To Tarp or Not to Tarp? Evaluating Effectiveness of Cover Crop Termination Methods and Weed Management Outcomes for Organic Vegetable Crop Production in the U.S. Midwest

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Introduction

This study was initiated in response to regional farmers' use of soil tarping as a termination tool for cash or cover crops without tillage. This research focuses on four termination treatments i) mowing & tilling, ii) mowing & tarping, iii) rolling & crimping, and iv) an un-terminated control in a spring-seeded oat-pea field mix. The aim is to assess the influence of these treatments on weed suppression, aboveground plant biomass, soil health, and ultimately on climate change resilience.

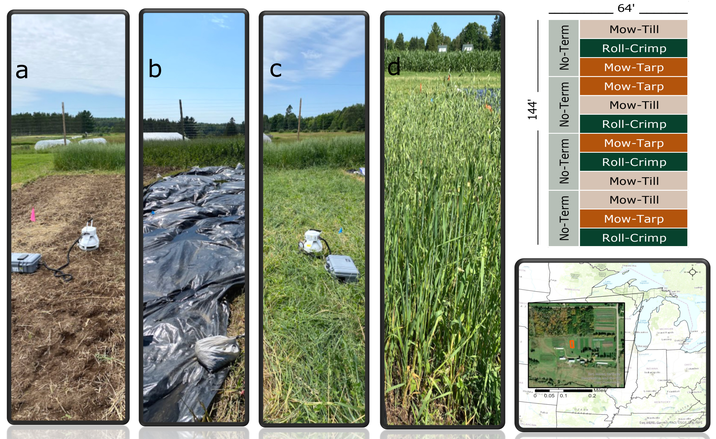

Figure 1. Four treatments were compared at the MOSA certified organic Michigan State University Upper Peninsula Research and Extension Center North Farm in Chatham, MI, including Mow-Till (a), Mow-Tarp (b), Roll-Crimp (c), and no-termination (d).

Methods

Prior to implementation of the treatments, a previously uncultivated field was roto-tilled and a oat-pea cover crop was drilled across the entire area consisting of a Ruse-Ensign-Nykanen fine sandy loam complex in May 2023.

- A total of sixteen plots were established on July 19, 2023 using a fully randomized block design containing four replicates of each treatment including methods i) Mow-Till, ii) Mow-Tarp, iii) Roll-Crimp, and iv) No-Term where the No-termination plots 12'(W) x 36' (L) were perpendicular to the other 12'(W) x 52'(L) plots (Figure 1).
- Biomass sampling consisted of 3 random 1 ft^2 quadrants samples (see Figure 2.) per treatment plot collected 10 weeks post-termination to determine cover crop and weed biomass. Biomass included all above ground plant material, both living and dead (Figure 3).

