



**Northern New York Agricultural Development Program
2025 Project Report**

**Year 5: Evaluating Environmental and Agronomic Benefits of
Common Field Crop Production Practices on a Northern New York
Dairy Farm**

Project Leader:

Laura Klaiber, MS, Nutrient Management Researcher, Miner Institute,
1034 Miner Farm Road, PO Box 90, Chazy, NY; 518-846-7121, klaiber@whminer.com

Collaborator(s):

Miner Institute personnel: Stephen Kramer, MS; Mark Haney; Matthew Kelting, MS;
Jacob Leduc, and Catherine Ballard, MS
Mike Contessa, Champlain Valley Agronomics, Peru, NY

Cooperating Producer:

Adirondack Farms LLC, Peru, NY

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, 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 crop that can be planted as late as October 10, early fall growing conditions 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-world assessment. The objective of this project was to establish a baseline relationship between the two tiled fields during 2024 and 2025 to compare against results following the implementation of CC+NT in one of the fields.

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, 2025.

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 (treatment period 2018-2022) and no-till corn production with a winter rye cover crop, which should begin in 2027 and last 2-3 years.

Results and Discussion:

Drainage and sediment and nutrient loading data are presented in Table 1. 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. In 2025, both fields generated 4 more inches of runoff than in 2024, but once again, the Field East generated approximately four times more total runoff than the Field West. However, unlike in 2024, Field West produced approximately two times more surface runoff than Field East, though the difference for tile drainage remained similar, with East producing approximately three times more than West. Relative to the 40 inches of

precipitation during 2025, the total volume of drainage from East and West represented 35% and 20% of the total precipitation.

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	11.56	0.041	0.177	14.12	0.19	15.19	67.4
East Surface	2.46	0.058	0.112	0.09	0.05	0.43	45.4
West Tile	3.66	0.007	0.017	7.08	0.03	7.21	4.0
West Surface	4.37	0.084	0.180	0.12	0.09	0.79	32.5
East Field	14.02	0.099	0.289	14.21	0.24	15.62	112.8
West Field	8.03	0.091	0.197	7.20	0.12	8.00	36.5

Table 1. Drainage (inches), nutrient and sediment loads (lb/acre) from Fields East and West during 2025 monitoring period.

As was seen in 2024, a large portion of the 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. Figure 1 shows the cumulative drainage from the tile drainage (Fig. 1A), surface runoff (Fig. 1B), and the field as a whole (surface + tile; Fig. 1C). Additionally, as can be seen in Figure 1, early in the spring runoff season (early March), while the tile drainage begins to flow at a higher rate from East, the West tile is only just beginning to flow at low rates. However, in Fig. 1B, we observed that the East surface produces roughly double that which was generated from the West surface. Figure 1C illustrates this clearly with the actual field flows not differing greatly during the March runoff period. Yet, when event flows begin to lessen and baseflows (flows from shallow groundwater, not those generated by immediate rainfall) take over in April and May, the shallower groundwater table in West gains prominence and Field East begins to produce more tile flows (and total flow) than Field West.

As would be expected given the difference in drainage amounts generated by the two fields, East produced roughly 50% more total P than West (Table 1). Both fields produced similar annual P losses to the 5-year average observed from 2018-2022 (0.22 lbs total P/acre). Surprisingly, there was no substantial difference between SRP losses from the two fields despite the difference in tile drainage. However, while the tile and surface each produced close to half of the total losses from East, there was very little SRP (or total P) delivered in the tile drainage from West, with the vast majority produced by surface drainage.

