

# Cushman Farms, CT

## COVER CROP DEMONSTRATION TRIAL CASE STUDY

2021-2025



### TRIAL TREATMENTS

Treatment	Description
<b>Herbicide + Tillage</b>	Cover crop terminated with herbicide & tillage
<b>Green Chop + No-Till</b>	Cover crop harvested as green chop and fully terminated with herbicide; no-till cash crop
<b>Roller Crimper + No-Till</b>	Cover crop terminated with roller crimper; no-till cash crop

### DEMO FARM OVERVIEW



Roller crimping on the Roller Crimper + No-Till treatment. June 2023.

CARO ROSZELL

<b>County</b>	New London, CT
<b>Watershed</b>	Thames
<b>Crops in Trial</b>	Corn silage
<b>Cover Crops in Trial</b>	Triticale & 3-species mix <sup>1</sup>
<b>Farm Size</b>	2,300 acres (21-acre study area) with about 1,800 milking cows
<b>Soils</b>	Fine sandy loam, 3-8% slopes
<b>Annual Precipitation</b>	47 inches
<b>Elevation</b>	390 feet

### TRIAL GOAL

To evaluate the impact of cover crop termination methods (tillage, green chop harvest, and roller crimper) on soil function and farm profitability. Cushman Farms has consistently used cover crops for decades. Jim Smith (co-owner and -operator) wanted to compare a new cover crop management practice (roller crimping) to both his current practice (green chop) and a practice they no longer use (tillage) to get the full picture of the costs and benefits.

### KEY TAKEAWAYS

- Increasingly extreme and erratic weather presented major **challenges to timely field operations**, impacting cover crop planting.
- Roller crimping can successfully suppress weeds without the need for herbicide, but it is very challenging to get the timing right.** Roller crimping was successful in one of the two years it was attempted, though even then, Jim Smith (co-owner and -operator of Cushman Farms) thinks the crimped residue was tying up nitrogen needed by the cash crop.
- Harvesting the cover crop as green chop led to a higher net income** compared to the other termination strategies. It provided the farm with a local feed source, reducing costly off-farm purchases.
- Despite removal of biomass from the Green Chop treatment, **soil health outcomes were very similar between all three treatments**; however, more years of data and a replicated trial design are needed to be confident in this result.
- In June 2023, Cushman Farms hosted a field day** with American Farmland Trust (AFT) and University of Massachusetts (UMass), which was planned to coincide with roller crimping timing so the attendees could see the equipment in action. Twelve people attended, including farmers, ag service providers, and graduate students. Jim Smith explained his approach to soil health management, his observations about the trial so far, and he demonstrated the use of the roller crimper. Artie Siller of UMass provided comments on relevant research on roller crimping and harvesting cover crop for feed.



Left to right: Julie Fine (AFT), Artie Siller (UMass), Caro Roszell (AFT), and Jim Smith (co-owner and -operator of Cushman Farms).

**INTRODUCTION**

Cushman Farms is a sixth-generation dairy operation owned and managed by the Smith and Cushman families. They are members of the Farmer’s Cow, a cooperative of six Connecticut family-owned farms, and the Cabot Creamery Cooperative. The farm encompasses 2,300 acres where they actively farm about 1,100 acres of corn silage and grass for feed and hay, while also caring for about 1,800 milking cows that produce around 14,000 gallons of milk per day.

Cushman Farms has consistently used cover crops for at least sixty years. Jim Smith has childhood memories of planting rye after corn silage every year. In Jim’s view, cover crops offer significant benefits, such as protecting the soil from erosion, reducing compaction, and building soil organic matter.

Decades ago, the farm planted its rye cover crop by broadcast seeding from their silage chopper or occasionally using a helicopter. When the farm started using a self-propelled silage chopper that couldn’t accommodate a broadcast spinner on the front, they adopted a different broadcast method, but weren’t satisfied with the results. In the past few years, Cushman Farms has transitioned to be almost entirely no-till, so now they use a no-till drill to plant cover crops.

While rye remains one of the farm’s primary cover crops, Jim started experimenting a few years ago with a cover crop mix of triticale, crimson clover, and radish. This mix protects the soil over the winter, and then in the spring, it can be harvested as **green chop**, a nutritious feed for their cows. Today, the farm harvests almost 600 acres of triticale cover crop mix each year.

