Northern NY Agricultural Development Program
2025 Project Report

Examining Spatial and Temporal Impacts of Tile Drainage on Corn Yield

Project Leader:
Quirine M. Ketterings, Cornell Nutrient Management Spear Program (NMSP), 323 Morrison Hall, Department of Animal Sciences, Cornell University.

Collaborators:
Consultants: Mike Contessa and Eric Beaver, Champlain Valley Agronomics. Campus: Manuel Marcaida III, Kirsten Workman (PRO-DAIRY). Northern New York dairy farms.

Background:

Tile drainage creates optimal growing conditions by removing excess water, reducing soil erosion, and enhancing nutrient availability. By alleviating waterlogging in poorly-drained low-lying areas, tile drainage can reduce within-field yield variability and improve long-term yield stability. Tile drainage enables more consistent soil moisture conditions and better nutrient distribution across fields, helps crops withstand weather extremes and enables earlier field access after rainfall, allowing for timelier planting and harvesting.

While benefits are well understood, there is a need for quantitative evidence that captures both the spatial and temporal impacts of tile drainage to support farmer decision-making. Yield monitor data from tile-drained fields can provide the spatial and temporal insights needed to quantify these benefits providing measurable evidence of tile drainage benefits for within-field uniformity and year-to-year consistency.

Methods:

Yield data were obtained from five corn grain, nine corn silage, and four soybean whole-farm datasets in northern New York (Table 1). A subset of these farms also shared tile information. For tile impact evaluation, farmers provided multi-year yield monitor datasets along with georeferenced tile-drainage maps for participating fields. All yield monitor data were processed to correct for flow, moisture, and pass delays, after which cleaned point data were interpolated using kriging to a 6-ft × 6-ft grid. Yield stability zones were then delineated using three or more years of interpolated yield data, identifying consistently low- and high-yielding areas as well as zones of persistent variability (Figure 1).

Two farms supplied corn grain data while three farms shared corn silage data along with tile drainage datasets, including digital maps and installation years (Table 1). Additional tiled soybean fields were included as well, contributed by one farm. For the pre- and post-tile yield analysis, fields were required to have at least two years of yield data both before and after tile installation. This data requirement ensures analytical reliability, which limited the analysis to the three fields for grain and soybeans and nine fields with sufficient corn silage records.

Table 1: Participating northern New York farms with tiled corn grain and corn silage fields that provided yield data and tile drainage information for this study.

Crop Type	Farms	Total number of tiled fields	Fields included in the analysis
Corn grain	2	26	3
Corn silage	3	21	9
Soybean	1	15	3

Figure 1: Example of a tiled field overlaid with corn yield stability zones derived from at least three years of yield monitor data. The lines indicate the approximate location of tile lines.

Using the year when tile drainage was installed, yields were compared between pre- and post-installation periods to evaluate changes in both yield and yield variability. Statistical analysis was conducted using linear mixed models to account for differences among fields and years. This approach enabled quantification of the spatial and temporal impacts of tile drainage, providing evidence of yield recovery following installation, long-term yield gains, and increased yield consistency across fields under variable weather conditions.

Results:

Yield data summary

Data cleaning was completed for five corn grain and eight corn silage whole-farm datasets in northern New York, covering the 2011–2025 growing seasons. In collaboration with farmers and farm consultants, the dataset included harvest yield data from 860 fields (Table 2). Yield stability zones were generated for 6,672 acres of corn grain, 19,112 acres of corn silage, and 2,096 of soybean. A subset of these farms and fields was used to quantify the impact of tile drainage on yield and yield stability.

Table 2: Summary of farms, total fields, and acreage represented in cleaned yield data and yield stability zone for corn grain and corn silage in NNY.

Crop Type	Farms	Cleaned Yield Acres	Yield Stability Zone Acres	Total Fields with Yield Stability Zones
Corn grain	5	35,070	6,672	176
Corn silage	9	81,709	19,112	609
Soybean	4	14,835	2,096	75

Effect of tiles on yield

Yearly average yield and within-field spatial standard deviation (SD) for the pre- and post-tile periods were summarized using boxplots in Figure 2.

