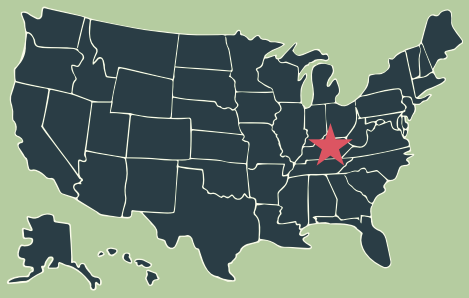
ORGANIC FARMING RESEARCH FOUNDATION

Farmer-Led Trials: Soil Solarization



2024

Farmer-Researcher:
Maggie Dungan
Salad Days Farm
Versailles, KY

ABOUT THE FARM

Maggie Dungan is the owner of Salad Days farm, a diverse vegetable operation situated on 30 acres in Versailles, Kentucky. Certified organic since 2015, the farm grows year round in the field and in high tunnels to supply their on-farm store, restaurants, schools, and four weekly farmers markets.

Maggie works hard to keep mechanization on her farm minimal, keeping only 1-3 acres of the 30-acre farm in production at a given time in order to focus on cover cropping, minimal tillage, and other soil health conservation practices.

Maggie Dungan in one of her high tunnels.

WHAT WAS THE ON FARM TRIAL ABOUT?

As part of her weed management Maggie uses solarization, the application of a clear plastic that heats up the soil and helps control unwanted plants and pathogens. Concerned about the effects of solarization on beneficial soil life, she conducted an on-farm trial to investigate the effect of solarization on microbes in her high tunnels.

This project hoped to answer many questions:

- What effect does solarization have on the beneficial microbes?
- If they go away, how much time does it take for them to come back?
- How does soil solarization affect the soil biological community?
- How long does it take soil microbes to return after applying soil solarization in a high tunnel?

Salad Days Farm high tunnel during the trial. Randomized plots are receiving the solarization treatment

What is solarization?

Solarization is the process of placing a clear plastic tarp over a field or garden bed to heat up the soil underneath. The intention of solarization is to kill weeds or grass, but is also known to reduce pathogen populations in the soil.

Organic farmers who focus on minimizing tillage must still manage pathogens, weeds, and other common challenges, and solarization offers potential benefits.

Maggie hypothesized that the soil microbes would come back , but was unsure of how long they would take to rebound. She also thought that there would be a decrease in soil microbe populations under soil solarization compared to non solarized soil.

However, Maggie was concerned about the impact of the treatment on her soil health, and had some questions - if solarization kills pathogens, won't it kill the good microbiology, too? How does heat smothering with a plastic tarp impact soil microbial activity? What is the impact on fungal to bacterial ratios?

Maggie had previously participated in a study with Rachel Rudolph at University of Kentucky that tested the effects of soil solarization on Sclerotinia and saw good results. Because of this trial, she wanted to learn more about the impacts soil solarization had on her soil microbes.

Maggie's Previous Research:
Effects of High Tunnel Soil Solarization on Sclerotinia sclerotiorum in the Temperate Climate of Central Kentucky

HOW WAS THE TRIAL DONE?

It was important that this trial take place in the high tunnels, since there can be a greater build up of soil pathogens in that environment.

The trial was conducted in a 100'x30' high tunnel. The experiment was arranged as a randomized complete block design with two factors and four replications. Factors were

solarization (tarped and non-tarped) and time (pre-treatment, 2 weeks after tarp removal, and 4 weeks after tarp removal). The fields were marked and measured in May.

Soil samples were taken and tarp was laid on treatment plots in early June. Plastic tarps were removed on July 4th. Soil was sampled again 2 weeks and 4 weeks, respectively after the tarps were removed.

Aerial view of the farm, showing high tunnels where research was conducted.

The patented MicroBIOMETER was used as our measurement instrument to test the presence of microbial biomass and fungal/bacterial ratio in the soil. The soil MicroBIOMETER is a field test that measures microbial biomass for soil, compost, and compost teas/extracts and provides the Fungal to Bacterial Ratio in soils and composts.

Microbial biomass (MB) can be used as a determinant of soil health as levels are indicative of the chemical, biological and structural characteristics of soil that are required for healthy plant growth. The MicroBIOMETER test only measures active and dormant bacteria and fungi, not dead microbes.

The results reported for MB are ug microbial biomass carbon/gram of soil. The results also show as a fungal:bacterial ratio, and the estimated percentage of total fungi and total bacteria.