Cushman Farms partnered with AFT in 2021 to start a five-year on-farm soil health demonstration trial exploring different cover crop termination strategies. Jim is motivated to try new practices to determine the best way to protect the soil while improving cash crop yield and/or cutting costs. Jim had never used a roller crimper before this trial, but was open to trying it. A **roller crimper** is an implement that crimps and pushes over the stalks of cover crops, leaving them as a dense mat on the soil’s surface that can protect the soil and minimize weeds in a no-till system. This trial included this new system and their current practice of harvesting green chop, both of which can be implemented without tillage. These two practices were compared to terminating the cover crop with both tillage and herbicide; while the farm no longer typically uses this practice, it is a common cover crop management practice on other farms.

**FIGURE 1: TRIAL DESIGN MAP**



**TRIAL DESIGN**

The demonstration trial (non-replicated) was established in a 21-acre field divided into three side-by-side sections (Figure 1). The field had previously been in a corn silage and cover crop rotation for many years. Each field section was assigned to one of three treatments:

- **Herbicide + Tillage** (6 acres)—cover crop tilled 2 weeks to 2 months *before* corn planting
- **Green Chop + No-till** (5 acres)—cover crop harvested as green chop about 2 weeks *before* corn planting
- **Roller Crimper + No-till** (10 acres)—cover crop terminated with a roller crimper a few days *after* corn planting

Corn silage was the cash crop each year, while the cover crop was either triticale or a 3-species mix of annual ryegrass, oilseed radish, and crimson clover (Table 1). An herbicide pass was used about one week after planting corn in all treatments every year, doubling up as weed control and ensuring cover crop termination. The only exception was that herbicide was not needed after roller crimping in 2023.

**Farming Reality Impacts Trial Plans**

The triticale cover crop was not successfully established in 2021 due to several factors. Extreme wet conditions that fall

**TABLE 1: CASH CROP AND COVER CROP ROTATION.**

	2021	2022	2023	2024	2025
<b>Herbicide + Tillage</b>	Corn Silage	Triticale (failed)	Corn Silage	3-Species Mix	Corn Silage
<b>Roller Crimper + No-till</b>	Corn Silage	Triticale (failed)	Corn Silage	3-Species Mix	Corn Silage
<b>Green Chop + No-till</b>	Corn Silage	Triticale (failed)	Corn Silage	3-Species Mix (harvested)	Corn Silage
<b>Year</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>

“We’ll definitely continue green chop, but I’m not sure we’ll go back to the roller crimper. A lot of it has to do with the number of acres we have to cover. If we were to try roller crimping again, we’d need to set up a planter with the roller crimper on the front to be able to roll and plant in one pass.” —**JIM SMITH**

delayed corn harvest. This pushed cover crop planting back to mid-October, limiting growth prior to winter. Manure digestate was applied a few days after seeding and again in the spring; the manure mats seemed to further suppress cover crop emergence, especially with a cold spring. Because of that, in spring 2022 there was insufficient cover crop to terminate.

Roller crimping was successful in spring 2023, with all cover crop termination occurring in May 2023. However in spring 2024, unusually warm weather led to early corn emergence, preventing the use of the roller crimper to terminate the cover crop, as corn was planted prior to roller crimping.

In spring 2025, all treatments were harvested as green chop, as the trial was ending.

**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 farmer 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 Note<sup>2</sup> for methodology details.

**Trial Expectations**

It was expected that Green Chop + No-Till would provide the largest economic benefit in the trial, as green chop is valuable animal feed. At the same time, removing this cover crop biomass from the field was expected to reduce the cover crop’s soil benefits. It was expected that the roller crimper treatment would provide the most soil benefits by keeping the full cover crop residue in place without disturbing the soil with tillage.

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. In Jim’s case, with only a few years for individual cover crop treatments on a field that had previously been in cover crops, large changes in soil health were not anticipated. Additionally, since cover crops were used in all three treatments, the potential difference between the treatments was not very large.

Without a replicated design, observed differences cannot be 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 the 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 Note<sup>2</sup> for methodology details.