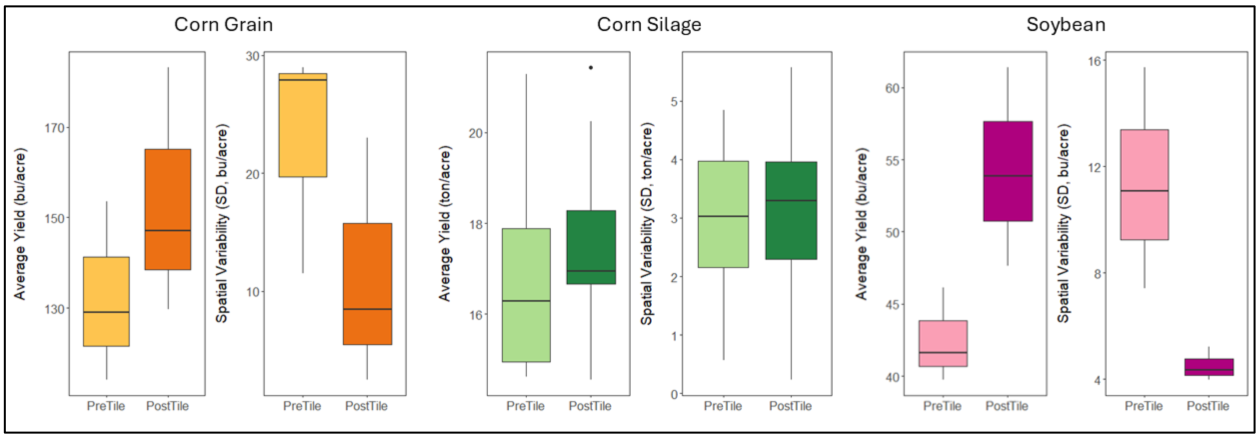

Figure 2: Comparison of yield and within-field variability of corn grain, corn silage, and soybean yields before and after tile drainage installation. This dataset included two fields with at least two years of yield data both at pre-tile and post-tile installations.

Grain yields generally trended higher after tile drainage was installed. On average, grain yield averaged 22 bu/acre higher post-tile compared to pre-tile. While this increase was not statistically strong due to the small number of fields included, the direction and magnitude are consistent with improved drainage. Moreover, within-field yield variability decreased by 11 bu/acre after tiling (Figure 2). Variability after tiling was significantly reduced. Thus, for corn grain, tiling reduced within-field yield variability, along with a positive trend in overall yield.

For corn silage fields, yield averaged 0.71 tons/acre higher after tile installation, while within-field spatial variability was slightly higher as well (0.08 tons/acre). Neither result was statistically significant. The field-level random effect accounted for the variance in the yield, suggesting meaningful differences among fields, while the SD model showed no field-level variance, indicating that yield variability was driven entirely by within-field year-to-year fluctuation rather than consistent field-level differences.

Soybean yield averaged 12 bu/acre higher after tile installation compared to the pre-tile period, while within-field spatial variability was lower by 7 bu/acre. Although results were not statistically significance, both approached the 0.10 significance threshold. The field-level random effect accounted for the yield variance, suggesting that field differences were relatively small compared to within-field year-to-year fluctuation.

Selected field case analysis illustrating yield and spatial variability response to tile drainage
Tile drainage is generally expected to improve both yield levels and yield consistency across a field, with higher average yields and lower spatial variability after installation. To illustrate these potential changes, we selected fields with at least four years of yield data both before and after tiling (Figure 3). Results across the three fields tell a more nuanced story than the expected pattern of higher yields and lower variability post-tiling.