Some of this can be understood by examining the flow-weighted mean concentration (FWMC) of the drainage waters, a measure of the average concentration over a specified period of time. In addition to producing only a third of the runoff of the East tile, the west tile also produced drainage waters with 17% and 10% of the SRP and total P concentrations, respectively, as was observed in East. However, the SRP and total P generated by surface runoff from West was enough to make up much of the difference between the two fields. Opposite of that observed in the tile drainage, West produced higher surface drainage rates and P concentrations than East, such that it ultimately

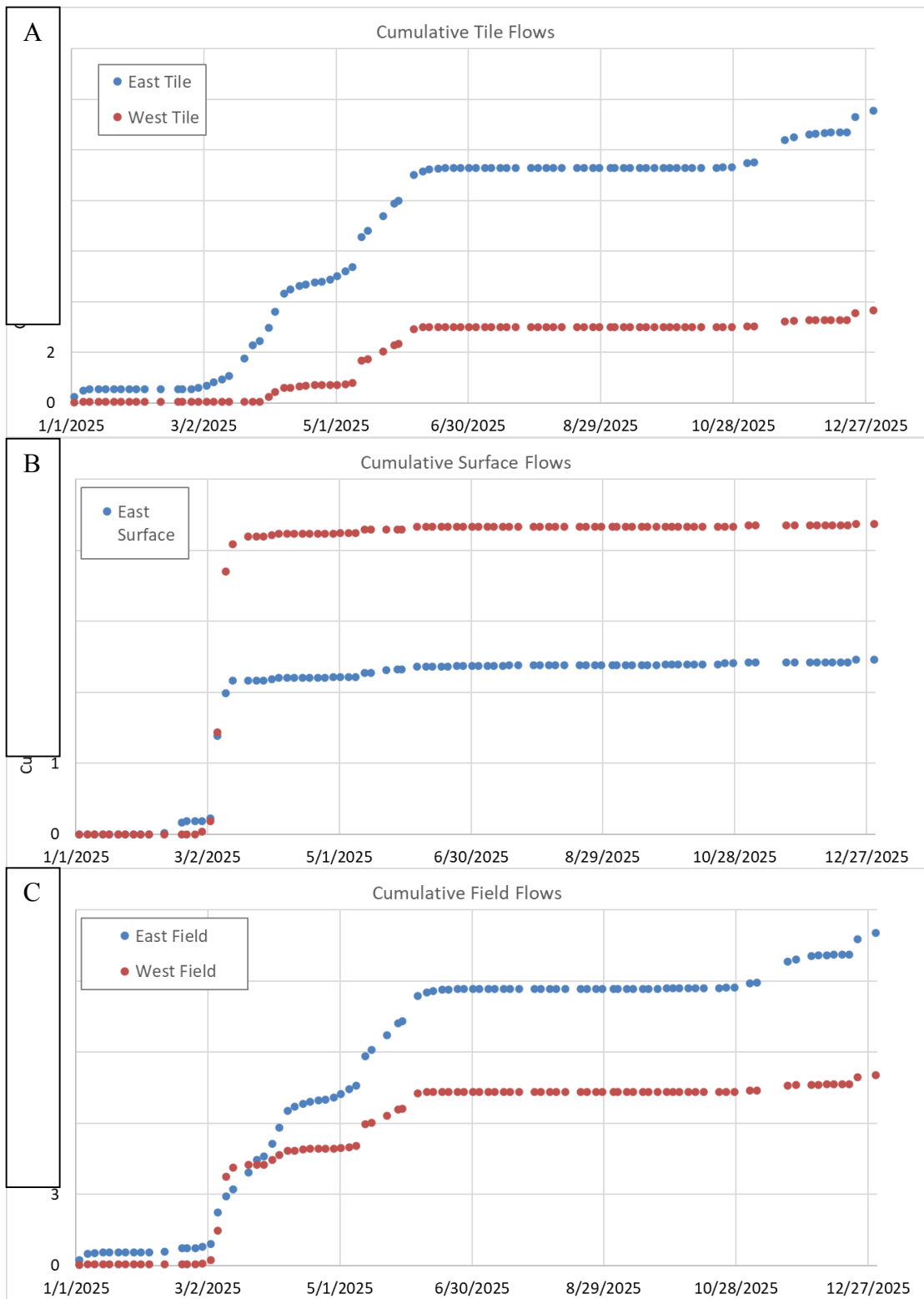


Figure 1. Cumulative flows from (A) tile drainage (B) surface runoff and (C) field-scale (surface + tile) during the 2025 monitoring period.

produced 53% more total P losses than East, though still producing only roughly two-thirds of the field-scale losses from East.