**In-Field Soil Health Assessment (IFSHA)**

While there was not a consistent trend in the resource concerns identified by the IFSHA, there were slightly fewer overall resource concerns identified for Herbicide + Tillage and Green Chop + No-Till compared to the Roller Crimper + No-Till (Table 2). The variation in resource concerns identified may be due to treatment effects (the difference in cover crop termination impacting the resource concerns), or due to subjective variability in the assessment.

**TABLE 2: RESOURCE CONCERNS IDENTIFIED BY THE IN-FIELD SOIL HEALTH ASSESSMENT.** Numbers one through five indicate the year of the trial (1=2021, 2=2022, etc.). Red indicates the resource concern was identified in the given year; blue indicates the resource concern was **not** identified in the given year.

Resource Concerns	Herbicide + Tillage					Green Chop + No-Till					Roller Crimper + No-Till					
	Year	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Compaction																
Soil Organism Habitat Loss																
Soil Organic Matter Depletion																
Aggregate Instability																

**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).

**There was no difference between treatments for any of the indicators in any year.** This could be due to the lack of major management differences between treatments, and due to the short timeframe of the project, as small changes in management can take over five years to create major changes in soil health.

**Overall Soil Health Score**

The overall score remained in the **high** range for all five years, likely because of Jim’s long-time use of cover crops. High overall scores indicate the soil is functioning relatively well



JIM SMITH

*Left side of frame: Roller Crimper + No-Till treatment; corn looks pale and stunted. Right side of frame: Green Chop + No-Till treatment; corn is dark green, taller and more lush. July 7, 2023.*

“The tillage stirs up the weed seeds so they germinate quickly. When we mowed the green chop and left the stubble right there, that seemed to really suppress the weeds. The roller crimper also suppresses weeds; however, it requires more nitrogen to break down that extra rye residue. Our corn didn’t do as good in that roller crimper plot, and that is probably why.” —JIM SMITH

compared to farms with soils of similar texture, but there are still constraints that could be improved with management. While improvements in management could further improve soil functionality, the trial’s length was not adequate for roller crimping or no-till to improve the overall score over Jim’s status quo management.

**Physical Soil Indicators**

The overall scores for the physical indicators (predicted water holding capacity, aggregate stability, surface hardness, and subsurface hardness) were mainly in the **medium** range. A medium score indicates a need for improvement with a risk of soil constraints. Soil processes are functioning inadequately, and addressing this should be considered in the field management plan. **The four indicators and bulk density were not different between treatments in any year.**

**Biological Soil Indicators**

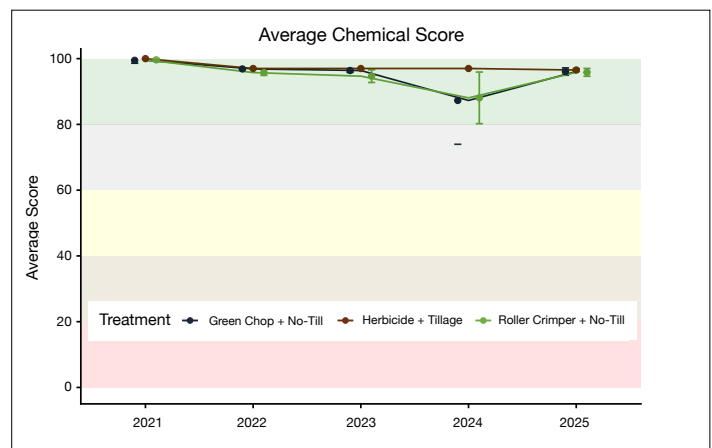
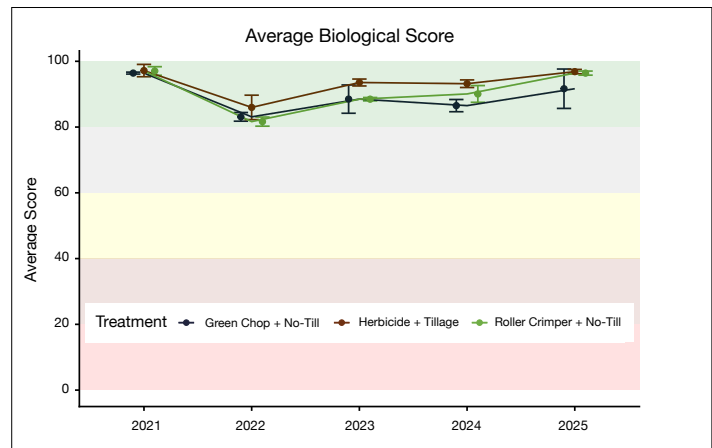
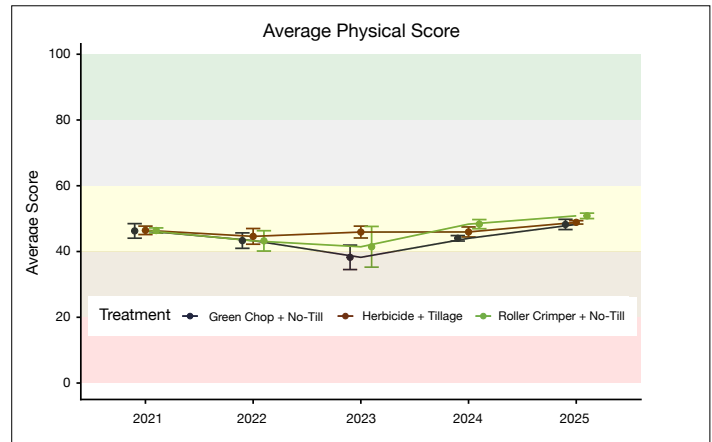
The overall scores for the biological indicators (organic matter, ACE soil protein index, soil respiration, and active carbon) remained in the **very high** range for all treatments, indicating very well-functioning soils. **The biological indicators were not different between treatments in any year.**

