Pleasure View Farm, KY

COVER CROP DEMONSTRATION TRIAL CASE STUDY

2021–2025

TRIAL TREATMENTS

Treatment	Description
Occasional Cover Crop	Small grain cover crop after soybeans
Yearly Cover Crop	Cover crop (small grain or diverse mix) planted every year

DEMO FARM OVERVIEW

Healthy soil at Pleasure View Farm in the Yearly Cover Crop field during the 2022 In-Field Soil Health Assessment. Healthy growing roots, earthworms, and biopores are visible.

SCOTT FRANKLIN

County	Henry, KY
Watershed	Headwaters Drennon Creek
Crops in Trial	Corn & soybeans
Cover Crops in Trial	Cereal rye & 3-species mix[1]
Farm Size	3,800 acres (27-acre trial)
Soils	Silt loam soils with 2-12% slopes
Annual Precipitation	51 inches
Elevation	899 feet

TRIAL GOAL

To evaluate the effects of yearly cover crop management on farm profitability and soil function, in particular, increasing organic matter and water holding capacity, and decreasing compaction. After using cover crops intermittently for about a decade, Mark Roberts (owner of Pleasure View Farm) wanted to explore the idea of using cover crops more consistently and introducing cover crop mixes.

KEY TAKEAWAYS

- **This trial confirmed for Mark Roberts that cover crops are beneficial** for his farm by protecting the soil from erosion and by increasing organic matter. Rather than continuing to use cover crops occasionally, the trial convinced Mark to plant them every year.
- **There were fewer overall resource concerns for the Yearly Cover Crop treatment** identified by the In-Field Soil Health Assessment. However, due to the trial not being a replicated research design, differences cannot be confidently attributed to the increase in cover crop frequency. There were no other differences in soil sample results between treatments.
- **Occasional Cover Crop consistently held the highest net income.** Differences in net income between the treatments were mostly due to additional cover crop costs as well as slight variations in cash crop yield.
- **Mark found that learning from the experiences of other farmers conducting cover crop trials was very beneficial**, providing inspiration, ideas, and the certainty that cover crops can be successfully integrated into his farming practice.

> "I wanted to see if cover crops really paid. I've always liked cover crops, wanted to use them heavily…but this trial let me know that they do work."
> **— MARK ROBERTS**

Mark Roberts at a field day hosted on his farm in September 2024.

KENDRA FARRIS PHOTOGRAPHY

American Farmland Trust

Mark Roberts owns and operates Pleasure View Farm with his father, Willis Roberts, in Pleasureville, Kentucky. Willis purchased the home farm in the early 1960s and has been expanding operations ever since. The Roberts family grows row crops on 3,800 acres—primarily corn and soybeans, as well as other crops like tobacco, hemp, and sorghum.

Mark has planted small-grain cover crops, such as rye and wheat, intermittently since 2012 to curb erosion and improve soil water-holding capacity. He has found that the weather after corn harvest often blocks timely cover crop planting, so he typically only plants cover crops after soybeans. He plants cover crops in the fall and terminates them early in the spring before planting corn.

Advancing his commitment to soil health practices, in 2023, Mark completed the transition from moldboard plow and disking to a combination of vertical tillage and no-till. Vertical tillage is used shallowly (1–2 inches deep) two out of three years to manage surface compaction and residue. Nutrients are applied annually and, since 2018, by variable rate on one-third-acre grids to place fertilizer only where it's needed most.

In recent years, Kentucky farmers have expressed increased interest in learning more about cover crop adoption on row-crops to increase cash crop resiliency, increase soil organic matter, improve weed suppression, and more; Mark is no exception. While he already plants a wheat or rye cover crop after soybeans, Mark wanted to know if he could do more to prevent soil degradation. As a result, Mark partnered with American Farmland Trust (AFT) in 2021 to start a five-year trial to compare small-grain covers only after soybeans (Occasional Cover Crop) to a consistent and, if possible, more diverse cover crop mix every year after both corn and soybeans (Yearly Cover Crop). Mark's trial was part of a larger on-farm soil health demonstration trial network.

The project aimed to evaluate whether consistent cover crop use could reduce erosion, aggregate fine-textured soils, and increase infiltration, drainage, and water-holding capacity in a corn-soybean system. It also aimed to determine if planting a multi-species cover crop mix after soybeans could accelerate alleviating compaction and building soil organic matter, and whether these soil health changes could ultimately positively impact the farm's bottom line.

