

Canaan View Dairy, CT

COVER CROP DEMONSTRATION TRIAL CASE STUDY

2021-2025



TRIAL TREATMENTS

Treatment	Description
Herbicide	Use herbicide to terminate cover crop
Green Chop	Use flail mower to harvest cover crop as green chop

DEMO FARM OVERVIEW



Artie Siller, technical support provider from UMass (left) examines a triticale plant for maturity stage with Ethan Arsenault (middle) and Kristen Irvin of AFT (right). April 2023.

CARO ROSZELL

County	Litchfield, CT
Watershed	Mianus River-Frontal Long Island Sound
Crops in Trial	Corn silage
Cover Crops in Trial	Triticale
Farm Size	450 tillable acres (25.5-acre trial) with 300 milking cows
Soils	Silt loam & loamy sand with small areas of sandy loam on slopes up to 3%
Annual Precipitation	50 inches
Elevation	750 ft

TRIAL GOAL

Assess the economic and soil health impacts of harvesting green chop for dairy cattle feed from no-till planted triticale cover crop. Specifically, determine if harvesting green chop can provide an economic benefit without diminishing the soil health benefits of cover crops.

KEY TAKEAWAYS

- **Green Chop treatment had a higher net income** compared to the Herbicide treatment, due to the value of the harvested forage.
- **Despite removal of biomass from the Green Chop treatment, soil health outcomes were not noticeably diminished**; however, more years of data and a replicated trial design would be needed to be confident in this result
- **There were minimal differences between Green Chop and Herbicide soil test results.** This could be due to long-term use of cover crops on the field prior to the trial, the small difference between treatments (a cover crop was grown on both treatments), or the relatively short time period in which this trial was conducted.
- **Baseline levels of soil organic matter and nutrients were high** in this field because it has historically received regular manure applications due to proximity to the home farm; this also could have played a role in mitigating soil health losses in the Green Chop treatment.
- Overall, this trial suggests that for fields that receive regular manure application and have high soil organic matter and fertility, **harvesting cover crop for feed can be profitable while still providing soil health benefits.**



AMANDA FREUND

“I’ve got to really take care of my land. I don’t have a ton of land to deal with. If I don’t take care of it, I’m not going to get the yield I need to produce feed for my cows.”

—ETHAN ARSENAULT



ETHAN ARSENAULT



ETHAN ARSENAULT

Mowing triticale for green chop, May 2023.

Triticale green chop being merged into rows after mowing, May 2023.

Canaan View Dairy was established in 2022 as a partnership between Lloyd Vaill and Amy Vaill, long-time owners of Lo-Nan Farms, and Ethan Arsenault, their mentee and first-generation farmer. By leasing Freund Family Farm, a 5th generation family farm that began milking cows in 1949, Lloyd, Amy, and Ethan were building their new venture from the strong foundation of a family farm dedicated to soil health. As long-time soil health advocates, Freund Family Farm began planting a rye or wheat cover crop after annual silage harvest for their dairy cows in 1975. In addition to this soil health practice, they used a zone tiller for reduced tillage corn planting and applied liquid digestate twice per year.

The Freund family partnered with American Farmland Trust (AFT) in 2021 to start a five-year on-farm soil health demonstration trial exploring new cover crop termination techniques. When they leased their farm in summer 2022, Ethan, the new on-the-ground operator, was also enthusiastic about soil health practices, and the trial continued with a few modifications. While both the Freund family and the new managers have a long history of planting cover crops, they still encounter challenges and are interested in exploring the economic and soil health impacts of various management techniques.

Farmers in the region typically use long-day (≥ 105 -day) silage corn varieties, and the late harvest makes it hard to fit in a cover crop. A shorter-season variety (such as a 95-day) allows for earlier cover crop planting, which helps with establishment and biomass accumulation, resulting in greater potential soil health gains. However, the trade-off is that shorter-season varieties can have lower yields.

