CORNELL Small Farms PROGRAM

**Summer 2022**

# Tarping in a no-till transition: Lessons from a long-term cropping systems experiment in small-scale organic vegetables

Tarps are becoming a multifunctional management tool on small-scale organic vegetable farms. Tarping, or occultation, involves the use of black, durable (5-6 mil), impermeable plastic, that is applied to the soil *between* plantings. Tarps are reusable over multiple years and adaptable to different applications in a vegetable rotation. They are often left in place for 3-4 weeks, though this can vary based on tarping goals and time of year. Shorter durations, <2 weeks, in high tunnels and mid-summer periods and longer durations, 6+ weeks, when killing sod and overwintering for early spring planting. Tarps are commonly used to hold beds weed-free between plantings, create a stale-seed bed for weed prone crops and improve soil conditions for the following crop with less tillage. In the Northeast, this "placeholder" function is especially valuable when soils could be too wet and inaccessible for field operations.

*Tarps applied to beds between crops alongside untarped, tilled beds.*

Tarps serve as a tillage tool by providing many of the bed preparation services typically provided by tillage. When beds are tilled, tarps can prepare soils and kill weeds without supplemental passes. They also fill a no-till niche by creating weed-free planting conditions for the following crop without relying on heavy applications of organic mulches, materials that are not appropriate for all crops and can be difficult to source and labor intensive to apply.

*Lettuce planted in tilled beds (left) next to no-till beds using tarps (right).*

As tarps are applied across more beds and farms, there are a growing number of questions about how they work, what short and long-term effects they have, and how to use them successfully with less tillage**.** Our research has been working to answer these questions through a long-term cropping systems experiment. Over 8 years, we have grown a mix of crops (cabbage, winter squash, lettuce, broccoli, and beets) in a permanent bed management system and compared tarping using no-tillage alongside other practices – including conventional tillage and no-till without tarping. We've documented changes along the way – monitoring our weeds, soils, labor, crops – to help us answer **what role tarps can play in the transition to successful no-till vegetable production.**

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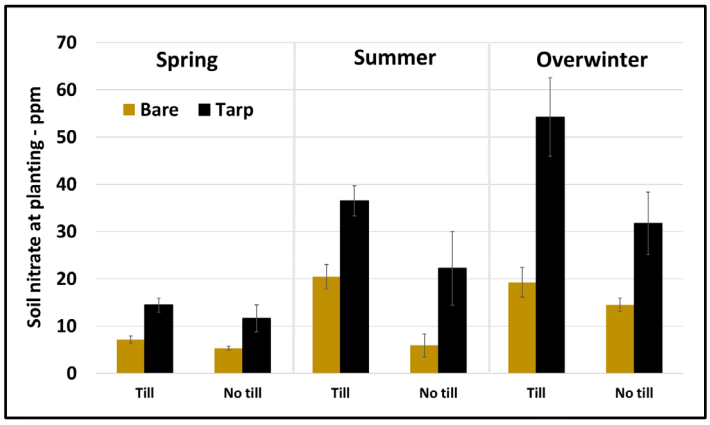
**Tarps can hold beds weed free until it's time to plant.** Tarps applied overwinter or early spring can set beds up for early planting or be left in place until whenever beds are needed. Tarps left in place for 3 weeks have killed living annual weeds for planting with no tillage, similar to tarps of longer duration. Tarps can be applied directly crops, cover crops, and weeds, after mowing if necessary. Short duration tarps alone are not as effective for killing perennial weeds. In fields with persistent perennials, using tarps for longer duration, up to a full season, in combination with tillage option before moving toward no-till.

*Tarping over cabbage and oat-pea cover crop residue, removing tarps the following year, and planting winter squash with no-tillage.*

**Tarps can improve soil conditions for no-till planting.** Tarps do not dramatically warm soils in spring but do increase temperatures by several degrees on average. These changes can add up over several weeks while tarps are down, increasing total soil degree days by 10-30% depending on the season of application. They also regulate soil water and maintain relatively constant soil moisture. We have found crops can inherit higher levels of plant-available soil nitrogen after tarps are removed, regardless of the time of year. After a 3-week tarp, we find soil nitrate levels 2-4 times untarped soils and highest with longer durations and when applied overwinter. This result is likely a combination of both greater microbial activity in warm, moist soils and fewer leaching losses from spring thaw and rains.