TRIAL DESIGN

Mark Roberts and AFT established the demonstration (non-replicated) trial using two side-by-side fields (Figure 1). Roberts purchased these fields in 2011; prior to that, the fields had been hayed. From 2011 to 2021, both fields were in row crop rotations with periodic use of cover crops.

> "I wanted to go to a multi-species cover crop. I have found out we need good weather, enough rain, and we need to plant this stuff very early."

FIGURE 1: TRIAL DESIGN MAP

The farm's usual approach—a corn-soybeans rotation with cereal rye cover crop only after soybeans—was implemented on a 9-acre field. The newer approach—a cover crop after each cash crop (small grain after corn and a diverse mix, if possible, after soybeans)—was implemented on the adjacent 18-acre field. The trial started with soybean planting in 2021, and both treatments followed the same cash crop rotation (Table 1). Both fields had cover crops terminated with herbicide ahead of cash crop planting and shared the same nutrient and tillage programs.

Farming Reality Impacts Trial Plans

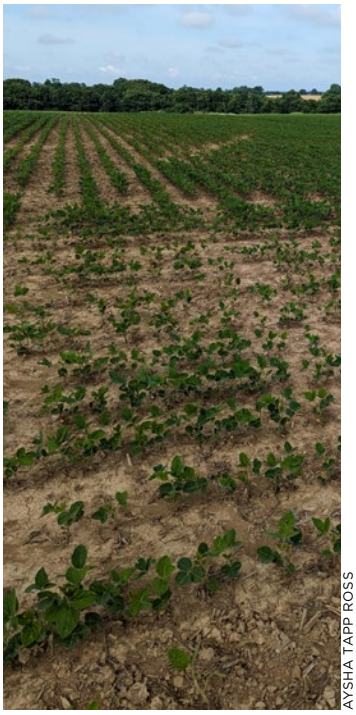
Despite a consistent core design, real-world factors introduced several adaptations. Due to a delay in trial implementation, Roberts adjusted the plan and seeded cereal rye (instead of a cover crop mix) after soybeans in December 2021 to ensure cover crop growth that late in the season (Table 1). In fall 2023, Mark planted a cover crop after corn in the Occasional Cover Crop field in error; the cover crop was terminated 47 days after planting to correct the error. This adaptive approach reflects the challenges and value of farmer-led research in dynamic agricultural systems.

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)

TABLE 1: CASH CROP AND COVER CROP ROTATION. Trial treatments began in 2021 with soybean planting; fall 2020 to spring 2021 is included for historical context. The 3-species mix included crimson clover, annual ryegrass, and oilseed radish.

Yearly Cover Crop		Soybeans	Cereal Rye	Corn	Cereal Rye	Corn	Cereal Rye	Soybeans		3-Species Mix
Occasional Cover Crop	Cereal Rye	Soybeans	Fallow	Corn	Fallow	Corn	Fallow	Soybeans		Cereal Rye
Year	**2020**	**2021**		**2022**		**2023**		**2024**		**2025**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KENDRA FARRIS PHOTOGRAPHY

Left: Soybean cash crop following rye cover crop on the Yearly Cover Crop field, May 2024. Right: Participants of the September 2024 field day watch as KY Soil Scientist, Scott Aldridge, walk the audience through performing an In-Field Soil Health Assessment. Soybeans were harvested 5 days prior.

and used alongside published machinery costs and crop prices to estimate average annual per-acre net income by treatment. See Technical Note[2] for methodology details.

Trial Expectations

We anticipated that the more frequent cover crop use in the Yearly Cover Crop treatment would gradually lead to improved soil health, and that a diverse cover crop mix containing legumes could reduce fertilizer costs and increase yield. However, 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 Mark's case, with only four years of yearly cover cropping in a field that had previous occasional cover crop use, it was anticipated that any measurable soil health or economic changes in this trial 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 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[2] for methodology details.

In-Field Soil Health Assessment (IFSHA)

While there was not a consistent trend in the resource concerns identified by the IFSHA (compaction, soil organism habitat loss, soil organic matter depletion, and aggregate instability), the **Yearly Cover Crop field had fewer overall resource concerns identified compared to the Occasional Cover Crop field** throughout the trial.

