient losses from fields can contain sediment bound P (PP), dissolved P (DP), organic-N, and ammonium.

These nutrient can come from the soil, amendments (fertilizer or manure), and/or decaying plant material.

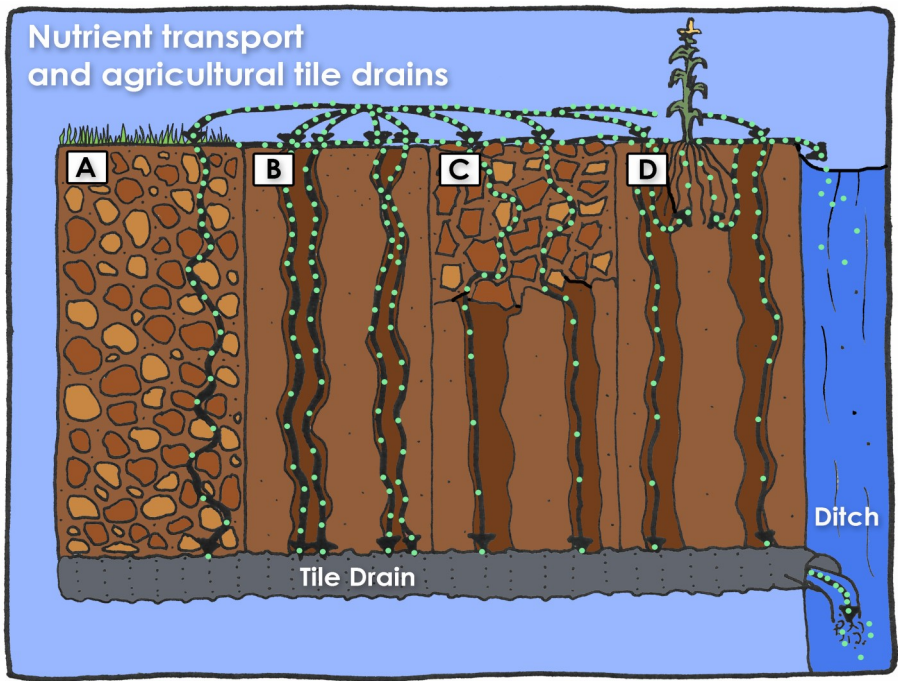

Figure 2. Representation of soil type and nutrient flow in A) Sandy soil with matrix flow, B) Clay soil with preferential flow via macropores, C) Tilled soil with disturbed surface macropores, and D) Plant uptake of nutrients. (Illustration courtesy of Amanda Gervais)

Risk (cont'd)

Preferential flow in tile drained fields

Nutrient loss to tile drains can occur through a process called preferential flow or also referred to as macropore flow (Figure 2). Macropores (larger holes or paths in the soil) can be caused by worm holes, root channels, and cracks formed on dry soil, which can act as direct conduits, or preferential paths, for leached N, DP and PP from the soil surface to tile line.

The development of preferential flow paths in the soil varies significantly with soil type and management. Preferential flow can be more common in grass fields, no-till fields, and clay soils. Cover crops can also increase macropore prevalence by increasing number of root channels. Generally soils that have high microbial activity and permanent plant cover can have increased soil porosity. This aids in soil drainage but larger pores can lead to higher nutrient loss. Soils with high clay content have shrink/swell properties. When these soil types get excessively dry, the clay may shrink causing cracks in the soil. These can be direct conduits to the tile line.

Overall, macropores decrease water and nutrient residency time, decreasing the potential for nutrients to be filtered out of the water by slowly percolating through the soil profile. Soils with very high levels of soil test P are at even higher risk as these soils have even less capacity to filter out P before it reaches the tile lines.

Practices such as perennial crops, cover crops, and injection or light disking of soil amendments can reduce the risk of nutrient loss through leaching, runoff, and tile drains.

Tile Drainage in Vermont

In November 2018, new legislation on tile drainage was signed into law. For a complete list of VAAFM RAPs visit: https://agriculture.vermont.gov/rap

Nutrient loss to tile drains can be reduced with good management, following the 5 R's: right source, right amount, right place, right manner, and right time. Other conservation practices have been and will continue to be developed to address these issues.

Create an emergency plan in the event that large amounts of manure enters a tile drain. Take immediate steps to stop the flow and prevent discharge to surface waters. This can be performed by capping the tile outlet or intersecting the tile system and diverting flow into a collection area away from surface waters. Contact the Vermont Agency of Agricultural at (802) 828-2430 to report the spill and get assistance with subsequent remedial actions.

For more information on reducing phosphorus loses in tile drainage refer to:

Tile Drainage in Vermont Factsheet No. 6: "Manure Management"

Tile Drainage in Vermont Factsheet No. 7: "Edge of Field Management"

UVM Tile Drainage and Doughnuts webinar series: http://www.uvm.edu/extension/cropsoil/

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March 2019

A publication of the University of Vermont Extension Northwest Crops and Soil Program.

This material is based upon work supported by USDA/NIFA under Award Number 2015-49200-24225.