Nitrogen losses were consistent with the amounts and pathways of drainage that occurred from each field. In Field East, where tile flows dominated the field’s water budget, more

N was lost (14.2 lbs/acre) than in West (7.1 lbs/acre). When tile drainage is present, N losses are typically driven by the amount of subsurface drainage that occurs from a field. Because tile drainage creates a more favorable environment for nitrate production than an untiled field (warmer, more oxygen), while also creating a conduit for that nitrate to be lost from the soil (with tile drainage waters), tile drained fields generally produce substantially more N losses than a similarly non-drained field. While East often had a higher water table than West, with the tiles present, it was still able to achieve those favorable nitrate-production conditions and thus, higher N concentrations were observed in the tile waters from East compared to West.

The FWMC of total N in the tiles during the 2025 monitoring year was 9.6 mg/L and 5.9 mg/L for East and West fields, respectively. However, when we include the surface drainage data, which is very low in N, and consider the data at the field-scale, both fields generated a total N FWMC of 4.9 mg/L, well below the recommended threshold of 10 mg/L.

The 2024 and 2025 data was also evaluated with regression analyses to determine whether the strength of the relationships between the two fields was sufficient to advance to the treatment stage of the project (implementing NT+CC in one of the fields). The following series of graphs illustrates the regression relationships at the field-scale level for total drainage and each of the water quality chemistry constituents, with the exception of the ammonium data. The ammonium data only showed a very small relationship, but as it has only been a very small fraction of the total N lost from the field, it is not a reason to delay the onset of the treatment period. The R^2 value communicates the strength of the relationship, with a relationship of 1 indicating the strongest possible relationship, while a value of zero indicates that the values occur randomly, with no pattern detected. To assess the relationships, it was necessary to first transform the data using a base 10 logarithm to achieve normality, strengthening the statistical analysis, but resulting in unitless values in the graphs.

The graphs in Figure 2 illustrate the relationships between the two fields for each of the response variables. These graphs demonstrate moderate to strong relationships for each variable throughout the duration of the calibration period (2024-2025). Based on the number ($n = 24$) strength of these relationships, it is recommended to transition to the treatment period to align with the beginning of the growing season in 2026.