One way to offset the lower yielding short-season silage corn is to harvest the cover crop biomass as **green chop** for cattle feed. While this method removes most above-ground cover crop biomass from the field as feed, it still offers year-round active root growth and soil cover, which has soil health benefits.

With a tight land base for their 300 milking cows, Ethan wanted to prioritize growing additional forage to ensure adequate feed without spending a lot of money on feed purchase and hauling. Most of his cover cropping experience included using a short-season corn and terminating cover crops in April when they were still small. Ethan was

interested to see what would happen to soil health and his bottom line from letting the cover crops grow until mid-May.

TRIAL DESIGN

The 25.5-acre field selected for this trial had previously been in continuous corn silage with a broadcasted wheat or rye cover crop the week after silage harvest. It had historically received frequent manure applications.

The demonstration trial (non-replicated) consisted of side-by-side areas comparing two cover crop termination strategies (Figure 1):

- Herbicide (7 acres)
- Green Chop (18.5 acres)—This area is larger because it originally also contained a treatment for roller crimping, which was later removed from the trial in 2022.

Short-day silage corn was planted and harvested as the cash crop on the same days across both treatments, and triticale was planted as the cover crop (Table 1). The only difference

“It was maybe five hours of extra work a year to get this project done, so it didn’t add a lot to my plate, but it did bring a lot of value.”—**ETHAN ARSENAULT**

FIGURE 1: TRIAL DESIGN MAP



TABLE 1: CASH CROP AND COVER CROP ROTATION.

Green Chop	Corn Silage	Triticale (harvested)	Corn Silage	Triticale (harvested)	Corn Silage	Triticale (harvested)	Corn Silage	Triticale (harvested)	
Herbicide	Corn Silage	Triticale (not harvested)	Corn Silage	Triticale (not harvested)	Corn Silage	Triticale (not harvested)	Corn Silage	Triticale (not harvested)	
Year	2021		2022		2023		2024		2025

between treatments was whether the triticale was terminated via harvest as green chop or terminated via herbicide. Green chop was harvested in the second week of May, when the triticale was about three feet tall and in flag leaf (the last leaf has emerged, but no grain heads have started to form). The triticale in Herbicide was terminated with herbicide soon after cover crop harvest was complete in Green Chop, to ensure the green chop was not contaminated by herbicide.

Farming Reality Impacts Trial Plans

In 2022, when the farm changed management, the trial continued with a few modifications, such as no longer including a roller crimping treatment. Ethan was not as interested in roller crimping and wanted to keep the trial simple. For this case study, we therefore focus on the two treatments Canaan View Dairy continued to implement until 2025.

Data Collection

Soil health indicators were analyzed annually in the field using the qualitative observation-based NRCS In-Field Soil Health Assessment (IFSHA) and soil samples collected in the springs of 2021 through 2025. Data from 2021 reflect baseline conditions prior to treatments. Cornell Soil Health Lab provided the quantitative Comprehensive Assessment of Soil Health (CASH) and bulk density data. Annual field operations data, including machinery, inputs, input costs, and yield, were provided by the farmers in the cover crop years (2021-2025) and used alongside published machinery costs and crop prices to estimate average annual per-acre net income by treatment. See Technical Note1 for methodology details.

Trial Expectations

We anticipated triticale harvested for forage (Green Chop) would provide the larger economic benefit, but that it might mean slower soil health improvements compared to leaving the full cover crop in the field (Herbicide).

Previous research indicates that soil health benefits tend to take longer than five years to accrue, even for first time adopters of cover crops who start with degraded soil and are making a significant change in management. With the trial field’s previous management including long-time use of cover crops, manure, and reduced tillage, it was anticipated that any measurable soil health changes in this demonstration would be small, if even detectable.

Without a replicated design, observed differences cannot be confidently attributed to the effect of the treatment as opposed to field variability or other factors. Replicated trials allow for more confident analysis, however, can be difficult to implement on a commercial operation.

SOIL HEALTH CHANGES

Due to this demonstration trial not being a replicated research design, **the analyses below are for general comparisons only** and should not be used to draw formal conclusions about what caused any identified differences. See Technical Note1 for methodology details.

