Tarping to Improve Weed Management and Reduce Tillage in Vegetable Systems

Vegetable weed management

One of the most significant challenges for vegetable growers is weed management. Weeds account for substantial yield loss each year. Cultivation is commonly used by vegetable growers to manage weeds. However, repeated cultivation can break down soil structure and lead to erosion. Plastic mulch is an effective tool used by many growers. The downside is that plastic mulch requires specialized equipment to apply and is typically used only once and then discarded. Herbicides are another option, but environmental and human health concerns may leave vegetable growers with limited herbicide choices. Hand weeding is a common practice for small-scale vegetable growers but is laborious. Due to these limitations, there is a demand for alternative weed management methods such as tarping.

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What is tarping?

Tarping utilizes a large, impermeable plastic sheet, most commonly a silage tarp, spread over the intended plot before planting the cash crop. The tarp is left in place for several weeks, depending on air temperature and the goal behind the tarp use. Most commonly, tarps are used to create a weed-free planting area with ideal soil moisture conditions. Many growers prefer to prepare the planting area by applying amendments and tilling for the next crop before applying the tarp. The tarp acts as a "placeholder" to hold beds weed-free between plantings; when removed, the area is ready for planting. Tarping kills weeds via two processes: occultation and solarization.

What is occultation?

Occultation refers to the blocking of light. Tarps block sunlight, resulting in weeds that are unable to photosynthesize. Tarping via occultation utilizes an opaque tarp, most commonly a black or white silage tarp. The tarp blocks the sunlight from weeds; these weeds will become etiolated and appear spindly and white. They will eventually die due to lack of access to light. This same environment can aid in cover crop termination, as well.

What is solarization?

Solarization uses a clear tarp to create a warmer environment as sunlight passes through, allowing weeds to photosynthesize. Solarization aims to kill weeds beneath the tarp due to excess heat. If high enough temperatures are not attained, weeds will continue to thrive underneath the tarp.

Why tarp?

Tarping is an alternative weed management method. Tarps are a great investment for growers and are relatively inexpensive because they are multifunctional and can be used for multiple years. The tarp typically provides weed control only following the first two to three weeks after tarp removal. After this, other weed management methods will need to be utilized. Tarps can provide many of the same functions tillage does, such as killing weeds or decomposing cover crops, making it great for no-till systems. Once tarps are applied, the soil moisture stays somewhat consistent until tarp removal, except during longer tarping periods in the warm summer months. Heavy rains can delay planting for weeks if the ground is too wet. However, a tarp can block rain infiltration and allow for earlier planting. In addition, the tarp blocks excess rain, which can decrease nitrate leaching from the soil. Tarps can also help preserve soil moisture if irrigation/rainfall occurs before tarping.

Other Tarping Uses

Stale seedbed

Tarps can flush weeds from the weed seed bank and terminate those weeds before planting the cash crop, aiding in the stale seedbed technique. The environment beneath the tarp can be conducive to seed germination if warm and moist conditions persist. The tarp blocks the sunlight, and therefore, germinated weed seedlings die. This results in less weed emergence during the growth period of the cash crop. When the opaque tarp is removed a weed-free planting bed lies beneath the tarp. Black and white tarps are most common. However, clear tarps may be used to stimulate weed germination. If conditions are not warm enough, the clear tarp may help flush weeds from the soil seed bank, but another form of termination method may be required prior to planting.

Figure 1. Food at First Garden in Ames, IA. Tarp terminated cereal rye for approximately four weeks prior to planting tomato transplants (A) and tomato crop with cover crop mulch providing weed control (B).

Cover crop termination

Tarps can terminate cover crops without the use of herbicides or tillage. Figure 1 provides an example of a cereal rye cover crop, crimped and tarped prior to planting tomatoes. Once cereal rye reached anthesis, the cover crop was knocked down using a t-post and tarped for about three to four weeks. The tarp was then removed, and the soil was loosened with a broadfork before planting vegetable transplants. The terminated cereal rye biomass acted as mulch, keeping weeds at bay for much of the growing season.

Figure 2. Global Greens in Des Moines, IA. Large tarp applied for multiple months during the summer to terminate grass and weeds to eventually transition to production land.

Transitioning fallow land into production

Growers looking to transition sod or fallow land into production can use tarps for an extended period over the summer to kill existing vegetation. This allows for the termination of grasses and weeds without herbicide use, allowing for easier land transition to planting beds. Figure 2 shows a large tarp used to kill existing cover during the summer to transition fallow land into production.

