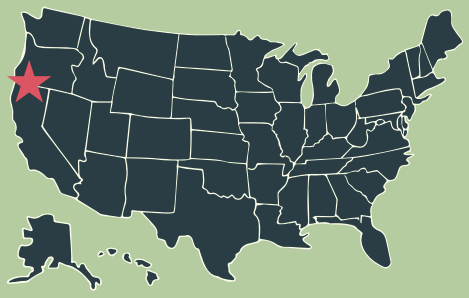
ORGANIC FARMING RESEARCH FOUNDATION

Farmer-Led Trials: Occultation Tarping



2024

Farmer-Researcher:
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Verdant Phoenix Farm
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ABOUT THE FARM

Rhianna Simes, M.S.Ed. owns and operates Verdant Phoenix Farm, a 10 acre urban farm and education center located in Jackson County, Oregon. In 2020, the property burned to the ground in the Alameda wildfire. The project site has Medford Silty Clay Loam, a common soil type in the region, has been fallow for 16 years, and is certified organic through Oregon Tilth (2024). Verdant Phoenix Farm is also part of the The Soil Inventory Project, NRCS EQIP & CSP, and has received funding for research through the USDA's Western Sustainable Agriculture Research and Education (SARE) Farmer/Rancher program.

Rhianna Simes with her seed collection

IN A NUTSHELL

Occultation tarping has the potential to transform small farm management practices in ways that help organic farmers save money, access inexpensive, easy-to-implement strategies to terminate cover crops, and manage weeds in the field while protecting soil tilth. We studied this innovative, no-till strategy to better understand the impacts on soil health and plant termination.

Verdant Phoenix Farm's research reflected that occultation tarping resulted in terminated weeds and higher soil moisture levels. In the same plots, soil carbon, nitrogen and respiration rates were reduced under occultation, which is inconsistent with what we predicted. Seeing the beneficial impact of tarping on weed suppression and crop termination, Verdant Phoenix Farm will continue the practice of occultation tarping, and will conduct further research to evaluate the practice over multiple growing seasons.

Previous occultation research has been conducted in Maine, Vermont and California, but did not have a soil health and plant termination focus. See *Additional Resources* at the end for related research.

Verdant Phoenix Farm fields during the trial. A split plot design was used for side-by-side trial of occultation tarping.

What is occultation?

Occultation tarping, or weeding with tarps, involves laying a vinyl tarp on the soil surface for 4-6 weeks, allowing the active soil food web to breakdown the organic matter and smothered plants on the surface. The tarp is then removed and seeds are planted.

WHAT WAS THE ON FARM TRIAL ABOUT?

Rhianna's farmer-led trial project aimed to answer the question, "What is the effect of occultation tarping and tilling on soil health and weed termination in a small-scale farm setting?"

Rhianna wanted to investigate the effect of occultation tarping vs tillage on the fields, in order to understand which strategies increase soil health while terminating weeds. Tarping is an effective way to terminate weeds and prepare beds for planting without the use of tillage, but this trial sought to understand how tarping impacted soil health vs tillage in the same field.

As an organic, no-till farm, terminating cover crops and weeds while protecting soil tilth is a priority for Verdant Phoenix Farm. Through the use of occultation tarping vs tillage, soil erosion can be reduced, the use of herbicide for weeds is eliminated, water holding capacity and therefore drought resilience increases, soil organic matter remains intact through aggregate stability, soil life is protected, and the environment benefits.

Rhianna had 10 years of experience utilizing occultation tarping successfully. When she heard about OFRF's Farmer-Led Trials Program, she thought it was the perfect opportunity to research and demonstrate the impacts of occultation tarping vs tillage on soil health, weed and cover crop termination. Her long term goal is for farmers and agricultural professionals in Oregon to learn more about this strategy and recognize it as a practice that improves and protects soil health. OFRF provided the support to study this strategy and reflect the clear impacts and opportunities of occultation tarping.

HOW WAS THE TRIAL DONE?

The trial took place between April- October 2024. In order to evaluate the effect of tillage and tarping on soil health and plant suppression, Verdant Phoenix Farm utilized a split plot design with tillage (tillage/no-till) as the main plot and tarping (tarping/no tarping) as the subplot. Plots were arranged across 4 blocks (replications) in the field. The field location was chosen because of its uniformity and proximity to irrigation. Rhianna noted very little variation in fertility and soil moisture in the field.