In-Field Soil Health Assessment (IFSHA)

There was not a substantial difference in IFSHA results between treatments. All four resource concerns (compaction, soil organic habitat loss, soil organic matter depletion, and aggregate instability) were identified for both Herbicide and Green Chop in most years. The exception was that soil organic matter depletion was not identified as a concern in Year 3 for either treatment, or in Year 4 for Herbicide. The variation in resource concerns identified may be due to treatment effects, variability of the qualitative assessment, or differences in environmental conditions when the assessments were made.

Comprehensive Assessment of Soil Health (CASH) Report

The CASH report analyzes 12 indicators (four physical, four biological, and four chemical indicators, listed below) and provides indicator-specific and overall soil health scores (0–100, 100 being best).

While there were differences between treatments for the biological indicators over the course of the project, these differences were consistent throughout the project, including during baseline evaluations before treatment implementations, indicating these were inherent differences between the field sections and not differences due to treatment effects (see Figure 2). There were no differences between treatments for any other indicators. This could be due to the long-time use of cover crops on the field prior to the trial, the small difference between treatments (a cover crop was grown on both treatments), or the relatively short time period in which this trial was conducted.

“I was hoping to see dramatic changes in organic matter from leaving the triticale behind. It was hip high—there was a significant amount of residue there. But by corn silage harvest, both sides of the field looked similar because the triticale residue broke down really well. I think more years would have been good. In my opinion, five years is not a lot of time to see soil changes.” **—ETHAN ARSENAULT**

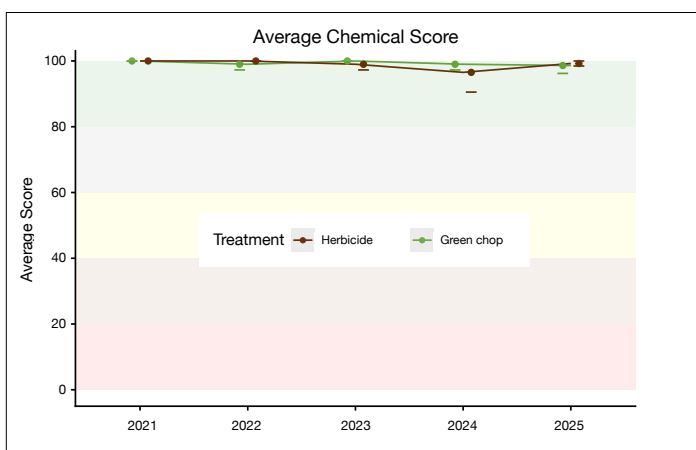
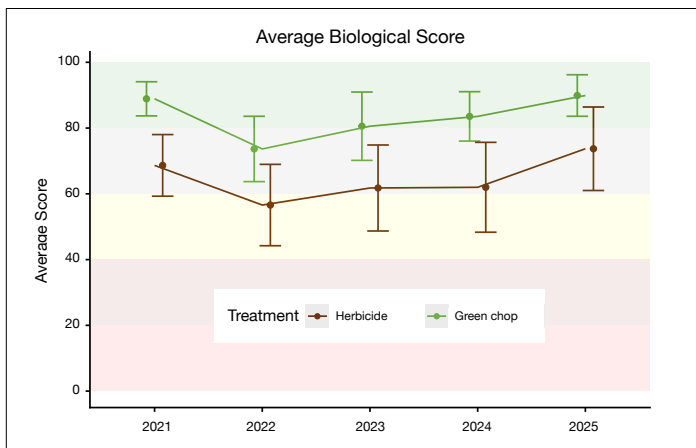
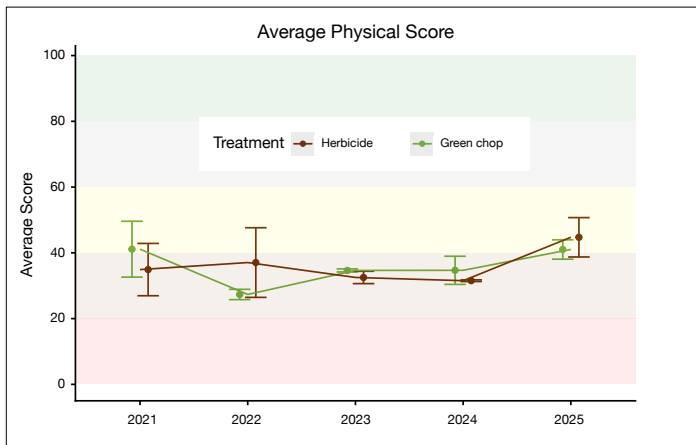


