Cornell University
Cooperative Extension

Agronomy Fact Sheet Series Fact Sheet 57

Subsurface (Tile) Drainage Benefits and Installation Guidance

Introduction

Subsurface tile or artificial drainage is the practice of placing slotted drain tubes beneath the soil surface well below tillage depth to help lower the water table of poorly drained fields and/or wet areas within fields. Though the concepts and benefits of artificial drainage are ancient, it continues to be an important crop production practice for modern agriculture and changes in input prices and crop values has made subsurface drainage an even more valuable investment.

While watersheds are very dynamic systems and research continues to improve understanding of the role of land use within a watershed, there is evidence that manure constituents can leach to subsurface drain lines if not properly managed. Fact sheet 58 addresses mitigation options to reduce the risk of loss of manure nutrients by leaching and transport through tile lines.

In this fact sheet we discuss the benefits of tile drainage for forage and grain crops and give practical guidance on tile drainage installation. It should be recognized that tile drainage is equally useful on vegetable and fruit farms, particularly apples, and protects the grower's large investment in expensive trees.

Benefits of Tile Drainage

The extent to which subsurface drainage benefits field crop production depends on soil type and varies with weather conditions in any given year. By helping convey subsurface water away from the field that would otherwise remain saturated for a longer period of time, tile drainage results in the following benefits:

- The soil surface dries more quickly and more uniformly (helping to reduce or eliminate wet areas), and soils warm up faster. This means that land preparation and planting can begin sooner.
- Crops can establish a deeper root system resulting in greater access to both soil nutrients and soil water, allowing for reduced sensitivity to both extreme wet and extreme dry conditions.
- Crop yield and forage quality increase compared to undrained conditions, as a result of better timing of crop establishment in the spring, improved growing conditions all year, and less weather-dependent harvest timing. Enhanced forage and grain crop production on the farm reduce the need for feed imports and this makes farms more environmentally sustainable as well.
- Tile drainage reduces overland flow and the loss of soil and nutrients through erosion and runoff.

Figure 1: Clean water exiting a modern tile drain.

When to Consider Tile Drainage?

Tile drainage is a good investment when the planting of crops is often delayed due to saturated soil conditions in early spring, where the harvest window is uncertain or erratic due to saturated conditions, and where yields are low, perhaps requiring forage to be purchased.

Accordingly, the greatest value per dollar spent on tile drainage is to tile-drain the worst-drained fields first. Farmer experience and soil survey information from the Natural Resources Conservation Service (NRCS) are the best resources for determining fields to tile drain.

Contracting

Contact your local Soil and Water Conservation District (SWCD) for a list of tile installation contractors and to request layout and design assistance. For addresses of New York State SWCD offices, access the following website: http://www.nyacd.org/districts.html.

As a general guideline, the cost of tile drainage is typically about $1.00 per foot of tile, with actual price determined by the tiling intensity. Intensive tile installation may cost $800 to $1000 per acre.

Installation Guidelines

There are two common ways that modern subsurface drainage systems are installed. The most basic approach is placing a single random line to drain a specific wet area in a field. This often works well when most of the field is reasonably well-drained, but has isolated wet spots. When drainage is more consistently restricted across the field, the more complete and beneficial approach is to "pattern-drain" an entire field at regular intervals. Guidance for pattern drainage includes:

- Use 30 to 50 feet parallel pattern systems instead of single random lines to facilitate uniform drainage across a field and to reduce per foot installation costs. Tile is appropriate on flat lands as well as hillsides. Wider tile spacing is often used to reduce cost without sacrificing crop yield but soil type should be considered to determine the optimum spacing. Consult the New York State Drainage Guide (accessible at ftp://ftp-fc.sc.egov.usda.gov/NY/engineering_tools/drainage_guide_ny.pdf) for recommended tile spacing.
- Corrugated plastic drainage tubing, called "tile" after the original clay sections, should be installed deeper than the 2 feet minimum cover required by NRCS specifications; 4 to 4 ½ feet depth works well in the loam, sandy loam, silt loam, and clay loams of New York State as long as more restrictive, less permeable, soil layers are not encountered. The deeper depth is recommended because: (1) the tile line provides for a deeper rooting zone for growing crops; (2) water is filtered through more soil before it reaches the tile; (3) the tile is harder to reach with preferential flow through earthworm holes or cracks caused by dry weather; (4) the tile will not be harmed by sub-soiling practices; and (5) the tile is protected from damage by heavy field equipment. Placing tile deeper than 5 feet is not recommended for any of the New York State soil types.

Summary

In times of high crop prices and input costs, and heightened environmental concerns such as P runoff in overland flows, subsurface drainage is as important as ever. Farmers should consider running payback numbers for their farm fields and prioritizing the wettest fields for tile drainage installation for the greatest return on investment.

As more is understood about the movement of water and nutrients through the soil, research continues to determine the most effective and practical best management practices (BMP's) to mitigate concerns that could otherwise limit the use of this effective and important practice for growing crops.

Additional Resources

- Agronomy Fact Sheet 58: Subsurface (Tile) Drainage Best Management Practices. To download, access: http://nmsp.cals.cornell.edu/guidelines/factsheets.html.
- Emergency Action Plan Factsheet, NYS AEM. http://www.nys-soilandwater.org/aem/cnmp.html.

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

Steve Mahoney, Joe Lawrence, Quirine Ketterings, Karl Czymmek, Eric Young, Larry Geohring

2011