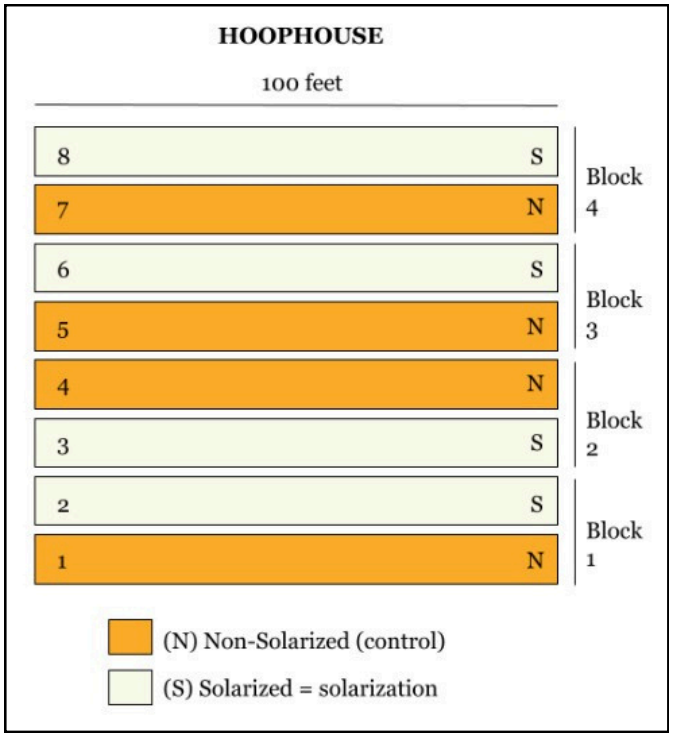


Figure 1. Plot map of the solarization trial at Salad Days Farm.

"The data helped confirm that the practice of solarization was having an impact, and not the one I originally thought it would"

- Maggie Dungan, farmer-researcher

FINDINGS

To evaluate the effect of solarization on soil microbial life, we conducted an analysis of variance (ANOVA) to determine if the treatments had a "statistically significant" effect. The ANOVA calculates the amount of variation that exists between the data points, gives us mean averages, and also tells us the probability (p-value) of the difference being due to chance. A p-value of <0.05 tells us that there is a less than 5% chance that our results are due to random variation, or conversely, allows us to say with reasonable certainty (95%) that the treatment effect is "real".

Table 1. Average soil microbial biomass and fungal to bacterial ratio for solarized and non-solarized plots.

Treatment	Microbial Biomass (ug C/g)	F:B Ratio
Non-solarized (Control)	263	0.442
Solarized	354	0.600
P value	0.001	0.014

Overall, soil microbial biomass was higher under solarization at 354 ug C/g compared to 263 ug C/g for the non-solarized plots, and fungal:bacterial ratio were higher in solarized plots (0.600) vs. non-solarized plots (0.442) (Table 1).

There was a significant solarization by time interaction for microbial biomass ($P<0.02$), where microbial biomass in solarized plots increased after solarization, while microbial biomass in non-solarized (control) plots decreased over time (Figure 2). We hypothesize that this may be related to soil moisture, but this cannot be confirmed.

Taken together, these results suggest that solarization does not have detrimental effects on soil microbial communities. That said, the results don't give us an indication about the community structure in terms of thermophilic and thermophobic microorganisms, and organisms other than fungi or bacteria.

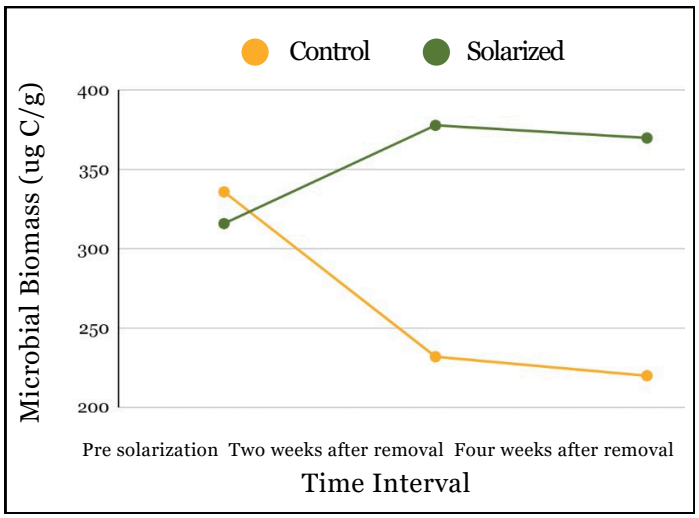


Figure 2. Change in microbial biomass over time in solarized and control plots.

MicroBIOMETER with soil samples.

TAKE HOME MESSAGES

Maggie's objective was to determine whether soil solarization had a detrimental effect on microbial populations, and these data tell us that microbial populations do not decrease with solarization. Maggie plans on incorporating soil solarization into her production system, and looks forward to seeing how it impacts her production in the long term. As is typical with scientific research, more questions have surfaced and there are many ideas for follow-up research, including:

- What is the composition of microbial communities present in various phases of solarization?
- How will solarization impact subsequent crop yields or pest pressure?
- Does microbial biomass differ in a high tunnel vs field environment?
- What impact does repeated solarization have on microbial biomass or composition?

ACKNOWLEDGEMENTS

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