Soil solarization at an organic farm: effects on weed emergence, soil nutrients, and soil microbial communities

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Introduction

Weed management is one of the main challenges for organic agriculture. Soil solarization has been shown to be an effective mitigation strategy for weeds and soilborne plant pathogens[(1)] but few studies have been conducted in cooler climates such as the Pacific Northwest[(2)].

Objectives

- Determine if soil solarization reduces weed emergence at an organic farm in Oregon
- Compare soil temperatures in solarized and non-solarized soil
- Investigate if soil nutrients and soil microbial communities differ in solarized vs. non-solarized soil

Materials and Methods

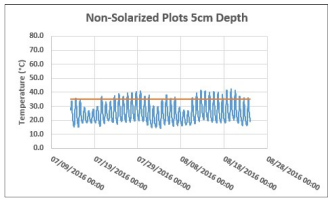
A field experiment was conducted in summer, 2016 at Gathering Together Farms, Philomath, OR. Plots (0.91 m x 30.48 m) were installed in a fallow field on 7/13/16. Solarized and non-solarized plots were established with four replicate plots per treatment. Soil temperatures were monitored with iButtons at 5 and 15 cm depths. Soil samples were collected at the beginning and end of the four week trial at depths of 5 and 10 cm. Subsamples were frozen and DNA extracted for microbial community analysis with Illumina MiSeq. Remaining soil was submitted for nutrient analysis. Solarized plots were covered with 1.5-mil clear plastic film; non-solarized beds were left uncovered. Immediately after the plastic film was removed, plots were disked and seeded with Sudan grass. Two weeks later, the number of weeds in the Sudan grass crop was determined.

Plot Layout

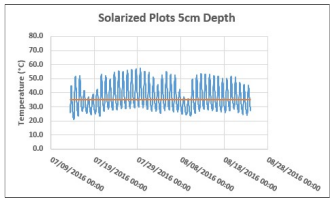

Solarized and control plots immediately following installation.

Visual comparison of a solarized plot vs. a neighboring control plot after plastic removal.

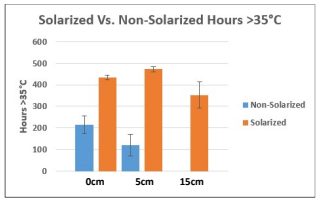
Temperature Results



Average temperatures vs. time at 5cm across all control plots.

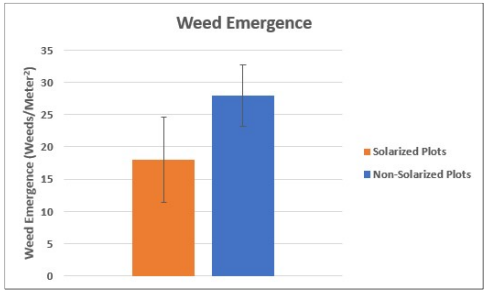


Average temperatures vs. time at 5cm across all solarized plots.

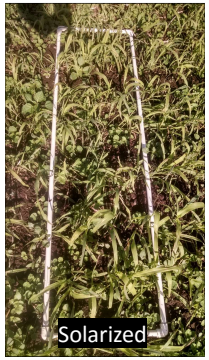


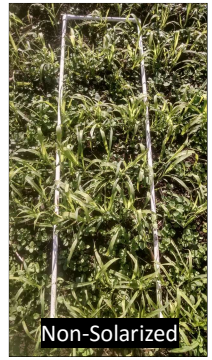
Average number of hours exceeding 35°C in all plots.

Weed Emergence Results



Weed emergence among Sudan grass cover crop in solarized and control plots.





Weed emergence counts were taken using a 3 ft², plastic quadrat. (Averages were converted into m².) The data were collected two weeks after the plastic was removed from the solarized plots. The entire field, including all research plots, was disked and planted with Sudan grass immediately after the plastic was removed.

Soil Nutrient Analysis Results

Soil Nutrient Analysis

	ppm		
Lab ID	Active C	P	K
NS week 0	1089	284	698
S week 0	925	261	480
NS week 4	971	268	582
S week 4	1009	286	580

Results from soil macro-nutrient analysis. 'NS': Non-solarized. 'S': Solarized.

Statistical Tables

Hours >35°C Statistics

Plot	0 cm	5 cm	15 cm
St.Dev NS	40.73	50.12	0.00
St.Dev S	11.16	11.58	60.19
P-Values	0.001	0.001	N/A

One-sided T.test results.

Weed Emergence Statistics

Plot	Weeds/m²
NS Avg.	28.00
S Avg.	18.00
NS St.Dev	4.74
S St.Dev	6.61
P-Value	0.01

One-sided T.test results.

Results

- Weed emergence was significantly (P = 0.01) reduced in solarized vs. non-solarized plots
- Maximum, minimum, and average soil temperatures in solarized plots were significantly greater than in non-solarized plots for both soil depths. The number of hours above 35°C also differed between solarization treatments at all depths.
- Soil microbial community analyses are underway but have not been completed yet.

Discussion/Conclusions

Soil solarization appears to have merit for controlling weeds in organic agriculture in Oregon. Even though soil was disturbed immediately after solarization, weed emergence in a subsequent crop was 35% less in solarized than in non-solarized plots. Based on previous studies, soil temperatures achieved in the solarized plots should also be sufficient for the suppression of certain soilborne pathogens (*Pythium* and *Phytophthora* spp.). Additional research is needed to evaluate the effect of soil solarization on weeds when soil disturbance is minimized.

Acknowledgments:
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References:
[1]Gamliel, A., and Katan, J. 2012. *Soil solarization: theory and practice.* St. Paul, Minnesota: APS Press.
[2]Parke, J. L., and Funahashi, F. 2016. Soil solarization in container nurseries and field production. Digger. 60:33–36.