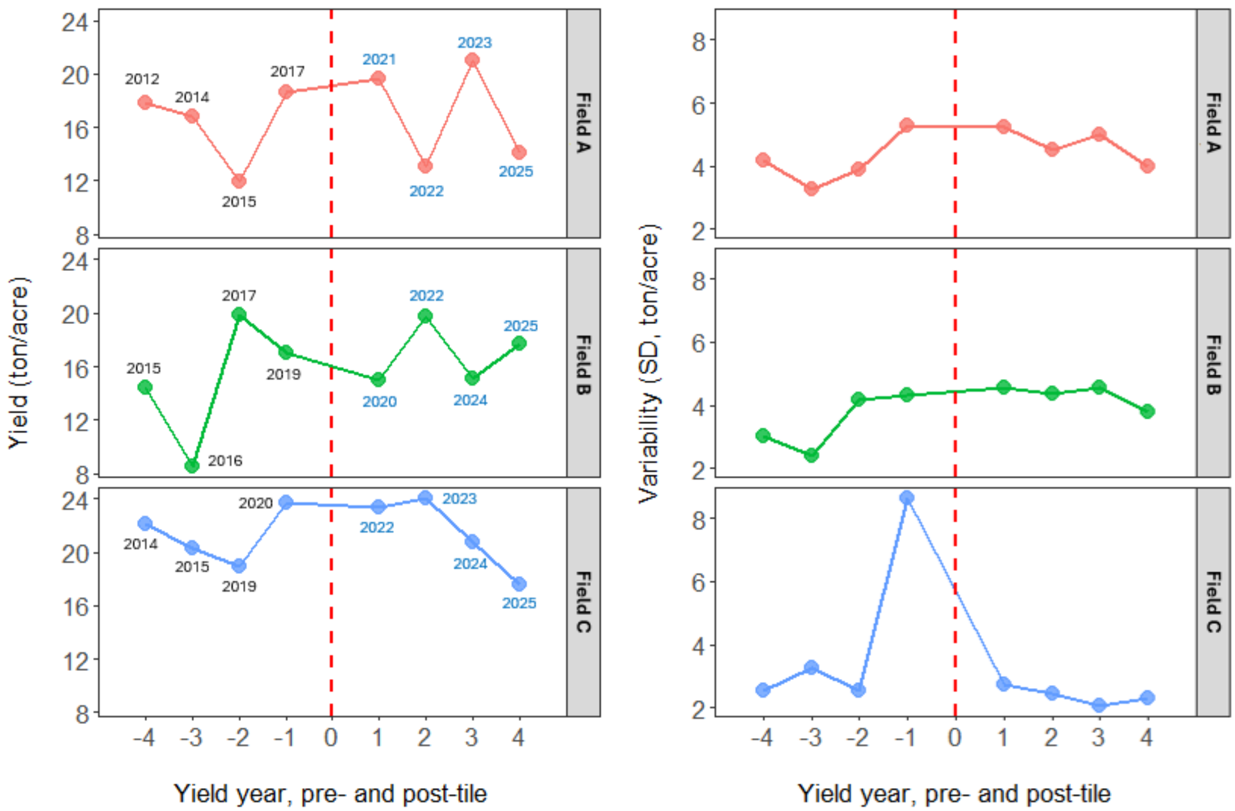

Figure 3: Spatial yield (left) and within-field yield variability expressed as standard deviation (right) for three fields (A, B, and C) across years relative to tile drainage installation (year 0, dashed red line). Negative values on the x-axis represent pre-tile years and positive values represent post-tile years, with each increment corresponding to a successive harvest year rather than a fixed calendar interval. Harvest years are labeled on each data point. Fields were selected to have a minimum of four harvest years both before and after tile installation.

Pre-tile yields fluctuated considerably in Field A, ranging from a low in 2015 to high years in 2012 and 2017. Following tile installation, yields initially increased and reached the highest in 2023, suggesting an early positive response. However, 2025 saw a notable drop back to below pre-tile levels, which may reflect weather-driven variability rather than a tile drainage effects. On the variability side, spatial SD remained stable throughout, ranging between 4 and 6 ton/acre both before and after tiling, with post-tile showing lesser within field yield variability.