*Soil nitrate in tarped and untarped plots using different application times depending on the crop in the rotation.*



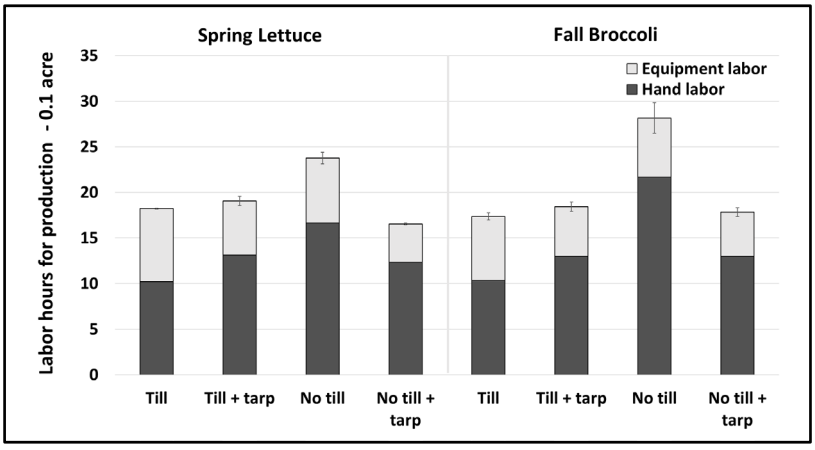
Despite these tarp benefits, no-till soils can still be more difficult to plant and require other strategies to manage compaction and residues for good crop establishment. Restrict field traffic to between-bed pathways and modify planting tools and practices to get transplants to set and seeds into harder ground. For residues, select the appropriate crop type (e.g., direct seeded vs transplanted) to follow based on the previous crop, flail mowing large crops, and physically cutting and/or removing residues (e.g., brassica stalks are tough) can help.

**Tarps can provide big weed and labor benefits for no-till.** Tarps are a promising strategy for the management of annual weeds. Over 8 years tarps have consistently left us a clean bed for planting while also reducing the emergence of annual weeds in the following crop. Tarps can help create a stale seed bed, where warm, moist conditions under the tarp can stimulate seed germination, followed by seedling death as they are starved for light. In this application, it is important to minimize soil disturbance after tarp removal to avoid the introduction of new weed seeds to the soil surface.

Tarping with no-till can effectively draw down the weed seedbank over time. We've found over a 70% reduction in the weed seed bank when comparing no-till with tarping to conventional tillage. This has largely been driven by the control of our primary winter annual weed, common chickweed, rather than summer annuals. This is likely the combined result of tarps: 1) inducing fatal germination of weed seeds, 2) suppressing weeds between crops, especially the shoulder seasons, that would otherwise produce seed, and 3) in the case of continuous no-till, minimizing the introduction of weed seeds from greater soil depths. Complementary weed management tactics are often needed, keeping weeds from going to seed, especially for long-season crops. We have found a no-till system that uses organic mulches, like rye hay, has been more effective at reducing the seedbank of hairy galinsoga, our dominant summer annual weed.

Tarps have also shown to reduce labor for no-till by at least 30%, most of this savings is in bed preparation. Handling tarps and sandbags does take time, adding hand labor, and we have found this can lead to equal or more total labor compared to conventional tillage depending on the year. Tarps are also bulky and messy, especially when covered in water. Sizing tarps to fit for different application times or fields and developing a rotation

*Labor invested in crop production based on timed hand labor and equipment operations in tilled and no-till soils with and without tarping.*



plan that sets a destination when they come off can help lead to some labor efficiencies. All labor is also not equal and often tarping comes at time of the year, late fall or early spring, when fields would otherwise not be accessible for equipment operations.

**Other soil management practices can have quicker and more dramatic impacts on soils and yields, often more than tillage and tarps.** Surprisingly, we've found that tarping with no-till has yielded equivalent to conventional tillage. We have also compared the use organic mulches, either rye hay or deep compost, in combination with tarping and tillage practices. These mulches can provide soil cover, conserve moisture, and add organic matter with more season-long weed suppression for no-till. Rye hay initially lowered yields in the early years of our trial (as much as 40%), largely due to pests (i.e., slugs, cucumber beetles), but yields have improved relative to bare ground in later years. Much of this benefit was seen in spring crops in the year after mulch application. For example, in beets, when mulch was applied the previous year, yields increased by 35% relative to unmulched beds. Deep compost practices take a lot of compost, we applied >1.5in annually in the first four years, equal to 50-70 tons per acre per year. This led to a two-fold increase in organic matter and consistently high yields but quickly contributed to nutrient loading (e.g., >4x rec soil P levels). Overall, our mulching practices have been a more consistent driver of crop yields then tarping or tillage in our trial.

## Considerations for trialing tarping with RT and NT practices on your farm:

- Tillage can take many forms with tarps. Use fewer passes, go shallower, try no-till.
- Plan time for different tarp application windows. Overwinter for early crops, 3 weeks in-season, and longer for perennials weeds.
- Consider crop and soil conditions before and after tarping. Start with transplants to minimize problems with higher residue and/or rougher planting conditions.
- Keep them busy throughout the season. Hold prepped beds and kill weeds after crop harvest to contain weeds from becoming bigger problems.
- Plan for supplemental weed management tactics, especially in long-season crops and fields with high weed seed banks.
- Integrate with other soil health practices, mulches and cover crops, for organic matter and living roots.

## Additional Resources.

Contact: Ryan Maher, **rmm325@cornell.edu**

Find articles and more: **smallfarms.cornell.edu/projects/reduced-tillage**

**Tarping in the Northeast: A Guide for Small Farms.** Check it out here →

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