**Chemical Soil Indicators**

The overall scores for the chemical indicators (phosphorus, pH, potassium, and minor elements) remained in the **very high** range for all treatments, indicating very well-functioning soils. **Three of the four indicators were not different between treatments in any year.** Soil pH scores were lower in spring 2024 for Green Chop + No-Till and Roller Crimper +

**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.



“One of my “aha” moments in this trial was that the earlier I get the rye cover crop planted the better. It gets a lot more established. Especially with the rainfall patterns we have now, we’re getting inches of rain in an hour instead of the smaller storms we are historically used to.” —JIM SMITH

No-Till compared to Herbicide + Tillage but then returned to no difference in spring 2025.

**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 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, and limited data for successful treatment implementation. See Technical Note<sup>2</sup> for methodology details.

Overall, **Green Chop + No-Till had the highest cover crop cost** due to the additional cost of harvesting the green chop. However, **Green Chop + No-Till also had the highest net income** due to the value of that forage.

**Cover Crop Costs**

Cover crop seed costs and seeding rates (100 lbs./ac/yr) were consistent across the treatments each year, but there were small differences in planting costs and larger differences in termination costs (Figure 3). **Green Chop + No-Till had the highest overall cost** due to the green chop harvest equipment. The other two treatments' costs were very similar, within \$5 to \$8 of each other.

**In the first year of the trial**, the triticale cover crop was planted with a 20' broadcast seeder (\$9.10/ac) but did not establish well, resulting in a failed cover crop stand which did not have to be terminated.

**The following year**, the 3-species mix<sup>1</sup> was planted using a 20' broadcast seeder (\$9.10/ac) after a harrow pass (\$9.75/ac) on Herbicide + Tillage and a 40' no-till drill (\$27.20/ac) on the other two treatments. For termination the following spring, Herbicide + Tillage used one tillage pass and one herbicide pass, while the Green Chop + No-Till used one herbicide pass after the green chop was harvested. Roller Crimper + No-Till did not use any herbicide, with the only termination cost coming from the 12' roller crimper (\$6/ac). This was the only successful roller crimping year, and it showed that roller crimping can result in lower cover crop costs compared to other termination strategies.