Overall Soil Health Score

The overall score (average of all 12 indicators) remained in **high** range for all five years. High overall scores indicate the soil is functioning relatively well compared to farms with soils

FIGURE 2: AVERAGE PHYSICAL, BIOLOGICAL, AND CHEMICAL SOIL HEALTH SCORES BASED ON CASH REPORT.

To represent sample variation within each field section, errors bars are present to indicate one standard deviation. Red = very low, Orange = low, Yellow = medium, Light green = high, Dark green = very high.



of similar texture, but there are still constraints that could be improved with management.

Physical Soil Indicators

The average scores for the physical indicators (predicted water holding capacity, aggregate stability, surface hardness, and subsurface hardness) scored in the **low to medium** ranges (Figure 2). A medium score indicates a need for improvement with a risk of soil constraints. A low score indicates that soil processes are functioning poorly and should be addressed.

There were no differences between treatments for the four indicators and bulk density.

Biological Soil Indicators

The average scores for the biological indicators (organic matter, ACE soil protein index, soil respiration, and organic carbon) remained in the **high to very high** ranges for Green Chop from the baseline year onward, and **medium to high** for Herbicide (Figure 2). Green Chop had higher ACE soil protein, soil respiration, and active C scores than Herbicide, however the differences were due to inherent field differences, not differences due to treatments, as the rate of change over time was similar for both treatments.

Chemical Soil Indicators

The four chemical indicators (phosphorus (P), pH, potassium (K), and minor elements) consistently scored **very high** (optimal range) during the course of the project (Figure 2), except the P scores for Green Chop which scored very low due to excessive P. The P scores for Herbicide were higher than those for Green Chop, but this difference was present in the baseline scores and did not change over time. None of the other scores were different between treatments.

ECONOMIC CHANGES

We calculated per-acre cover crop costs, value of production (crop yield times crop price), and net income (value of production minus all machinery and input costs) by crop year with the intention to analyze the effect of the treatments on annual economic outcomes (costs versus benefits). No statistical comparisons were made for economic calculations due to the side-by-side, non-replicated trial design. See Technical Note¹ for methodology details.

Cover Crop Costs

Three of the four years, Green Chop held a lower overall cover crop cost than Herbicide (Figure 3).

Cover crop planting machinery and seed costs were the same between treatments within each year, but there was variation between years (Figure 3). Planting machinery ranged from \$18/ac to \$40/ac, depending on the custom hire rate each year. Cover crop seed costs ranged from \$37/ac to \$47.16/ac due to price fluctuation, using non-GMO seed in Year 1 versus conventional seed in other years, and increasing the seeding rate from 100 lb/ac (Years 1 & 2) to 120 lb/ac (Years 3 & 4).



In the first year of the trial, the total cover crop cost for Green Chop was \$45.40/ac lower than Herbicide; while no herbicide was required to terminate the cover crop for Green Chop, the higher termination machinery (mow and harvest, \$55.60/ac) offset some of that cost savings.

In the second year of the trial, the total cover crop cost for Herbicide was \$26.52/ac lower than Green Chop; this was the only year in which Herbicide held the lower overall cover crop cost. Termination material costs for the Herbicide treatment were lower than the previous year due to using a different herbicide mix and herbicide applicator, and Green Chop harvest costs were higher due to using different harvest machinery.