Occasional Cover Crop had two to four resource concerns identified each year, whereas Yearly Cover Crop had two years in which no resource concerns were identified (Table 3). Of note, Occasional Cover Crop had soil organism habitat loss and aggregate instability resource concerns every year, while Yearly Cover Crop did not. Differences between treatments may be due to treatment effects (consistent use of cover crops reducing resource concerns) or due to subjectivity in the assessment and field variability.

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 substantial difference between treatments for any of the indicators in any year, suggesting that any differences that may result from the slight short-term increase in cover crop frequency are not measurable. This could be due to Mark's previous occasional use of cover crops and his conversion to low-tillage on both fields during the course of the project.

Overall Soil Health Score

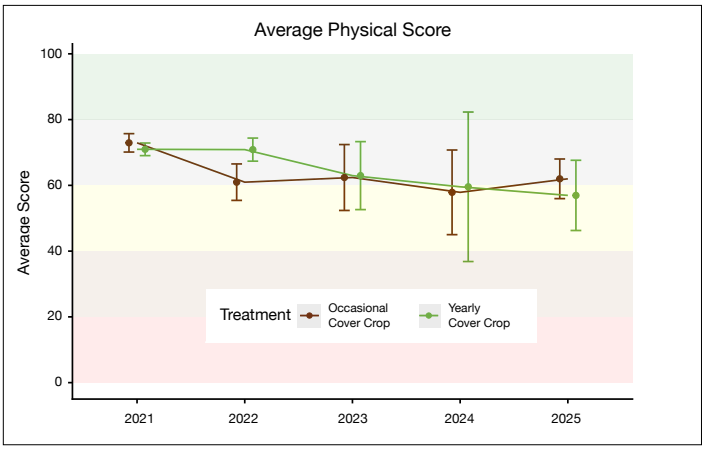
The overall soil health scores were in **medium to high** categories for all five years. Medium scores indicate that yields and sustainability of farming may be constrained and could further decline over time if soil health is not addressed through management practices. High overall scores indicate the soil is functioning relatively well compared to farms with soils of similar texture, but there are still some constraints and opportunities for further improvement through better management.

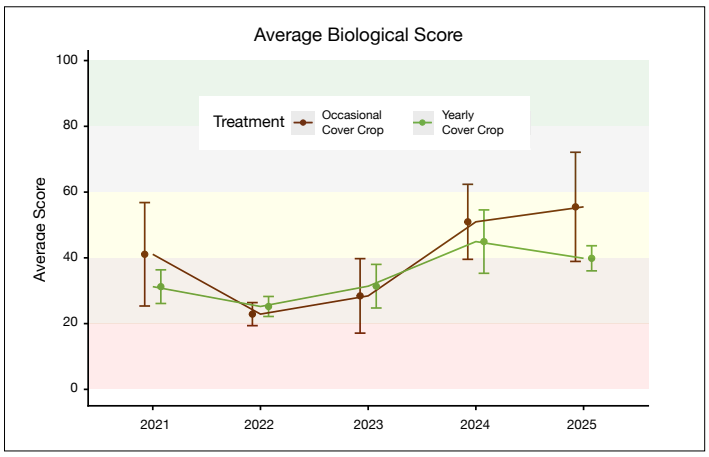
TABLE 3: RESOURCE CONCERNS IDENTIFIED BY THE IN-FIELD SOIL HEALTH ASSESSMENT. Numbers one through five indicate the year of the trial (1=2021, 2=2022, etc.). Red indicates the resource concern was *present* in the given year, blue indicates the resource concern was *not present* in the given year.

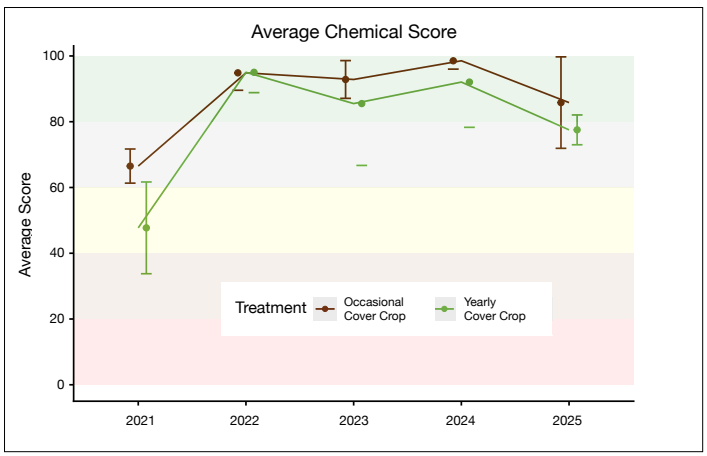
Resource Concerns	Occasional Cover Crop					Yearly Cover Crop				
Year	*1*	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*
Compaction										
Soil Organism Habitat Loss										
Soil Organic Matter Depletion										
Aggregate Instability										

"It's hard to move the needle very much in five years on organic matter, and that's really what we're after. So, I'd like to continue using cover crops."