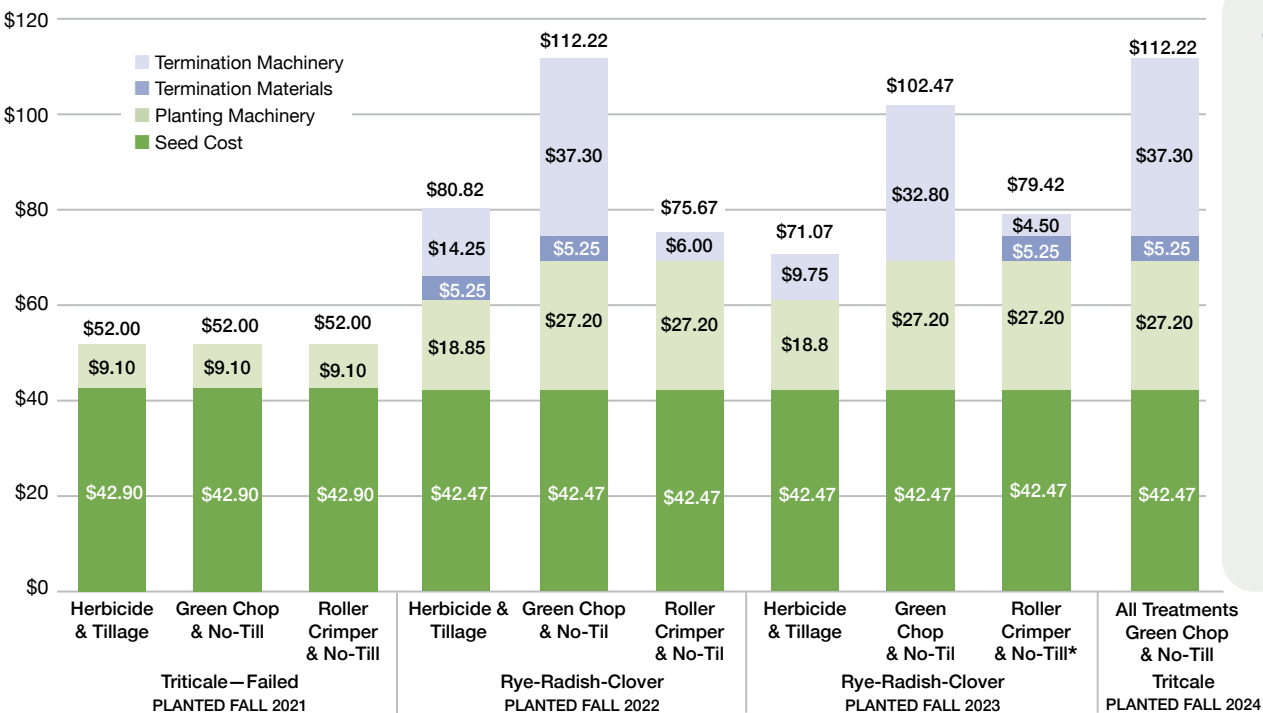
**In the third year**, planting costs were identical to the previous year, and termination costs were slightly lower. The roller crimper could not be used in the Roller Crimper + No-Till treatment due to the corn emerging prior to crimping, so herbicide was used instead (\* in Figure 3).

**The final cover crop** was triticale planted in fall 2024 with a no-till drill. Since this was the end of the study, Jim terminated the entire field by harvesting green chop, followed by a pre-plant herbicide, resulting in \$112/ac total cover crop cost for all treatments.

**Net Income**

Net income (value of production minus costs) differed between years and treatments (Figure 4). Since a cash crop was not planted after the final cover crop, net income was not calculated for that final crop year (2024–2025). Corn silage yields were reported to be the same per treatment each year, so we do not present the cash crop yield results; however, they are included in the net income calculation.

**FIGURE 3: COVER CROP COSTS BY TREATMENT AND SPECIES**



“I liked the green chop treatment the best. It definitely provides extra feed—a couple tons to the acre. We have to travel so far to get feed, 26 miles one way. Anything that we can harvest locally is a huge financial benefit.”  
—JIM SMITH



**The first crop year (2021-2022)** experienced challenges as the triticale cover crop did not establish. The only difference between treatments was a tillage pass (\$9.75/ac) for Herbicide + Tillage, resulting in the other two treatments having higher net incomes by that amount (Figure 4).