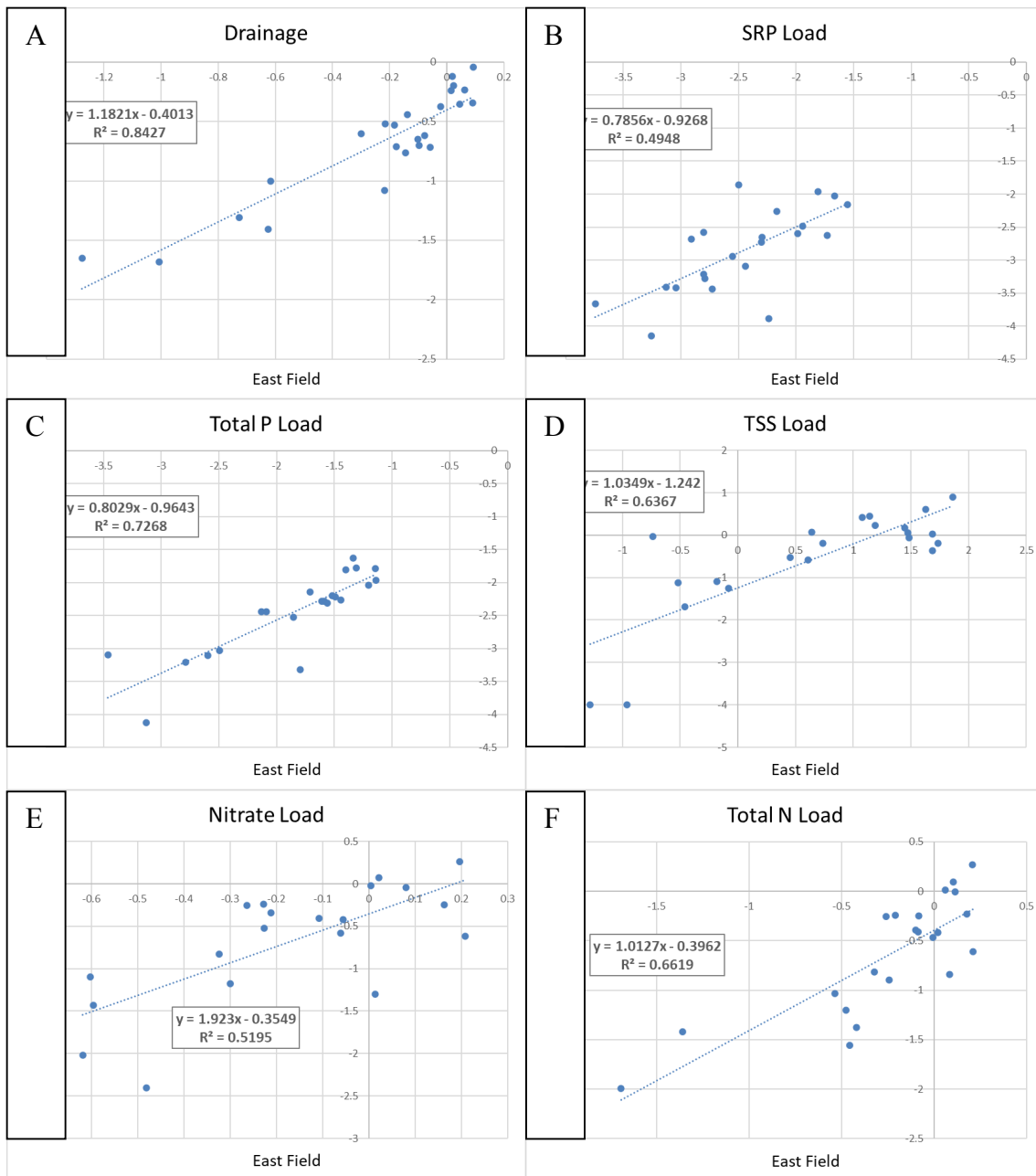


Figure 2: Event data by field (sum of surface and tile for each field) for A) event drainage volume, B) SRP load, C) total P load, D) TSS load, E) nitrate load, and F) total N load during the calibration period when both fields were tiled and managed identically. Event load data (lb/acre) were transformed 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 2025 was to continue monitoring runoff events as initiated in December 2023 with both fields equipped with systematic tile drainage systems. These data were evaluated with regression analyses to determine the strength of the relationships between the two fields and it was determined that the data was sufficient to proceed to the next step in the project, transitioning to the treatment period during which Field East will transition to no-till corn production with a winter rye cover crop planted in the fall.

Outreach:

Results from this ongoing project will be presented at the November 2026 Joint Annual Meeting of the Soil Science Society of America, Crop Science Society of America, and American Society of Agronomy.

Next Steps:

A NNYADP grant was received to continue monitoring the fields in 2026 during which we will transition to the treatment period. During the treatment period, Field West will continue to be managed as it has been since 2018, while Field East will transition to no-till corn production with a winter rye cover crop planted in the fall.

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 this report will be published in the May 2026 issue of the Miner Institute *Farm Report*.

For More Information:

Laura Klaiber, Nutrient Management Researcher, Miner Institute, 1034 Miner Farm Road, PO Box 90, Chazy, NY; 518-846-7121, klaiber@whminer.com