Tarping and reduced tillage practices

Growers use tillage practices for various reasons, including to warm and dry out the soil or to terminate weeds or cover crops. Tarping can fulfill these needs and replace the need for tillage. Black and clear tarps create warmer soil temperatures than bare ground, allowing for better seed germination conditions when non-tarped soil temperatures remain low. Many growers use tillage to incorporate cover crop residue. Tarps can perform a similar function by speeding up cover crop decomposition, as the warm environment beneath the tarp can aid in the microbial breakdown of plant material.

Cost of materials

The average cost of a 40-foot x 100-foot silage tarp is about $300. Clear greenhouse plastic is commonly used for solarizing. A 40-foot x 100-foot clear tarp costs about $360. Greenhouse plastic can also be salvaged from a high tunnel. Tarps can be used for multiple years, making the investment worthwhile for growers.

Securing tarps

There are various objects which can be used to secure tarps. Figure 3 shows some of these methods: sandbags (A), cinder blocks (B), t-posts or old fencing (C), and burying tarp edges (D). Burying tarp edges to secure tarps also requires sandbags. Growers using clear plastic for solarization may consider burying the edges to trap heat. Choosing a non-windy day to apply tarps is recommended. If wind levels are low, it can take as few as two to three people to secure the tarps. Medium to high wind levels can make getting tarps low and tight to the ground challenging, requiring more labor. Sandbags are recommended about every five feet to secure the edges, and less frequently down the middle of the tarp.

Storage and longevity

Tarps are sustainable tools and can be reused for 5-10 years if stored and cared for properly. There are multiple ways to roll or fold tarps for storage. Keeping tarps safe from weather events and away from rodents is recommended. Cleaning tarps, especially if muddy, will help reduce the weight of the tarp. Cleaning and storing tarps is not absolutely necessary, and many growers simply store tarps outside.

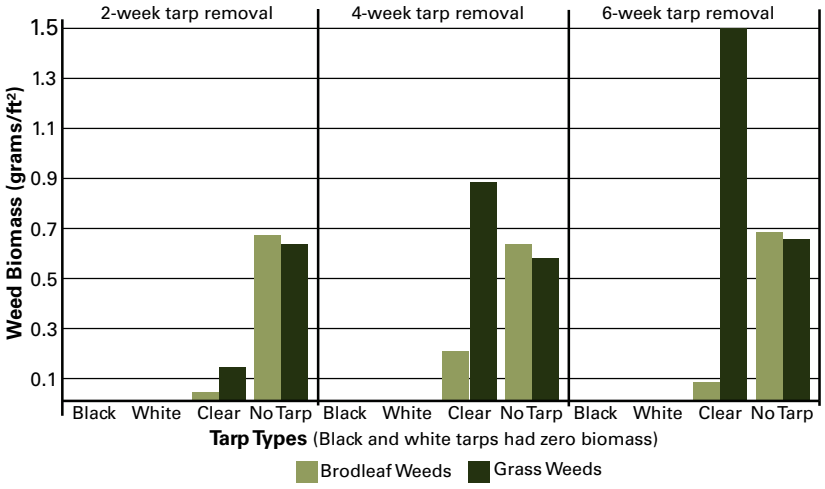
Color selection and time frame

Results from the Iowa State University experiment in the spring of 2023 showed that black and white tarps create a weed-free planting bed at the time of tarp removal (Table 1). However, clear tarps stimulated weed growth. Weed biomass accumulated the longer the clear tarp was applied. This demonstrates that spring temperatures in the north central United States are typically not warm enough to terminate weeds underneath clear tarps. Clear tarp treatments and no-tarp control treatments required cultivation to terminate weeds prior to planting the cash crop, whereas black and white tarps did not. On average,

Figure 3. Variety of tarp securing methods. (A) a tarp secured with sandbags at Grade A Gardens in Earlham, IA. (B) Cinder blocks used to secure tarps at Cedar Creek Gardens in Midland, SD. (C) T-post, old fencing parts, and logs used to secure tarps at Food at First Garden in Ames, IA. (D) Buried tarp edges at Iowa State Horticulture Research Station in Ames, IA.

Table 1. Broadleaf and grass biomass (grams/ft^2), taken at time of tarp removal at Iowa State University Horticulture Research Station in Ames, IA from the 2023 growing season. Six-week tarping period: April 7-May 22, four-week tarping period: April 24-May 22, two-week tarping period: May 5-May 22.
*No-tarp treatment data are the same across time periods as the no-tarp treatment did not have multiple time treatment periods (two, four, and six weeks), as no tarp was applied.

