Bullseye Farms, CA

COVER CROP DEMONSTRATION TRIAL CASE STUDY

2022–2025

TRIAL TREATMENTS

Treatment	Description
No Cover Crop	No cover crop planted
Cover Crop	3-species cover crop mix of bell beans, winter pea, & vetch; mow & till termination

DEMO FARM OVERVIEW

Cover crop termination with Wilcox Eliminator, April 2024.

PAUL LUM, AFT

County	Yolo, CA
Watershed	Lower Sacramento
Crops in Trial	Tomato, cucumber
Cover Crops in Trial	3-species mix (bell bean, winter pea, common vetch)
Trial Size	56 acres
Soils	Sandy loam & silt loam and relatively flat
Annual Precipitation	20 inches

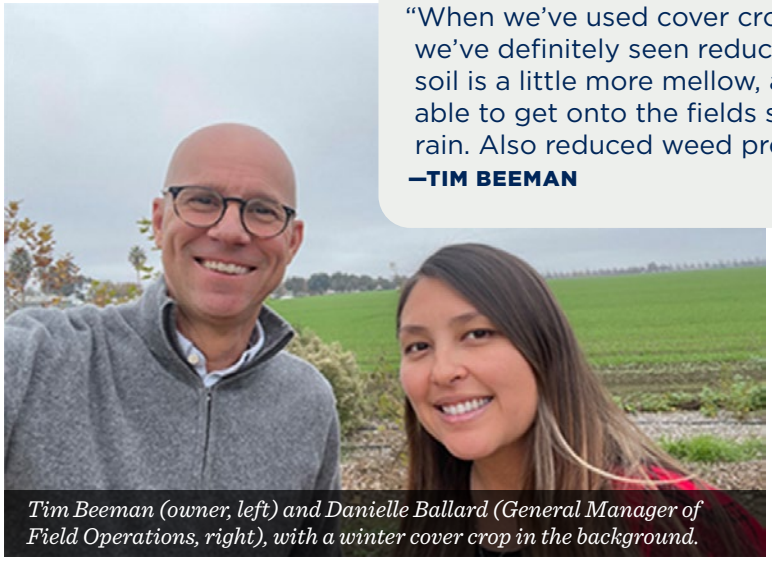
TRIAL GOAL

To learn whether winter cover crops improve soil function (structure, water holding capacity, and soil organic matter) and farm profitability. Tim Beeman has been integrating cover crops in his orchards and row crops for several years but was interested in a side-by-side comparison of cover crops versus no cover crops in a row crop field that had never been cover cropped.

KEY TAKEAWAYS

- In this trial, there were only **two crop years** in which a cash crop followed the cover crop.
- **The Cover Crop field had a higher overall soil health score, soil pH score, and active carbon score** compared to No Cover Crop. Due to the side-by-side trial design, differences cannot be confidently attributed to the addition of cover crops.
- **Cover crop costs** were almost identical all three years a cover crop was planted.
- **Net income** was higher for Cover Crop the year tomatoes were planted, due to a 10% higher yield. Net income was higher for No Cover Crop the year cucumbers were planted.
- While they didn't see cover crops give a consistent economic benefit or widespread measurable soil health changes within the short trial, **Bullseye Farms is committed to planting cover crops going forward,** as they know these changes take time.
- **A demonstration field day** was held at the trial site in 2024 to share the benefits of cover crops and of the trial design with farmers and agricultural professionals. Two growers out of the 43 attendees planted cover crops the following year as a result of the learnings from the field day.

"When we've used cover crops in the past, we've definitely seen reduced runoff. The soil is a little more mellow, and we're able to get onto the fields sooner after rain. Also reduced weed pressure."
—TIM BEEMAN



Tim Beeman (owner, left) and Danielle Ballard (General Manager of Field Operations, right), with a winter cover crop in the background.

TIM BEEMAN

American Farmland Trust

PAUL LUM, AFT

No Cover Crop on left, Cover Crop on right. *March 2024, prior to cover crop termination. Note the soil crusting and cracking on left—signs of poor soil aggregation that can be addressed by cover cropping.*

Tim Beeman is a fourth-generation farmer and owner of Bullseye Farms, located 20 miles north of Sacramento, California. Their General Manager of Field Operations, Danielle Ballard, has worked on the farm for the last five years, managing various field operations including cover crop planting.

Established in the early 1900s, this family farm produces tree crops such as almonds, walnuts, and pistachios, along with multiple row crops like processing tomatoes, sunflowers, cucumbers, corn, alfalfa, and wheat. Processing tomatoes are one of the higher value crops and are occasionally planted in consecutive years.