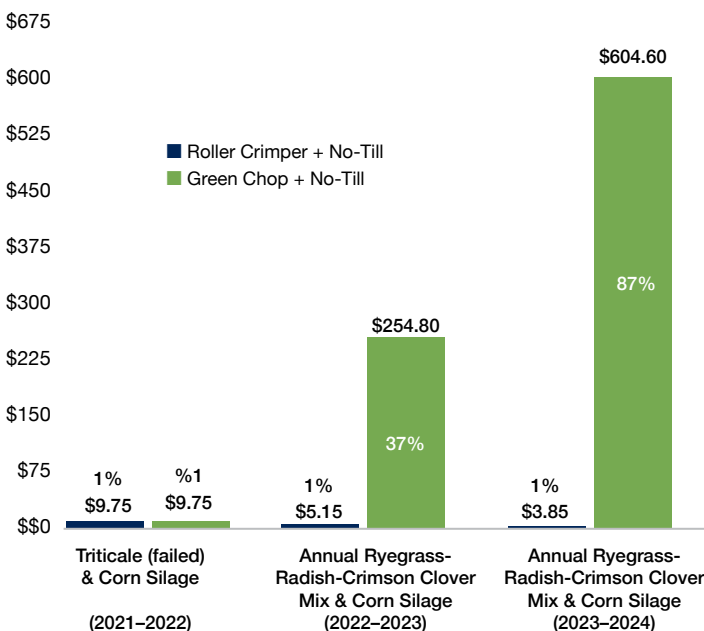
**In the second crop year,** Green Chop + No-Till held the highest net income. Though cover crop costs for this treatment were \$31.40 higher than Herbicide + Tillage, the 4.5 tons/ac of forage (\$286.20/ac) vastly outweighed the costs. The net income for Roller Crimper + No-Till was only \$5.15 higher (1%) than Herbicide + Tillage, due to the lower cover crop costs (Figure 3).

**The third crop year (2023-2024)** reflected the same trend as the previous year. Green Chop + No-Till held the highest net income, as the 10 tons/ac of additional forage (\$636/ac) again far outweighed the \$31.40 higher cover crop costs. The unusually warm spring weather might have been why the forage yield was much higher this year than the previous, and it also led to the failed roller crimp due to early corn emergence.

## CONCLUSIONS

This trial illustrated both the economic potential and practical challenges of integrating cover crops into a dairy system. Jim Smith started this trial to compare three types of cover crop termination techniques, and according to the economic analysis, there was a clear winner. Green chopping (harvesting the cover crop biomass for feed) showed the

**FIGURE 4: DIFFERENCE IN NET INCOME (\$/AC) OF ROLLER CRIMPER + NO-TILL AND GREEN CHOP + NO-TILL COMPARED TO HERBICIDE + TILLAGE BY CROP YEAR.** Average net income of Herbicide + Tillage each year was \$700.77/ac, \$691.45/ac, & \$691.45/ac, respectively. Positive values indicate higher net income than Herbicide + Tillage.



“I think this trial just cemented the ideas that cover crops are a great thing to do. It’s given me a clearer picture of the benefits of harvesting cover crops and using no-till. It just makes a lot of sense to do what we’re doing.” **—JIM SMITH**

highest net income as it provided the farm with a local, highly nutritious source of feed. At the same time, the soil health lab analysis showed similar results across all treatments, despite this removal of biomass from one treatment, but this demonstration trial was not replicated, so we cannot draw conclusions about soil health benefits of roller crimping over harvesting the cover crop.

The successful use of a roller crimper was often prevented by weather challenges which have become a growing concern for all farmers. Although the crimping was effective in killing the cover crop and suppressing weeds in one season, Jim suspected nitrogen was tied up due to the high amount of carbon biomass, which is a common issue that requires proper management for those who are regularly planting green. Looking back at the treatment terminated with tillage and herbicide, Jim noted that tillage turned up weed seeds, making that treatment weedier than the others.

As part of this farm trial, Jim hosted an on-farm field day focused on cover crop use. In his opinion, the benefit of peer learning is that it spurs interesting conversations, generating ideas and curiosity to try new things.

The trial helped affirm Jim’s positive attitudes towards cover crops. He plans to keep using green chop as an economical way of incorporating cover crops across Cushman Farms. Going forward, he wants to further hone ways to plant cover crops as early as possible to ensure good growth and is considering seeding pre-harvest. One thing is for certain: Jim and his partners at Cushman Farms will continue to refine their use of cover crops, as they are fully committed to soil health on their farm.

“Building soil health is economical in the long run.” **—JIM SMITH**

## NOTES

- 1 3-species mix was a blend of annual ryegrass, crimson clover, and oilseed radish
- 2 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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