Table 1. Biomass at tarp removal



tarps are recommended to be applied for at least three weeks. However, these recommendations vary based on weather, time of year, sunlight, and vegetation beneath the tarp. Results from the Iowa State University experiment in the spring of 2023 show soil temperatures beneath different tarp types (Table 2). Figure 4 shows the area at the time of the tarp removal of black (A), white (B), and clear (C) tarps applied for six weeks, compared to a no-tarp control (D).

Table 2. Average soil temperature (degrees Fahrenheit) at two-inch depth underneath black, white, and clear tarps applied for six weeks compared to no-tarp. Tarps were applied April 7, 2023, and removed May 22, 2023, at Iowa State University Horticulture Research Station, Ames, IA.

Tarp type	Degrees Fahrenheit
Black	66.1
White	62.2
Clear	72.8
No-Tarp	65.7

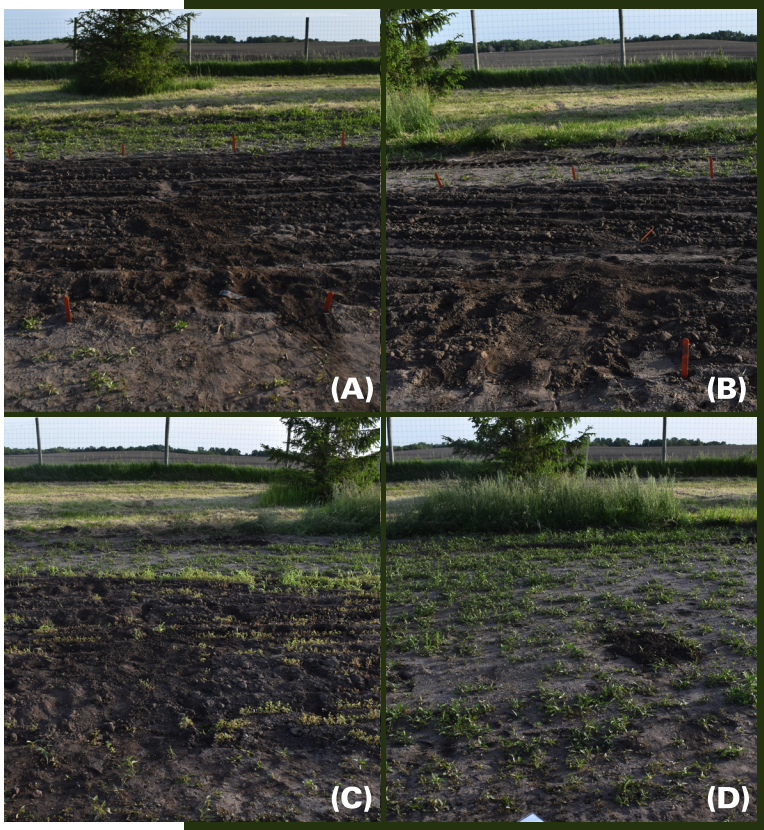


Figure 4. Tarping experiment at time of removal: six-week and control treatments, at Iowa State University, Ames IA. (A) Black tarp applied for six weeks. (B) White tarp applied for six weeks. (C) Clear tarp applied for six weeks. (D) No-tarp, control treatment.

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Acknowledgments

Tarping research is supported by North Central Region SARE Grant (Award no. LNC22-460).

References

Lounsbury, N., N. D. Warren, S. D. Wolfe, R. G. Smith. 2020. Investigating tarps to facilitate organic no-till cabbage production with high-residue cover crops. Renewable Agriculture and Food Systems, 35(3), 227-233.

Lounsbury, N., S. Birthisel, J. Lilley, R. Maher. 2023. Tarping in the Northeast: A Guide for Small Farms. The University of Maine Cooperative Extension. extension.umaine.edu/publications/wp-content/uploads/sites/52/2023/01/1075-Tarping-Guide_Jan2023.pdf

Mays, D. 2020. The No-Till Organic Vegetable Farm: How to Start and Run a Profitable Market Garden That Builds Health in Soil, Crops, and Communities. Storey Publishing, LLC. ISBN-10: 1635861896.

Rylander, H. 2019. Reusable Black Tarps Suppress Weeds and Make Organic Reduced Tillage More Viable. Cornell Small Farms Programs, Cornell University College of Agriculture and Life Sciences. smallfarms.cornell.edu/2019/01/reusable-black-tarps-suppress-weeds-and-make-organic-reduced-tillage-more-viable/.

Rylander, H., A. Rangarajan, R.M. Maher, M.G. Hutton, N.W. Rowley, M.T. McGrath, Z.F.

Sexton. 2020. Black plastic tarps advance organic reduced tillage I: Impact on soils, weed seed survival, and crop residue. HortScience, 55, 819–825.