Over the last ten years, Bullseye Farms has regularly used cover crops in their in their walnut, pistachio, and almond orchards. The cover crops help suppress weeds, reduce cracking in heavy clay soils, and allow earlier field access after a rain event.

After a few years of using cover crops in their orchards, they began integrating cover crops into their row crop rotations when possible. While the quick crop rotation and the need for spring tillage combined with unpredictable weather make cover cropping more challenging in row crops, Tim and his team have seen some encouraging benefits, such as less water runoff. They've learned they prefer not to plant grain cover crops in their row crop fields, as it's hard to work their thick root ball into the soil in the spring. Over the last several years, they've planted as many as 2,000 acres in cover crops per year, but the number varies widely based on fall rain and field accessibility.

Cover crops aren't the only soil health practice used on Bullseye Farms. Most years, compost is applied to a portion of their orchard and row crop fields, with the number of acres covered depending on the compost price. They also have used reduced tillage since about the year 2000, which works in concert with their buried permanent drip irrigation system. The farm recently purchased new tillage equipment (20'-wide Wilcox Eliminator implement) which allows for fewer tractor passes. This implement disks in the cover crop and other residue and smooths the surface with rollers to prepare the soil for planting in the spring. It is a one-pass implement that replaces the standard disc-plow implement which required two or three passes and went much deeper into the soil.

Bullseye Farms collaborates with the University of California on research trials and hosts field demonstrations, as they expand regenerative practice adoption across the farm. **In this project with AFT, they were excited to compare a newly cover cropped field to a control without cover crops**, to identify what benefits can be measured when cover crops are initially adopted.

TRIAL DESIGN

The original farm trial had been designed to start in 2021, but heavy rains prevented the planting of cover crops that fall, so the trial began with cover crop planting in fall 2022. The 56-acre field chosen for this trial had never been cover cropped before and had never received an application of compost. Before starting this trial, this field produced a tomato crop in 2021 and a sunflower crop in 2022, though the sunflowers were terminated early due to a buyer contract cancellation.

The demonstration trial (non-replicated) consisted of two side-by-side plots, one containing the Cover Crop treatment (35 acres), and the other the No Cover Crop control (21 acres) (Figure 1). An irrigation pipeline created the boundary between the two plots. The Cover Crop field had a winter cover crop mix of bell beans (45%), winter pea (35%), and common vetch (20%) planted in October or November with a

FIGURE 1: TRIAL DESIGN MAP

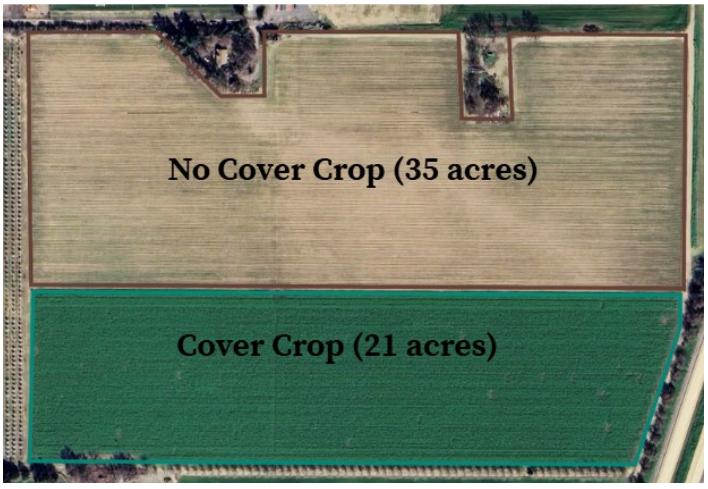


TABLE 1: CASH CROP AND COVER CROP ROTATION. The same 3-species cover crop mix was planted each year. White space indicates no living crop or cover crop in the field. Sunflower crop in 2022 was terminated early.

No Cover Crop	Sunflowers				Tomatoes				Cucumber			
Cover Crop	Sunflowers		Cover crop mix		Tomatoes		Cover crop mix		Cucumber		Cover crop mix	
Year	**2022**			**2023**				**2024**				**2025**

> "Unless you plant a control, you don't know if it's doing anything. We should do that in more of our fields. We normally do when testing other practices, but with the cover crops, we never had before this trial."**—TIM BEEMAN**

no-till drill. The cover crop was then terminated with tillage in early spring before the annual cash crop was planted (Table 1).

