Northern New York Agricultural Development Program
2024 Project Report

Evaluating Environmental and Agronomic Benefits of Common Field Crop Production Practices on a Northern New York Dairy Farm

Project Leader:

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Cooperating Producer:

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Background:

Increased awareness of the impact of nutrient loading from agricultural activities has driven public and producer interest alike in adopting practices such as cover cropping (CC) and no tillage (NT) corn production. While considerable strides have been made in adapting these practices to northern climates with short growing seasons, harsh winters, and unpredictable weather in the fall harvest and spring planting windows, there has been much less focus as to whether the intended environmental benefits are being achieved. Research has demonstrated that the agronomic benefits of NT+CC in combination are greater than the sum of the benefits of either practice in isolation and thus, NT is rarely implemented without the accompanying usage of CC.

However, in poorly drained soils, the transition to NT production can be challenging as the soil structure that was degraded by tillage practices takes time to recover. Therefore, the transition often carries less risk of crop loss when fields are systematically tile-drained. The combination of NT and tiling; however, can carry some risk as the improved soil structure (larger soil pores) in NT fields increases the risk of dissolved P loss through these large “macropores”, especially when manure is applied without incorporation to the soil. Previous research at these paired fields has indicated that installing tile drainage in a

field with corn production under conventional tillage had a substantial impact on the water balance for each field; total drainage was increased by 46%, but the primary runoff pathway switched from the surface to the subsurface. This increased subsurface drainage led to more than three times greater N losses, but no difference was observed for P.

Despite the possible benefits to the producer, there are also challenges related to implementing NT+CC in corn fields. Short growing seasons, allelopathic effects on the subsequent corn crop, and water and nutrient competition between the CC and corn during the early growth stages can all impact the quality and yield of the corn crop. Although cereal rye is a winter hardy cover crop that can be planted as late as October 10, early fall growing conditions in northern New York are highly variable and understanding the degree to which a well-established CC compared to a low biomass CC stand will impact water quality metrics is important for real-word assessment.

Methods:

Beginning in 2016, an edge-of-field monitoring project was established and conducted on two adjacent farm fields in Keeseville, NY. The fields are similar in size (5.8 and 5.9 acres), composed of the same soil type (somewhat poorly drained silt loam; Tonawanda series) and have mild slopes to direct surface runoff to monitoring stations at a corner of each field. Interceptor ditches and berms around the perimeter of each field ensure that each field is hydrologically isolated from adjacent land. Tile drainage was installed in one of the fields in 2016 (Field TD) at 35 ft. lateral spacing and an average 4 ft. depth. In June 2023, the second field (Field UD) was tiled in the same manner and instrumented for sample collection in the same manner as the originally tiled field. Surface runoff and tile drainage were sampled for every 0.67 mm of runoff and composited into a 15-L plastic container. Fully instrumented monitoring of surface runoff and tile drainage from both fields began on December 4, 2023 and continued through December 31, 2024.

Composite samples were collected from all runoff locations two times per week and analyzed for soluble reactive P (SRP), total P (TP), nitrate-N, ammonium-N, total N (TN) and total suspended solids (TSS; an estimate of erosion). Event loads were calculated by multiplying the sample concentration by the runoff volume during each event. Each response variable will be transformed using the base 10 logarithmic transformation followed by linear regression analysis to calculate the calibration period. relationships against which the treatment periods will be assessed. Once completed, this calibration will be used to assess the impacts of tile drainage from the treatment period of 2018-2022 and no-till corn production with a winter rye cover crop, which would begin in 2027 and last 2-3 years.

Results and Discussion:

The previously undrained field (UD) was tiled in June 2023 and a concrete septic tank was installed belowground at the field's main tile outlet to allow for equipment installation and sampling (Figure 1, p. 4). Drainage and sediment and nutrient loading data are presented in Table 1 (p. 3). Although Field West regularly produced substantially less total drainage than Field East when it was not yet tile-drained during the 2018-2022 monitoring periods, it produced four times more tile flow and total flow in 2024 due to

the generation of nearly four times more tile drainage volumes, as both fields produced nearly identical rates of surface drainage.