Vinyl tarps were applied to 10x10' subplots for six weeks and then removed for planting. When the tarps were removed, in-tact organic matter was present on the soil surface (long dead grass covered the soil). This residue was tilled into the plots with the use of a walk-behind tiller, however in the no-till plots the carbonous material persisted and served as a mulch in those area. After the tarps were removed, plots receiving the tillage treatment were tilled, and the no-till plots remained ready to be seeded (with the mulch on the surface). A polyculture mix of seeds was then planted in all blocks. Soil samples were collected from all subplots in early July. Visual observations (% cover) and photo documentation of weed and polyculture crop cover were noted in each subplot four and six weeks after crop planting (data not shown).

Soil samples were sent to the Oregon State University Soil Lab for soil tests recommended by the Soil Health Institute to measure soil organic carbon concentration, carbon mineralization potential, and soil aggregate stability. These are all indicators of soil health, and they directly impact the yield and profit of organic farms, including Verdant Phoenix.

Rhianna also evaluated weed termination and crop germination through observation, photo documentation, and an online tool called https://canopeoapp.com to evaluate the percent coverage of both weeds and the seeded polyculture.

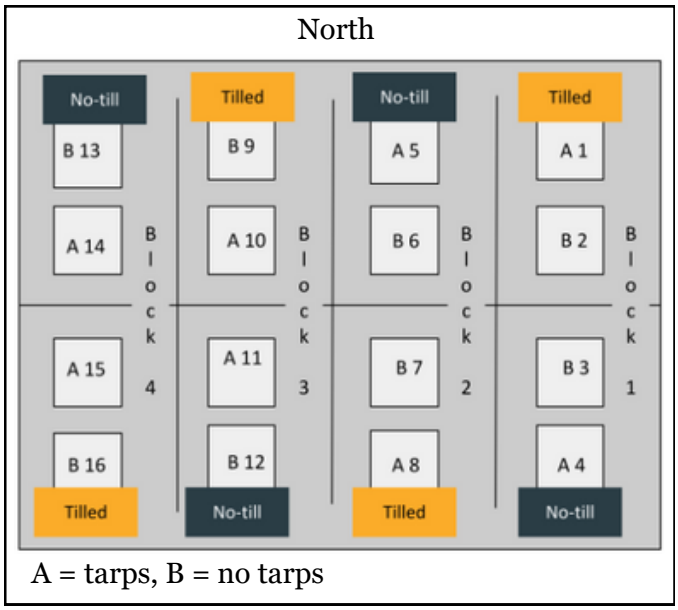
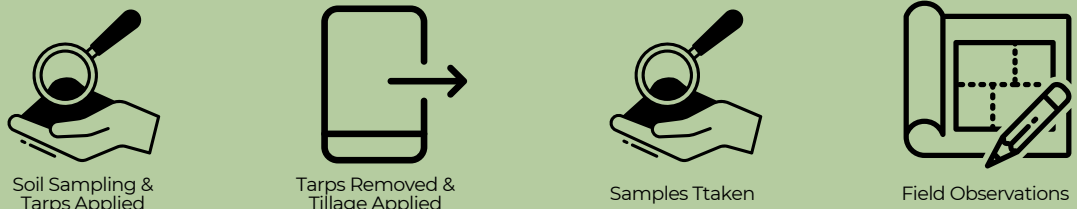


Figure 1. Plot map of trial conducted in 2024 at Verdant Phoenix Farms



"This program has given me the courage and support I needed to pursue my research in no-till farming through occultation tarping, and to share the impacts so that others benefit. I feel honored to be part of this effort."

- Rhianna Simes

FINDINGS

To evaluate the effect of tarping and tillage on soil characteristics, 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 mean averages, and also tells 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". Due to missing data, we analyzed the experiment in two separate ANOVA's looking at 1) the effect of tarping in tilled plots only, and 2) the effect of tillage in tarped plots only (Table 1).