Data Collection

Soil samples were collected in the fall and spring each year, starting in fall 2022 and ending in spring 2025, where fall 2022 reflects pre-treatment, baseline conditions. Soil samples were taken from the portion of both fields with the same soil type. Soil health indicators were analyzed with the qualitative observation-based NRCS In-Field Soil Health Assessment (IFSHA) and the quantitative Comprehensive Assessment of Soil Health (CASH) in addition to bulk density by the Cornell Soil Health Lab. Annual field operations data (i.e., machinery, inputs, input costs, yield) were provided by Beeman in the cover crop years (2022–2025) and used alongside published machinery costs and crop prices to estimate average annual per acre net income by treatment. See Technical Note[1] for methodology details.

Trial expectations

In general, cover crops gradually lead to improved soil health, which can bring about higher net income. However, previous research indicates that soil health benefits tend to take longer than five years to accrue. Additionally, we recognized that seed for cover crop mixes can be more expensive than other options, reducing likelihood of economic benefits outweighing the costs.

With only two crop years in which a cash crop followed a cover crop, it was anticipated that any measurable soil health or economic changes in this trial would be small, if even detectable. Without being 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 but 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[1] for methodology details.

In-Field Soil Health Assessment (IFSHA)

IFSHA results from spring sampling were used for the analysis. Both Cover Crop and No Cover Crop fields

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Cover crop field day, March 2024. Winter cover crop in the background.

consistently had all four resource concerns (compaction, soil organic habitat loss, soil organic matter depletion, and aggregate instability) identified by the IFSHA, so both fields have opportunity for significant soil health improvements. There was **no difference in the two treatments**.

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 individual and an overall soil health score (0-100, 100 being best).

Over the course of the project, there was a **difference in overall scores** between Cover Crops and No Cover Crops, as well as **differences in active carbon and soil pH**.

"I think it's important to remember that soil changes don't happen overnight. You can't really make that the expectation in your mind when you go into a project like this." **—DANIELLE BALLARD**

Overall Soil Health Score

The overall scores for both treatments remained in the **medium** category all four years (Figure 2), indicating a need for improvement. **The overall soil health score for Cover Crop noticeably improved over time and was higher than No Cover Crop**.

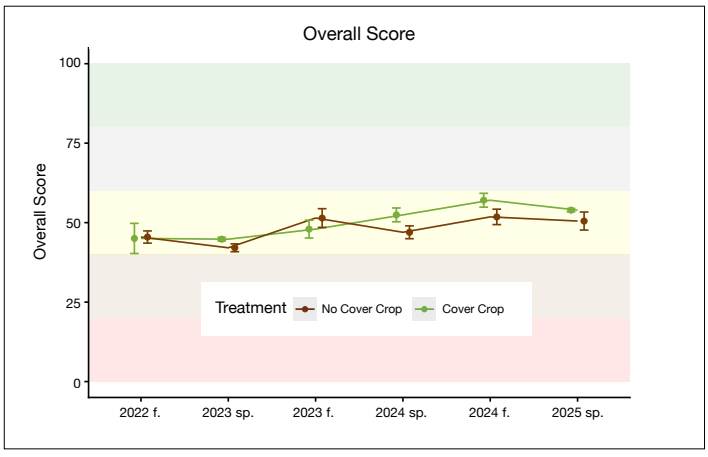
Physical Soil Indicators

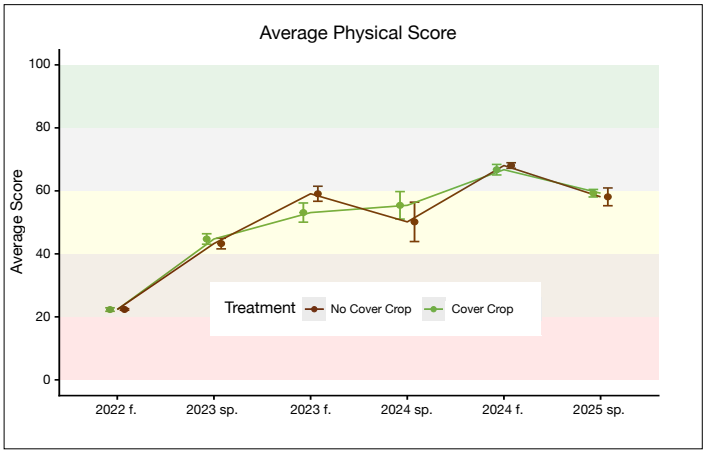
The average scores for the physical indicators (predicted water holding capacity, aggregate stability, surface hardness, and subsurface hardness) increased over the course of the project from **low to medium** (Figure 2). This increase was mainly driven by an increase in subsurface hardness scores, which may have been affected by the timing of soil sampling and tillage. There were **no differences between treatments for the four indicators and bulk density**.