However, a large portion of this difference in tile drainage is due to what appears to be a consistently higher water table in Field East as there was consistent tile flow during much of the year in between rain and snowmelt events. Fifty percent of the total tile drainage from Field East was from these periods between events, or baseflow periods. In contrast, only 10% of the tile drainage from Field West was baseflow, the remaining 90% of tile drainage flow occurred during weather-driven runoff events.

This increase in drainage from Field East resulted in greater nutrient exports as well, with 5.5 times more total P exported from Field East than West. As N losses are often strongly correlated with total drainage, it was unsurprising to see an equivalent difference as was observed with total drainage, rather than differences in concentrations of N species in drainage water. However, as we have previously observed in Field West tile drainage data, despite tile drainage generating 88% of the total drainage from Field East, the lower SRP and total P concentrations in tile drainage water versus surface runoff result in disproportionately low losses relative to the volume of drainage. But as with previous years, total P losses remained below 1.0 lb/acre and total N losses remained below 20 lb/acre in both fields, reflecting a high nutrient retention rate and use efficiency by the corn silage crop.

Location	Drainage (in)	SRP (lb/ac)	Total P (lb/ac)	Nitrate-N (lb/ac)	Amm-N (lb/ac)	Total N (lb/ac)	TSS (lb/ac)
East Tile	16.05	0.054	0.477	16.32	0.23	19.23	442.0
East Surface	2.18	0.086	0.187	0.10	0.13	0.48	68.9
West Tile	4.21	0.007	0.028	4.59	0.02	5.01	9.6
West Surface	2.22	0.054	0.095	0.12	0.11	0.49	12.3
East Field	18.23	0.140	0.664	16.43	0.36	19.71	510.9
West Field	4.42	0.061	0.122	4.71	0.13	5.50	21.9

Table 1. Drainage (inches), nutrient and sediment loads (lb/acre) from Fields East and West.

Only so much can be inferred from the 2024 monitoring period on its own. However, the drastic difference in surface and tile drainage produced by Field East relative to itself in the first five years of the project, as well as relative to Field West, demonstrates the necessity of completing a calibration period to characterize the inherent similarities and differences between the two fields. Following the completion of the calibration period in 2025, regression models will be developed from these data and used to compare against other treatment periods. Figure 1 shows the preliminary relationships between the two fields' (surface + tile) drainage and total P exports. These relationships will be developed for all variables at the field-scale (surface + tile) as well as by drainage pathway.

First and foremost, the calibration relationships will enable a more robust evaluation of the data from 2018-2022 when only Field West was tiled to assess the impacts of tile drainage on hydrology and nutrient transport and determine what differences were simply inherent differences in the field characteristics compared to what was a result of the

difference in management. The same process will occur moving forward if funding continues in 2026, with a new treatment period beginning to assess the nutrient management and water quality impacts of no-till corn production with a winter rye cover crop.