In the final two years of the trial, Green Chop had \$22-\$23/ac lower total cover costs compared to Herbicide. The total cover crop cost for Herbicide was higher in these years compared to the first two years of the trial, due to variation in custom hire costs and herbicide mix.

“We saw a very clear economic benefit to harvesting the triticale, a lot more value per acre coming out of that area of the field than leaving it in the field. Land is really tight, so it’s hard to ignore that economic benefit.” —**ETHAN ARSENAULT**

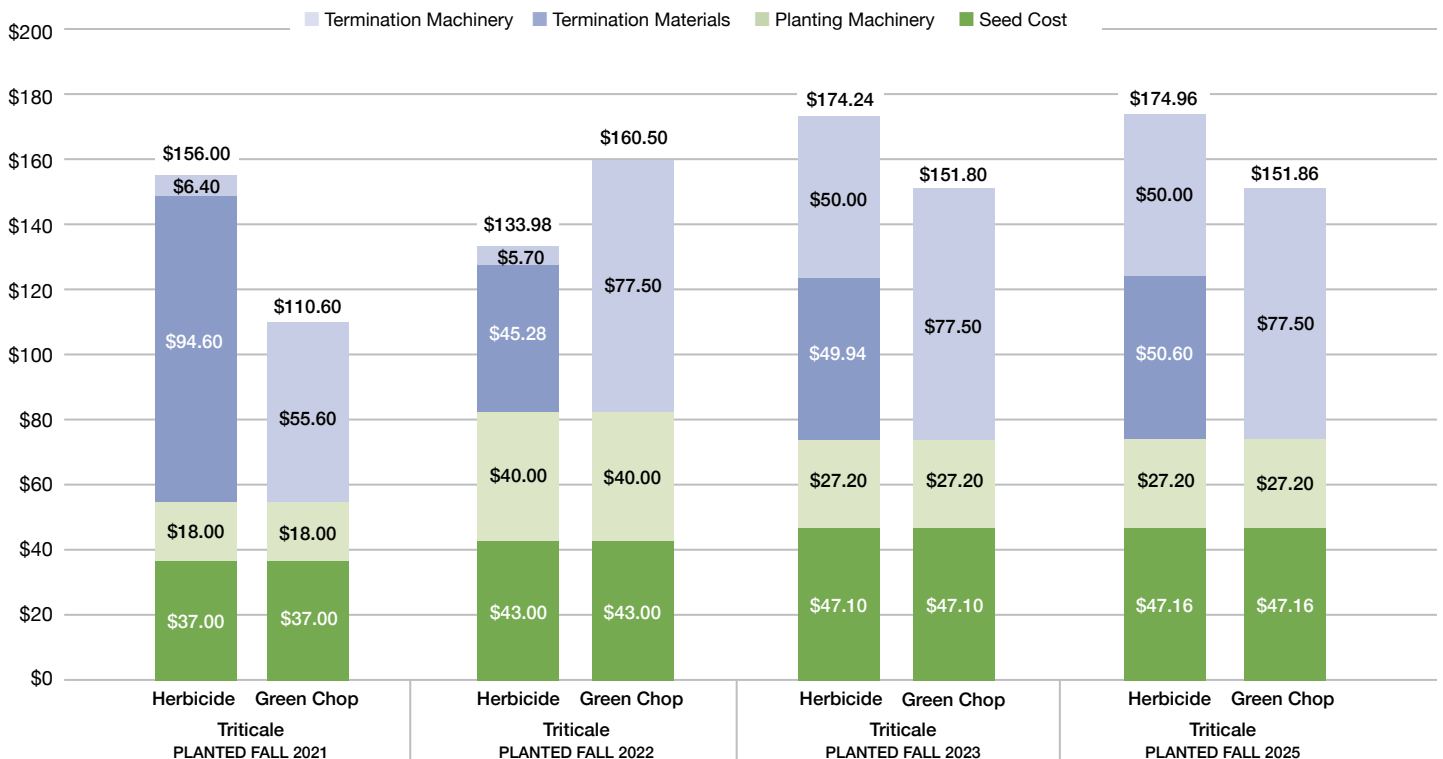
Net Income

Net income (value of production minus costs) differed between years and treatments due to slight variations in corn silage yields, revenue from the green chop, and differences in the cover crop costs. Since the final year did not include the planting of a cash crop, net income was not calculated. Due to the change in farm management that occurred in 2022, corn silage yield data was not collected for each treatment in fall 2022, but instead yield data was averaged across the entire field.

Green Chop held a higher net income than Herbicide throughout the trial due to the additional value of harvesting winter triticale for forage (Figure 4). Over the trial period, the green chop yield was 16, 3.6, and 3.4 tons/ac, driving the difference in net income between treatments each year. When asked about the large difference in triticale green chop yield between years, Ethan couldn’t identify a cause. He’s noticed over the years, however, that triticale yields fluctuate more than yields for alfalfa or grass.

Additionally, there were small differences between treatments for corn silage yield. In 2022, as mentioned above, yield data was not collected by treatment, however Ethan did not notice a major difference. In 2023, Herbicide corn silage yield (24.47 tons/ac) was slightly lower than Green Chop corn silage yield (25.06 tons/ac). In 2024, Herbicide corn silage yield (25.7 tons/ac) was slightly higher than Green Chop

FIGURE 3: COVER CROP COSTS BY TREATMENT AND CROP YEAR. While herbicide (termination material) is not included for Green Chop as a cover crop cost, herbicide was applied later in the season to suppress weeds which made the total herbicide cost between treatments either identical or very similar.





“Triticale is a very variable crop. Year one, the yield was high, but the second and third year it was just average. Alfalfa and grass are pretty consistent, but triticale is more variable.” **—ETHAN ARSENAULT**