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







Physical Soil Indicators

The average scores for the physical indicators (predicted water holding capacity, aggregate stability, surface hardness, and subsurface hardness) consistently scored in the **high** range, except in 2025 when Yearly Cover Crop scored in the upper medium range (Figure 2). A high score indicates high-functioning soils from a physical standpoint. **The four individual indicators and bulk density were not different between treatments in any year.**

Biological Soil Indicators

The average scores for the biological indicators (organic matter, ACE soil protein index, soil respiration, and organic carbon) increased from the **low** to **medium** range for both treatments from 2021 to 2025 (Figure 2). From 2022 to 2024, both fields experienced an increase in the overall biological soil indicators score (driven by increases in organic matter and ACE soil protein index scores), which could possibly be attributed to the switch to reduced tillage in 2023. **The four individual biological indicators were not different between treatments in any year.**

Chemical Soil Indicators

The average scores for chemical indicators (phosphorus (P), pH, potassium (K), and minor elements) ranged from **medium to very high** categories (Figure 2), with P increasing from medium to very high and K increasing from high to very high for both fields over time. Minor elements showed a deficiency in Mg in both fields and Zn in the Yearly Cover crop field in Year 1 that was remedied by Year 2. **The four indicators were not different between treatments in any year.**

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 treatments on annual economic outcomes (costs versus benefits). No statistical comparisons were made for economic calculations, specifically differences in yield, due to the demonstration trial not being a replicated research design. See Technical Note[2] for methodology details.

Year-to-year differences in cover crop costs were due to slight variations in seed, planting machinery, and termination machinery costs, and large variations in termination materials (Figure 3). Each year, **Yearly Cover Crops had a lower net income** than Occasional Cover Crops (Figure 4), primarily due to the additional cost of cover crops (Figure 4). Every year, cash crop **yields between the two fields were very similar** (within 2-4 bu/ac) (Figure 5).

Cover crop costs

Cereal rye seed cost per pound differed slightly year to year, while seeding rate remained constant (100 lbs/ac). In 2024, a 3-way cover crop mix was planted on the Yearly Cover Crop field; the radish (2.85 lbs/ac), ryegrass (4.64 lbs/ac), and crimson clover (7.5 lbs/ac) mix cost less than the cereal rye seed due to the much lower seeding rate.

"How do you put a return value on that soil and say, yes, it costs me $30 to put the cover crop out there, and I got $30 back? We can't. There's no way to do that. But when you see the soil, you see it not washing, you see then the test that the organic matter is going up, that's it right there."

Cover crop planting costs varied year to year, and in 2024 they differed between treatments (Figure 3). After the first year, in which cereal rye was planted with a 10-ft no-till drill ($35.90/ac), Mark changed to using a broadcast seeder and vertical tillage ($21.90/ac) in 2022 and 2023. In 2024, Mark went back to the no-till drill just to plant the cover crop 3-way mix to accommodate the radish seed.

Termination costs decreased over time with farmer adaptations. For cereal rye termination, Mark used a 90-ft sprayer ($6.40/ac), except for the final year when he used a 120-ft sprayer ($4.50/ac). The glyphosate mix was slightly different each of the first three years, resulting in a difference in termination material costs. Mark applied less and cheaper herbicide in the final year than in previous years, resulting in a much lower termination material cost that year.

Note that in the first three years, the same herbicide machinery operations and material inputs implemented on the Yearly Cover Crop field for cover crop termination were also implemented on the Occasional Cover Crop field for general weed suppression so they are not an additional cost of cover cropping for Mark; this is accounted for in the net income section below.

