Regenerating Fallow Fields for Organic Production Using Diverse Cover Crops

By Sarah Larsen

Eric Barnhorst is the owner/operator of Eva Mae Farm, an organic vegetable farm near Brighton, Ontario. In 2019, Eric wanted to scale up his land base to produce more vegetables for his growing markets and had a one-acre field in the perfect location for intensive vegetable production.

"It has sandy, well drained soil that warms up well in the spring with good road and water access", explains Eric. "But the problem was the topsoil was stripped by a previous owner and the organic matter was very low" — too low to grow high quality organic vegetables.

Eric knew one option to regenerate the field was to add tonnes (literally) of mineral amendments to balance the soil, in addition to compost and manure to bring the fertility and organic matter up quickly. This approach, however, would have been so costly that the ideal method to regenerate this field for production weren't clear. "I wanted to find a balance between speed of recovery and cost to implement, and it's a big enough investment that I wanted to have some clear data behind the method I chose", said Eric.

To inform his decision and help other ecological farmers in similar situations, Eric implemented a research trial in cooperation with EFAO's Farmer-Led Research Program. In spring 2020, Eric installed a randomized and replicated trial with five treatments on the one-acre degraded field.

A view of the field where Eric's replicates were laid out. He divided a 1-acre field into 20 30'x30' plots. In each row of 5 plots, he randomly assigned one of 5 treatments. In the fall, the control plots without cover crops died earlier, as seen in the brown rectangles in the photo.

For his control treatment, Eric chose to let the naturalized species grow and to mow them a few times a year (1). He compared this control to a gradient of more intense treatment methods including adding mineral amendments to balance the micronutrients in the soil and letting what was there grow (with periodic mowing) (2); adding mineral amendments, tilling, and seeding to a diverse, full-season mix of cover crops (3); doing the same thing with the amendments and cover crops, and also adding chicken manure (4); and doing the same thing with amendments, cover crops, and chicken manure, and also adding woody compost (5).

Eric had completed previous farmer-led research trials looking at green mulches for garlic and grafting tomatoes, and knew he wanted to set up a trial with a relatively high number of replicates in order to bring confidence to any differences he was measuring and observing. If there was a difference among treatments, he wanted to see it more than once, twice, or even three times — so he chose to replicate each of the five treatments five times.

To start, Eric measured the micronutrient status of the soil to guide his application of mineral amendments and took baseline soil samples to measure active carbon. Active carbon, also known as permanganate oxidizable carbon or POXC, is a sensitive indicator of soil health that measures a pool of labile, or readily usable, carbon that is available for microbes to process organic material. This microbial activity can, in turn, build organic matter. Therefore, greater active carbon levels reflect

The sorghum sudangrass crop was over 8′ fall in woodchip treatments.

greater potential to build soil organic matter and regenerate soil health.

Over the first season in 2020, he observed plant growth (naturalized species in the control and mineral amended plots and cover crops in the other treatments), tracked costs and labour, and took follow-up soil samples for active carbon in the fall and following spring.

In that first year, Eric saw consistent results across replicate plots. While micronutrient amendment alone did not increase active carbon, Eric saw active carbon increase in the other treatments. There did not seem to be an added soil health benefit from adding chicken manure or woody compost with cover crops. The diverse full-season cover crop, it seemed, was doing the bulk of the work towards regeneration.

"When I looked at the soil data, my observations with how the plants were growing, and added up the costs and labour for each treatment, the cover crops seemed to be the main factor driving active carbon. But one year wasn't enough for me to feel confident in this method, so I wanted to track these treatments over a few years to be sure," says Eric.

After conversations with Dr. Ralph Martin and EFAO's research team, Eric decided to continue the trial for two more seasons — while adding complexity to the design.

"Rather than make all of our conclusions based on active carbon, we wanted to see how the treatments affected subsequent crop growth, not just soil health", explains Eric. "So in 2021 we divided the plots in two and planted sorghum sudangrass in half of each plot and re-amended the other half of each plot based on updated soil tests." He acknowledges that "although sorghum sudangrass is a cover crop, we used it as an indicator of potential vegetable crop growth. It has the potential to put on a lot of biomass so we could compare its growth among the treatments."

Throughout the 2021 growing season, Eric measured the aboveground biomass of sorghum sudangrass in the half plots of each treatment and also continued to track active carbon in the plots with the original treatment and no indicator crop.

In spring 2022, Eric removed the half plots that had sorghum sudangrass from the trial and planted them back to a cover crop to prepare for vegetable production in future years; he planted the half plots that received two rounds of amendments to sorghum sudangrass. Like the previous year, he measured aboveground biomass of the indicator crop and took soil samples to measure active carbon.

"When we look at three years of data on active carbon, aboveground biomass of the indicator crop, and my observations of how the cover crop grew, we saw some consistent trends," says Eric. "Overall, this project showed me that planting a diverse full-season cover crop on soil that is mineral-balanced is an effective way to regenerate degraded or 'worn out' sandy soil. If the goal is long term soil health, using cover crops is a no-brainer." He also observed that "diverse full season cover crops maintained soil health on my productive land and helped clean up weeds, especially when used for two consecutive years".

However, when Eric evaluated the cost of each treatment relative to the biomass of indicator crop produced, he found that the intensive treatments with manure and woody compost were

Eric observed a less diverse cover crop of primarily sorghum sudan grass, radish, and oat regrowth in plots with chicken manure.

more cost effective for boosting next-year production than simply using the diverse cover crop mix alone. His choice of method moving forward will depend on the return on investment of the following cash crops.

"I am pleased to have this data to help make decisions on the farm moving forward, but I am also reminded that I can't bootstrap healthy soil in one year", states Eric. Even with gains in active carbon and clear yield benefits as seen in aboveground biomass, production areas in other parts of the farm that have had nutrient balancing and organic amendments over years looked better than the highest input treatment he compared in this project. ■

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Read Eric's full report at:
efao.ca/research-library/

Want to be a farmer-researcher like Eric? Have an idea for a farmer-led research trial that might answer some of your own on-farm questions about cover cropping, soil health, or other management practices? Attend the Farmer-Led Research Symposium online, Nov. 27th, 2023, and then come out to the EFAO Research team's open office hours to chat about your ideas. All are welcome! More info at efao.ca/events.

The deadline to apply for EFAO's Farmer-Led Research program for 2023 is January 14th, 2024. To learn more visit efao.ca/call-for-curiosity-2024.