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

	Organic Matter (%)	Total Nitrogen (%)	CO2 24h (µg CO2-C/g dry soil/day)	Moisture (%)
Tilled Plots				
No Tarp	12.7	0.53	152	6
Tarp	7.6	0.30	57	27
F test	**	**	**	**
Tarped Plots				
Till	7.6	0.33	57	57
No Till	8.8	0.34	65	65
F Test	*ns*	*ns*	*ns*	*ns*

ns denotes non-significant effects (p>0.05), ** denotes significant effects at p<0.01

Effects of Tarping in Tilled Plots

Under tillage, organic matter levels were relatively high (average 10.2%) as was total (organic+inorganic) nitrogen (0.42%), which may be reflective of a high level of crop residue that was incorporated during the tillage operation, and could

have impacted the soil samples submitted to the OSU Soil Lab.

Tarped plots that were tilled were higher in soil moisture (27% vs. 6% in un-tarped plots), presumably from the moisture trapping effect of the tarp.

After six weeks of tarping, tarped plots were lower in percent organic matter (OM) and total nitrogen (N), and exhibited a lower CO2 burst at 24h (soil respiration) compared to un-tarped plots (Table 1). This is the opposite of what was expected, and is indicative of lower soil biological activity under the tarps (at the time of testing) on this farm after the organic matter was incorporated by the soil food web. Visually, however, it was observed in the no-till, tarped plots that the active soil food web had incorporated the organic matter, leaving behind soil with intact aggregates, lots of visible life and tilth. The mechanisms that drive changes in the soil environment under occultation tarps are not well understood, and different soil health tests may be required. Previous occultation studies have produced inconsistent results, and it is suggested that a combination of factors such as ambient temperature, climate, tarping duration, time of testing, amount of crop residue and the soil to plastic contact may affect the soil environment (Birthesel et al. 2019, Rylander et al. 2020). However, none of the previous studies focused on no-till, organic systems, and many tilled first and added synthetic fertilizers before tarping.

It would be valuable to conduct further assessments to determine whether this pattern repeats itself in another growing season, how soil biological activity is active during the time the tarp is present, and how it bounces back over time (after tarp removal), and how soil temperature was affected by tarping.

In terms of weed biomass and subsequent crop germination, Rhianna observed that the tarped plots had significantly lower weed pressure, and higher levels of crop germination, which may be due to lower weed competition and higher levels of soil moisture conserved by the tarps.

Visual observation and photo records were taken during the trial, such as this image of post-tarp soil conditions with a long mulch.

Effects of Tillage in Tarped Plots

Comparisons of tilled and untilled plots under tarping did not produce statistically significant differences in the soil environment (Table 1). This suggests that the tarping helped to mitigate the drying effects of tillage, and kept soil OM, N, and respiration more consistent.

TAKE HOME MESSAGES

Soil health measurements are a snapshot in time, but they can help farmers understand the impacts of their management activities. Moreover, preliminary data gathering and review allows us to refine our questions and helps us to truly assess management practices. As well, plant termination measurements are important because they help farmers to identify which termination method is appropriate for their operation. Many organic, no-till farmers rely upon manual labor to address unwanted plant pressure, which is expensive and depends upon labor availability.

- The use of tarps did successfully terminate weeds without the use of tillage.
- Not only did the tarps prevent the use of herbicides and tillage to terminate weeds or cover crops, it also increased (or protected) soil moisture which supported the germination of the cash crop.
- The use of tarps may temporarily suppress biological activity after organic matter is incorporated by the soil food web.
- Under tarping, tillage did not have an effect on any of the soil health indicators (except aggregate stability), suggesting that tarping is a protective practice.

Future experiments could examine the effect of tarping on: soil temperature, the microbial community composition through PLFA testing, soil biological activity over time following tarp removal, and subsequent crop yield and quality.

ADDITIONAL RESOURCES

- OW19-345 “Effects of Occultation on Weed Pressure, Labor Costs, Product Quality, and Yield in Sustainable Vegetable Production”, California, 2019.
- FNE21-984 “Solarization or Occultation? Optimizing Tarping for Soil Health and Productivity in No-Till Vegetable Production”, Vermont, 2021.
- Bulletin # 1075, “Tarping in the Northeast: A Guide for Small Farms”, University of Maine Cooperative Extension

ACKNOWLEDGEMENTS

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