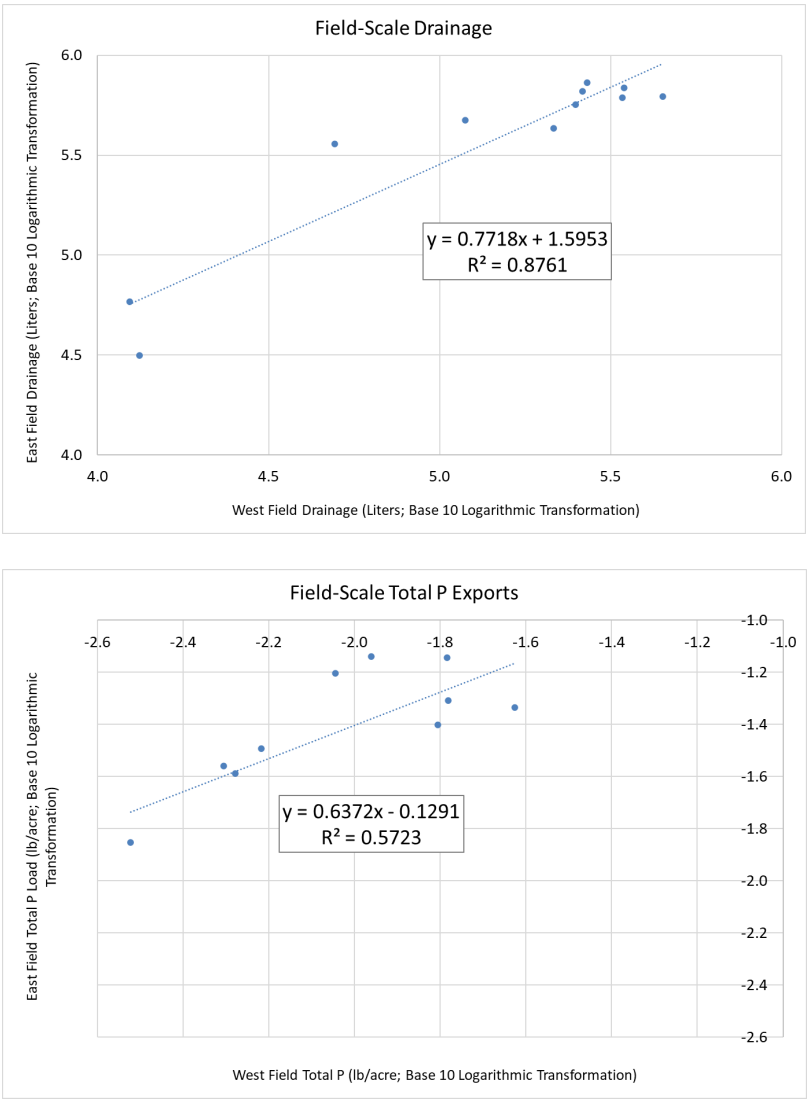

Figure 1: Event data by field (sum of surface and tile for each field) for A) event drainage volume and B) event total P export, during the calibration period when both fields were tiled and managed identically. Event load data (lb/acre) were transformed using the base 10 logarithm to achieve normality, strengthening the statistical analysis, but resulting in unitless values in the graphs.

Conclusions:

The primary focus of this project in 2024 was to monitor runoff events as initiated in December 2023 with both fields equipped with systematic tile drainage systems. These data will provide a baseline dataset for the comparison of additional crop production strategies, specifically no-till corn production with a winter rye cover crop. Although additional data collection is necessary to strengthen the calibration period data collected thus far, the preliminary comparisons suggest consistent patterns of drainage and nutrient exports between the two fields, such that a similar number of events sampled in 2025

should provide a robust enough calibration dataset to be able to initiate the treatment period in 2026.

Outreach:

- May 7, 2024: Invited testimony presented to Vermont Legislature House Committee on Agriculture, Food Resiliency and Forestry
- July 17-18, 2024: North American Manure Expo, Auburn, NY, attendance: 1,000+
- October 24, 2024: Tiling can tie down phosphorus better" article with summary of this NNYADP project, Hoard's Dairyman Intel online newsletter.
- March 28, 2025: Soil Health & Nutrient Management Workshop: Manure Roadshow, Yates and Ontario County Soil and Water Conservation Districts , Cornell PRO-Dairy

Next Steps:

A NNYADP grant was received to continue this work in 2025. The fields will continue to be managed in the same manner as in 2024 to create a robust calibration period dataset from which future treatments can be evaluated against to assess the impacts of no-till corn production with a winter rye cover crop on field hydrology and nutrient losses.

Acknowledgments:

We thank Adirondack Farms for the opportunity to establish a research site at these fields and its ongoing collaboration and assistance with the project. We also thank the Northern New York Agricultural Development Program for funding this research.

Reports and/or articles in which results of this project have been published:

A summary of the project's progress: ("Tiling can tie down phosphorus better") was published October 24, 2024 in Hoard's Dairyman Intel online newsletter. A summary of this report will also be published in a 2025 issue of the Miner Institute *Farm Report*.

For More Information:

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PHOTOs: on-farm monitoring station at research site, photos: Miner Institute