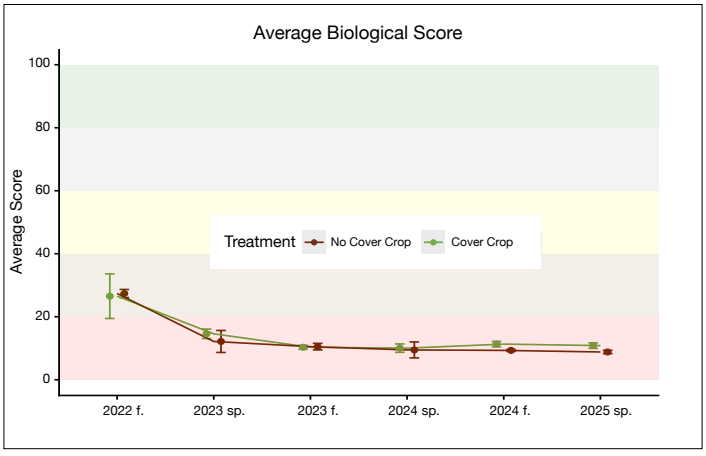
Biological Soil Indicators

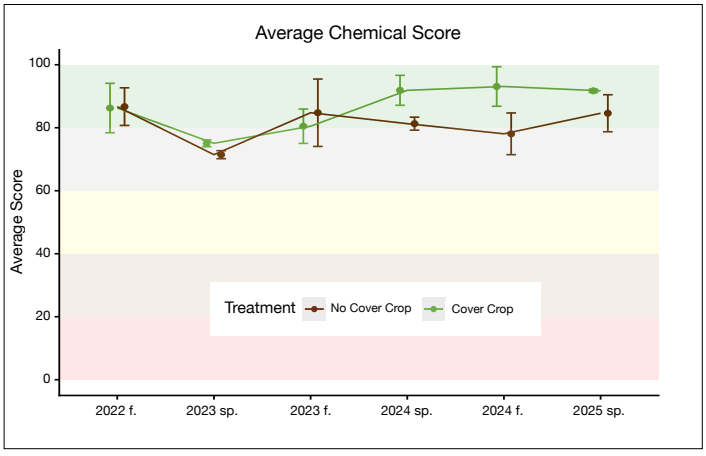
The average scores for the biological indicators (organic matter, ACE soil protein index, soil respiration, and active carbon) decreased from **low to very low** for both fields over the course of the project (Figure 2). While **active carbon scores were higher for Cover Crop than No Cover Crop**

FIGURE 2: AVERAGE OVERALL, 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.









after the first year, both fields' scores remained in the **very low** range. There were no differences between treatments for the other biological indicators.

Chemical Soil Indicators

The average scores for the chemical indicators (phosphorus, potassium, pH, and minor elements) fluctuated between **high and very high**. This finding is common for CASH analyses, since the assessment and management of soil chemical constraints is well-researched, standard practice on farms, and relatively easy to manage compared to other soil health indicators.

Cover Crop scores for chemical indicators were higher than those for No Cover Crop, driven mainly by **soil pH scores increasing for Cover Crop during the course of the project.** The lower pH scores are due to the soils being consistently basic (7.45–8.16). The increase in pH score could be due to the use of leguminous cover crops, which can acidify soils.

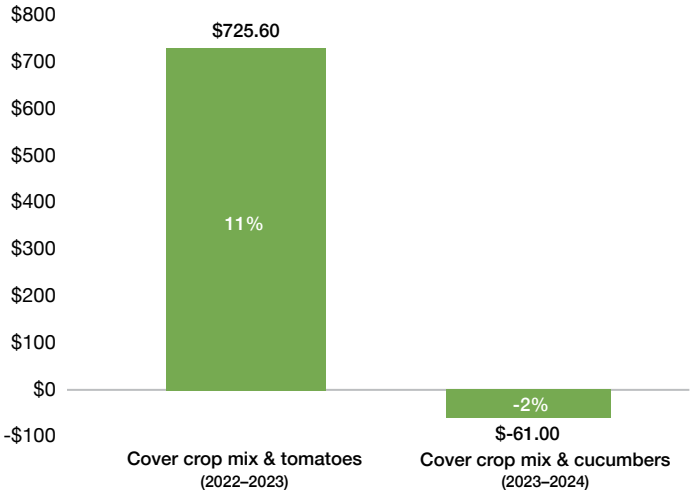
ECONOMIC CHANGES

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) to analyze the effect of the treatment on annual economic outcomes (costs versus benefits). No statistical comparisons were made for economic calculations due to lack of comparable data. See Technical Note[1] for methodological details.