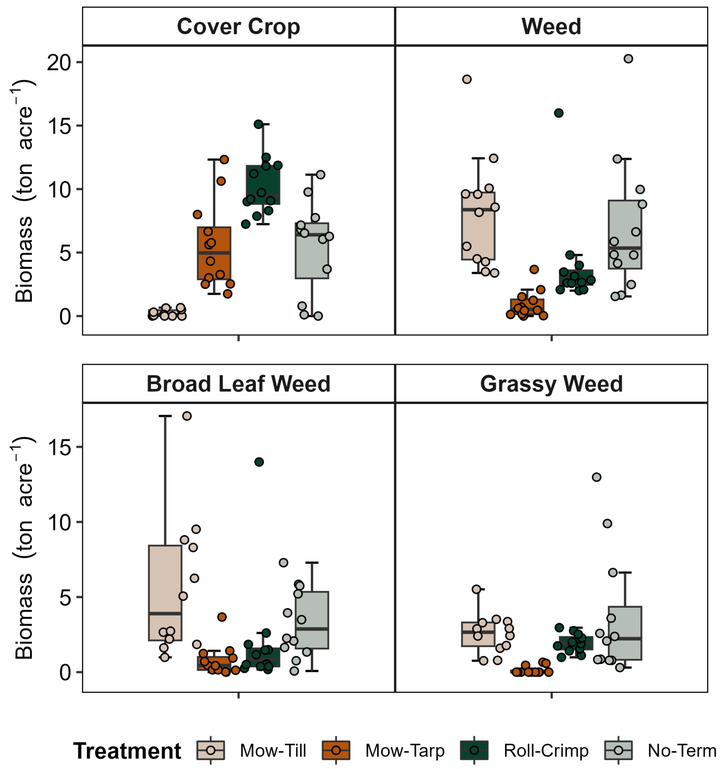

Figure 2. Aboveground dry matter biomass observations (points; tons $acre^{-1}$) for all treatments plots where plant type was separated into Cover Crop (top-left) and Weed (top-right), and where weed type was further separated to compare Broad Leaf Weed (Bottom left) with Grassy Weed (bottom right) biomass. . Boxplot lines represent median, 25%, and 75% quartiles, while whiskers represent quartiles ± 1.5 · interquartile range.

Table 1. Summary statistics, including number of observations (n), mean biomass (± standard error), and Tukey honest significant difference comparisons (Mean Test) for each plant type (cover crop and weed), and treatment. Linear mixed-effects models were used to estimate mean biomass where plant type (as Cover Crop or Weed) and treatment were fixed-effects and plot was a random-effect. The Tukey method was used to for all pair-wise mean comparisons in R.

Plant Type	Treatment	n	Biomass (tons $acre^{-1}$)	Mean Test
Cover Crop	Mow-Till	10	0.2 (± 0.1)	a
	Mow-Tarp	12	5.5 (± 1.0)	b
	Roll-Crimp	12	10.2 (± 0.7)	c
	No-Term	12	5.5 (± 1.1)	b
Weed	Mow-Till	12	8.2 (± 1.3)	a
	Mow-Tarp	12	0.9 (± 0.3)	b
	Roll-Crimp	12	4.0 (± 1.1)	c
	No-Term	12	7.0 (± 1.5)	ac

Significant between-treatment mean differences are indicated by (a), (b) and (c) at $p < 0.05$.

Results

Preliminary results showed numerous significant differences among treatments for both weed and cover crop biomass (Table 1 and Figure 2).

- The 8.2 (tons $acre^{-1}$) mean weed biomass detected in Mow-Till was significantly higher when compared to the 4.0 and 0.9 (tons $acre^{-1}$) means detected in Roll-Crimp and Mow-Tarp, respectively.
- The 0.2 (tons $acre^{-1}$) mean cover-crop biomass in the Mow-Till was significantly lower when compared to the 5.5, 10.2, and (tons $acre^{-1}$) means detected in Mow-Tarp, Roll-Crimp and No-Term, respectively.
- The 7.0 (tons $acre^{-1}$) mean weed biomass detected in No-Term was not significantly different than the 8.2 and 4.0 (tons $acre^{-1}$) means detected in the Mow-Till and Roll-Crimp treatments, respectively
- Cover crop biomass in the Roll-crimp and Mow-tarp treatments consisted of primarily dead or non-viable plants

Figure 3. Methods used for biomass sampling included 1 ft^2 metal quadrants, where hand cut and sorted samples were collected in paper bags, and subsequently placed in a drying oven prior to mass determination using a digital balance.

Discussion

Preliminary results show a variety of responses to cover crop termination treatments in terms of cover crop persistence, regrowth and/or weed growth.

The Mow-Till method, was effective in terminating cover crops, but resulted in higher weed biomass compared to other termination treatments. The Mow-till treatment showed significantly lower cover crop biomass, suggesting potential challenges in cover crop regeneration.

This research highlights the need for further research to refine cover crop termination methods for sustainably control weeds and regrowth of cover crops. This ongoing study aims to provide actionable practices for regional farmers, contributing to adaptive solutions in organic vegetable production amid climate change- induced challenges.