Northern NY Agricultural Development Program
2016 Project Report

Quantifying Long-Term Agronomic and Water Quality Impacts of Tile Drainage in Northern New York

Project Leaders:
- Eric Young, Stephen Kramer, Laura Klaiber, Catherine Ballard, Rick Grant; William H. Miner Agricultural Research Institute, 1034 Miner Farm R./PO Box 90, Chazy, NY 12921

Collaborators:
- Jon Rulfs, Adirondack Farms, Peru, NY.
- Champlain Valley Agronomics, Peru NY.
- Stephen Mahoney, River Bend Ag & Environmental Services, Altona, NY

Background:
Tile drainage remains a critical practice for Northern NY farms and improves crop production and profitability in poorly drained soils. With proper installation and nutrient management, nitrogen (N), and phosphorus (P) concentrations in tile drainage water are substantially lower than typically found in surface water runoff.

In addition to crop production and soil quality enhancements associated with improved drainage, tiling can reduce soil erosion and total P losses in some settings. While tiling may reduce P losses, it can increase N losses in some cases due to greater mineralization rates and drainage water fluxes compared to an undrained state. However, enhanced root growth and yields from tiling poorly drained soils also results in greater crop yields and nutrient removal over time compared to naturally poorly soils.

The practice of tiling has received heightened scrutiny due to the fact that some degree of nutrient export occurs with tile drainage. However, there is a lack of research directly comparing water quality and agronomic benefits of tile-drained and undrained sites in the Northeast using side-by-side field comparisons. There is a clear need for long-term studies that better quantify cost and benefits of tile drainage.

Due to the fact that some level of nutrient loss is inevitable with all production agriculture, benefits of tiling must be comprehensively evaluated with respect to field crop production, soil health, and potential water quality impacts.

The objectives of our project were to: 1) select an appropriate site to conduct a long-term study to compare agronomic benefits and runoff water quality between a tile-drained and naturally poorly drained field using a paired watershed approach, and 2) install tile-drainage in one field and necessary monitoring equipment to continuously measure runoff water quantity and quality from both fields.

Methods:
Fields were selected based on consultation with Champlain Valley Agronomics and Adirondack Farms, LLC in Peru, NY. The site is located in Keeseville, NY, approximately one mile south of the intersection of Port Douglas Rd. and Mace Chasm Rd. The fields have been managed in long-term grass and located directly across the road from each other. The fields both have somewhat poorly drained soil mapped as a Tonawanda silt loam (Fig. 1, Appendix).

Tile drains were installed in the field located on the west side of Mace Chasm Rd. in June 2016 with a tile plow by Adirondack Farms, LLC at an average depth of approximately 4 ft. below the soil surface. The tiles have a minimum grade of 0.001 and drain northward to a six inch diameter main outlet (Fig. 2). Tiles were installed at a 35 ft. lateral spacing. The tile main outlets to a concrete septic tank are equipped with a fiberglass surface water flume that can continuously record flow using an ultrasonic sensor (Teledyne/ISCO, Lincoln, NE) that measures water depth. Water then flows into a 1,000 gallon septic tank where it is pumped out upon filling with submersible pumps (manufacturer) to the nearby drainage ditch that drains to Mud Brook (Fig. 2). A fiberglass surface water H-flume was installed to measure surface water runoff from the fields (OpenChannelFlow, Boise, ID).

Both fields have earthen berms around the perimeter to direct surface water to flumes and prevent runoff entering the field from upslope areas. A surface water H-flume was installed in the undrained field to collect surface water runoff. This field was graded to create the proper elevation for surface water collection at the north end (Fig 2).

The tile drainage system engineering and sizing of surface water flumes was performed by River Bend Ag and Environmental Services/Stephen Mahoney. Water samples will be collected using autosamplers (Teledyne/Isco, Lincoln, NE) and based on flow level and programmed to take a 200 mL sample for each 0.7 mm of runoff water depth equivalent. We are currently working with Adirondack Farms and NYSEG (New York State Electric & Gas) to finish installing electricity to the site to power submersible pumps and monitoring instrumentation in 2017.

Results:
We had originally planned to take some water samples as part of the first year of the project. However, site selection and tile installation took longer than originally planned.

In addition, surface water runoff flumes took two months longer to build (custom built by manufacturer) than expected, which put the project behind schedule. In addition, tile installation and construction costs exceeded estimates, so money planned for sampling was instead used to cover the added construction expenses.

As of February 2017, we are waiting for the power supply for the site to be completed, which will allow the pumping system to operate and enable subsurface tile drainage monitoring. We expect to be monitoring runoff from both fields by mid-April 2017 depending on weather conditions.

The edge-of-field approach we are using is based on USDA-NRCS edge-of-field monitoring protocols designed according to the latest hydrologic science (i.e., paired small watershed design) to enable accurate/precise estimates of runoff flows and nutrient loading from both fields. We will also be able to monitor snow melt events and during cold times of the year since having power will allow us to utilize heat tape and electricity to run instruments. Our team has ample experience with this type of monitoring design and currently managing an NRCS-sponsored edge-of-field study at another location owned and operated by Miner Institute.

Conclusions/Outcomes/Impacts:
Results from this project will provide important baseline data comparing agronomic (i.e., crop yield/quality) and runoff water quality between a tile-drained and undrained field under highly similar field conditions. Such data are needed given the lack of sound, side-by-side field studies designed to quantify runoff and nutrient loading differences between tile-drained and naturally poorly drained crop fields NNY and the northeast region in general.

Outreach:
Results from this project will be shared with NNYADP publicist Kara Lynn Dunn and be presented at professional meetings once sufficient data has been collected. We will also share results with farmers, NRCS, extension folks, and others involved with agricultural water quality management in the region.

Next Steps:
Monitoring begins during spring 2017 and throughout 2017.

Acknowledgments:
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Reports and/or articles in which results of this project have been published.
See: www.nnyagdev.org/index.php/field-crops/drainage-management/

For more information: Eric Young, Miner Institute, Chazy, NY; 518-846-7121.