FIGURE 3: COVER CROP COSTS ON YEARLY AND OCCASIONAL COVER CROP FIELDS BY CROP YEAR. Occasional Cover Crop only had a cover crop planted in 2024. Cereal rye seeding rate was 100 lbs/ac, whereas it was only 17 lbs/ac for the 3-species mix. Cover crop termination materials and machinery shown in this graph were not added expenses for cover crop management; the same passes were used for weed suppression on the Occasional Cover Crop field even when a cover crop was not grown.

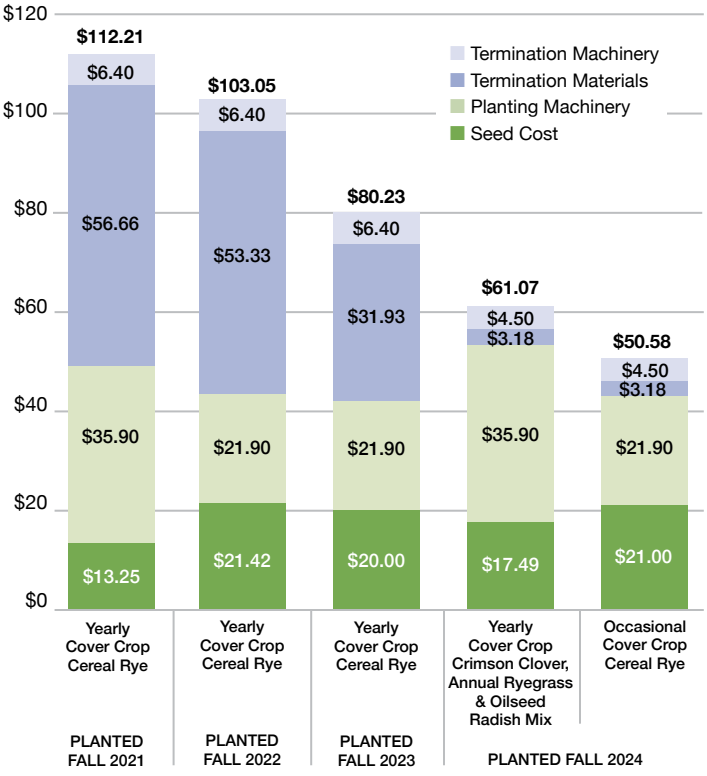
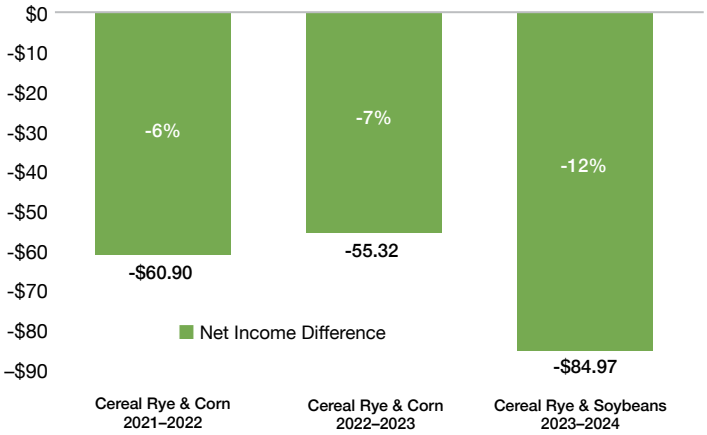


FIGURE 4: DIFFERENCE IN NET INCOME ($/AC) OF YEARLY COVER CROP COMPARED TO OCCASIONAL COVER CROP BY CROP YEAR. The average net income of Occasional Cover Crop each crop year was $947.91/ac, $830.47/ac, & $710.33/ac, respectively. Positive values would indicate Yearly Cover Crop had a higher net income; negative values indicate Yearly Cover Crop had a lower net income.