yield (24.3 tons/ac). Replicated plot data would be needed to assess outcomes for corn silage yield driven by cover crop treatments.

While Figure 3 showed termination materials (herbicide) only for the Herbicide treatment, herbicide was also used in the Green Chop treatment later in the year, after green chop harvest. Because of this, total herbicide costs between treatments were either identical or very similar, depending on the year.

FIGURE 4: DIFFERENCE IN NET INCOME (\$/AC) OF GREEN CHOP COMPARED TO HERBICIDE BY CROP YEAR. Average net income of the Herbicide treatment for the three crop years in this graph is \$595/ac, \$765/ac, & \$817/ac, respectively. Positive values indicate Green Chop had a higher net income than Herbicide.



CONCLUSIONS

With a few years of data to reflect on, Ethan is convinced that harvesting green chop from cover crops is a practice that works well for his farm’s bottom line while providing soil health benefits.

One of the biggest surprises Ethan observed during the trial was that the corn silage yields were so similar between the two treatments. In the Herbicide treatment, the corn silage was planted into standing triticale that was hip-high. He noted it was hard to even see the corn plants when they were coming up, as there was so much triticale residue. Though he feared this would have a negative impact on the yields, he was pleasantly surprised that the corn seemed resilient. Despite this, the economic benefit of harvesting the green chop proved to be the winner for Ethan.

Momentum is increasing in the region to experiment with triticale as a winter cover crop harvested as a double crop for feed, and Ethan enjoys sharing his learnings with others. Talking to neighbors, he says not everyone is interested in leaving behind their favorite long-season corn variety in order to add a cover crop. However, one neighbor did try planting triticale recently after talking to Ethan about seeding rates. Ethan happily reported his neighbor’s triticale stand was looking great, noting “I want everyone to do well.”

“If you’re tight on land base, don’t be afraid to harvest your cover crop. It’s very valuable.”

—ETHAN ARSENAULT

NOTES

1 For more information about the methods used for these analyses, see the Technical Note at <https://farmlandinfo.org/publications/cover-crop-demonstration-trial-case-studies>.

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