FIGURE 3: COVER CROP COSTS BY TRIAL YEAR. Cover crop termination (tillage) was not an added expense compared to No Cover Crop, as the same tillage passes were used in both treatments to prepare the beds for planting the cash crop.

> "The one year with the increased tomato yield, I mean that made it worthwhile. If cover crops gave a consistent yield increase like that every year, that would make them a no brainer." **—TIM BEEMAN**

FIGURE 4: DIFFERENCE IN NET INCOME ($/AC) OF COVER CROP COMPARED TO NO COVER CROP BY CROP YEAR. The average estimated net income of No Cover Crop each year was $6,374/ac and $2,514/ac, respectively. Positive values indicate Cover Crop had a higher net income; negative values indicate Cover Crop had a lower net income.



Overall, the cost of cover cropping was consistent across the three cover crop cycles in this trial. Net income, though, was not consistent, as the **Cover Crop treatment had a higher net income one year and lower net income the other year** due to an increased yield for tomatoes but not for cucumbers. With only two full crop years of data collected, we were only able to calculate net income for two crop years.

Cover Crop costs

Each year on the Cover Crop field, a cover crop mix of bell beans, peas, and vetch was planted at 60lbs/acre ($45.60/ac) using a grain drill ($15.40/ac), then terminated mechanically using a Performer ($22/ac), as shown in Figure 3. This adds up to a baseline cover crop cost of $83/ac., the high cost being driven by the higher cost of a cover crop mix versus a single species cover crop.

In fall 2022, cover crop planting operations cost an additional $3/ac compared to subsequent years due to an extra machinery pass (20′ bed roller) used for cover crop seed bed preparation. In the second and third years of the trial, the total cover crop cost was the baseline $83/ac.

Net income

Net income (value of production minus costs) differed due to variation in the cash crop grown between years, and the yields and cover crop costs between treatments.

The first year of the trial included a tomato cash crop. Cover Crop held the higher net income at $7,100/ac, which was $725.60/ac (11%) higher than No Cover Crop (Figure 4). The difference was mainly due to higher tomato yields with Cover Crop yielding 67 tons/ac, 6 tons/ac higher than No Cover Crop. Since tomatoes are such a high value crop, this 10% increase in yield resulted in a large increase in revenue, covering the cover crop costs.

Cover crop termination (tillage) was not an added expense when comparing the two treatments, as the same tillage pass with the Wilcox Eliminator was used for No Cover Crop to kill weeds and prepare the beds for planting the cash crop. The Wilcox Eliminator is a large and expensive piece of equipment, and not necessary when only weeds are growing (less biomass than a cover crop). However in this trial, it was used on both treatments for logistical ease instead of relying on only herbicide for weed control in the No Cover Crop treatment.

In the second year of the trial, the cash crop was cucumbers. Cover Crop had a lower net income at $2,453/acre, which was $61/acre (2%) lower than No Cover Crop. The treatments held the same cucumber yield, so the difference is attributed to the cover crop seed and planting costs. This year again, cover crop termination (tillage) was not an added expense.

Overall, more years of economic data are needed with a diverse crop rotation such as this to confidently state the economic impact of cover crops.

CONCLUSION

Tim and Danielle knew going into this trial they might not see substantial soil health changes in just a few years, even with adding cover crops to a field that had never been cover cropped before. But for them, it's the long game—they know cover crops are beneficial over time.

They're so committed to their cover crop journey that they hosted a field day in spring 2024 to highlight the cover crop trial. The 43 attendees (farmers and agricultural professionals) engaged with each other and speakers, including some from University of California. As a result of the learnings from the field day, two growers planted cover crops the following year.

We asked Tim and Danielle to share what advice they would give to a producer interested in trying cover crops for the first time. Tim said, "I would start simple with peas, beans, and vetch. Keep a grain out of there because the grain has a really thick root ball right at the soil level. It's a lot of work in the spring to try and work that into the ground—it'll be disheartening."

Danielle agreed, adding "Start small. Don't go out and decide you're going to cover crop every acre your first year. Just start on a small scale and see how it works."

> "As a farmer, it feels good to be growing a crop year round as opposed to fallow beds or weeds. In your heart, you know you're doing the right thing."
> **—TIM BEEMAN**

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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