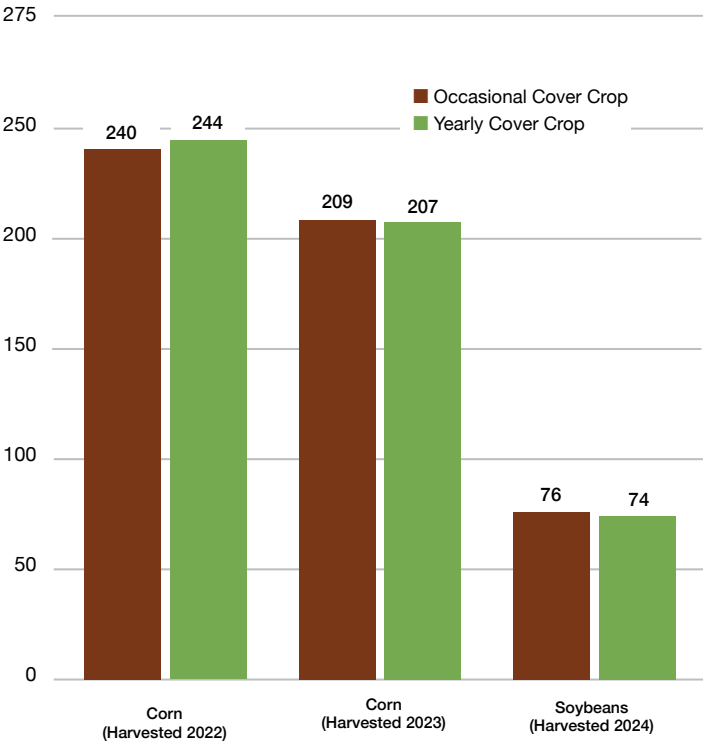


"Cover crop seed cost is a big challenge, especially in the farming climate the way it is right now. It's pretty tight. We know the rye works; it looks good. I agree the mixes would probably help too, but how can we afford it? We can't do it all. So yeah, price is a big factor when it comes to putting more in."

Net income & yield

Net income (value of production minus costs) differed between years and treatments due to differences in cash crop revenue (caused by slight yield variability) and, **primarily, due to cover crop costs. Occasional Cover Crop consistently held the highest net income each year** (Figure 4), **while holding comparable yields to Yearly Cover Crop** (Figure 5). For each crop year with a net income calculation, cereal rye preceded the cash crop for Yearly Cover Crop and there was no cover crop for Occasional Cover Crop. Net income was

FIGURE 5: CORN AND SOYBEAN YIELDS FOR OCCASIONAL COVER CROP AND YEARLY COVER CROP TREATMENTS PER CROP YEAR.



not calculated for the first soybean crop, as the cover crop treatments had not yet been established.

In the 2021-2022 crop year, the cost of cover crop implementation was offset by a 4 bu/ac ($24/ac) higher yield in Yearly Cover Crop compared to Occasional Cover Crop (Figure 5).

The next year, cover crop planting machinery costs were $14 less than the previous year, but cover crop seed cost increased slightly (Figure 3). Yields were 2 bu/ac (-$12/ac) lower for Yearly Cover Crop than Occasional Cover Crop (Figure 5).

In the final year, when soybeans were grown, the difference between treatments was mainly due to Yearly Cover Crop having $41.90/ac cover crop planting costs and 2 bu/ac lower yields ($26.60/ac) compared to Occasional Cover Crop (Figure 5).

CONCLUSIONS

Mark started this trial with a positive attitude towards cover crops that was affirmed over time. He had been using cover crops every other year on most of his farm, following soybeans. The trial provided the opportunity for Mark to see if planting cover crops every year would be worth it.

While he didn't see a difference in the lab tests between the two fields, Mark noticed a difference throughout trial implementation; occasional cover cropping was not enough to prevent soil from being washed away. **These observations, plus the learning and feedback obtained from his farmer peers conducting similar cover crop trials, convinced Mark that cover crops work and that they are needed every year.** With Mark's recent change to reduced tillage, his history of occasional cover crop use, and the relatively short non-replicated trial, it was not surprising that changes in soil health indicators did not differ between treatments.

The economic analysis conducted showed that net income was consistently higher on the Occasional Cover Crop, mostly due to cover crop costs not being covered by yield gains so far. The cost of including legumes in a cover crop mix (in this case, crimson clover) is a barrier for Mark. Despite Mark's positive perception of the benefits of planting a cover crop mix, he finds the per-pound cost is too high; he prefers to stick with what works and is most affordable, a cereal rye cover crop.

Mark's experience was strengthened by the exchanges he had with the other Kentucky farmers participating in this trial network. "The networking means a lot to me, it's really important," Mark said. This peer exchange provided Mark with inspiration and ideas about what is possible for the future of his soil health journey.

> "We tried planting green one time or two and didn't work very well, so I haven't tried it again. But since talking with the group of farmers doing the trial, and hearing them say they did it, then I know it's going to work if I can get my program set right."

NOTES

1 The 3-species mix planted in Yearly Cover Crop in fall 2024 included crimson clover, annual ryegrass, 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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