Field B displayed a more positive tiling response. Pre-tile years were marked by wide yield swings, most dramatically the sharp dip in 2016, which is a drought year. After tile installation, yields showed closer ranges within 16-20 ton/acre. The spatial variability was already moderate pre-tile and remained consistently low and in close range post-tile, generally holding below 5 ton/acre. This pattern showed that tile drainage appeared to have reduced waterlogging stress in the worst years while maintaining good performance in favorable years.

In Field C, pre-tile yields were relatively high and stable, which may reflect naturally well-drained soils or favorable recent conditions before installation. Post-tile, average yields have trended downward through 2024–2025. Possible reasons may include a series of unfavorable weather years post-installation, soil settling or disturbance effects from the tiling work itself, or the field simply not having had a severe drainage problem to begin with. On the other hand, variability spiked sharply on the harvest year before tile installation, dropped immediately after tiling, and remained consistently low thereafter. The low variability post-tile suggests that tile drainage has improved within-field yield uniformity despite decreasing average yields.

Across these three fields, tile drainage consistently reduced within-field spatial variability, but its effect on average yield was more mixed and field-dependent. Yield response to tiling may not be immediate or guaranteed, and depends on baseline drainage conditions, weather patterns in the years following installation, and how long it takes for soils to equilibrate after disturbance.

The limited number of fields and years included in the analysis constrained statistical power, and results should therefore be interpreted as exploratory evidence supporting potential yield and yield stability benefits associated with tile drainage. Additional years of yield monitor data will help evaluation of trends in yield and yield stability, allowing for a more comprehensive assessment of long-term drainage impacts.

Conclusions/Outcomes/Impacts:

This project demonstrates the value of yield monitor data for quantifying the spatial and temporal impacts of tile drainage. Across participating farms, extensive multi-year datasets were successfully cleaned and translated into yield stability maps, providing a foundation for evaluating drainage effects at field scale. Initial results from fields with sufficient pre- and post-tile data suggest higher average yields and reduced within-field yield variability in corn grain fields following tile installation. In contrast, silage fields showed little measurable change in either average yield or within-field variability during the evaluation period. Observed trends support the potential for tile drainage to improve both productivity and yield uniformity but additional post-installation yield data will be needed to enable more robust assessments and quantification.

Outreach:

The farms that shared data received their farm-specific yield reports that included yield per year of data submitted, with and without headland areas included, a multi-year yield report that can be used to set field-specific yield indices, and, for each field with at least three years of data, the yield stability zone maps. The precision ag team of the NMSP visited Champlain Valley

Agronomics on October 17, 2025, to talk about precision ag technology use, share initial findings for the tile drainage project, and discuss next steps.

Next Steps:
There is a growing statewide database to which the northern NY datasets will be added. In addition, we plan to expand the tile drainage database by incorporating additional years of yield monitor data from existing tiled fields and recruiting more farms with documented tile installations and multi-year yield records. As successive harvest data are collected, the analysis will be updated to strengthen analyses on long-term yield and yield stability responses to tile drainage. We anticipate an extension article from the work, once the additional farm data are processed. A tile drainage survey was developed under leadership of Kirsten Workman, PRO-DAIRY, and in partnership with Allen Wilder, Miner Institute, and shared with farming audiences in early 2026.

Acknowledgments:
We thank the participating farmers for sharing their yield monitor data and tile information.

Reports/articles in which the results of this project have already been published:
Initial summaries were shared at extension meetings with the invitation to join the project.

For More Information:
Quirine M. Ketterings, Cornell Nutrient Management Spear Program (NMSP), Dept. of Animal Science, Cornell University, qmk2@cornell.edu, 607-255-3061, http://nmsp.cals.cornell.edu.

Picture 1: Our precision ag team of the NMSP visited Champlain Valley Agronomics staff on October 17, 2026, to exchange information and ideas for advancing precision ag technology and use of yield monitor data.