

REDUCED TILLAGE ON PERMANENT BEDS – FREQUENTLY ASKED QUESTIONS

WEBINAR PRESENTED ON MARCH 9, 2017

Ryan Maher and Brian Caldwell – *Cornell University* and Mark Hutton – *University of Maine*

TARP LOGISTICS

Q: Where can tarps be purchased? Other equipment?

Check Ag supply stores. Silage bunk covers are an option and typically have some UV protection but we have found other durable, 5-6 mil, black plastic can work.

Q: How do you move the tarps?

Roll up or fold them. It is easiest to fold them.

Q: Is there a mechanical way to install tarps for larger operations? Will a plastic mulch layer lay down heavier tarp-scale plastic?

We have not looked at this. It may be possible to use winders and cable spools as some strawberry growers do with row covers.

Q: Can you use biodegradable tarps?

Black plastic is beneficial because it can be reused.

Q: Clear plastic vs black plastic?

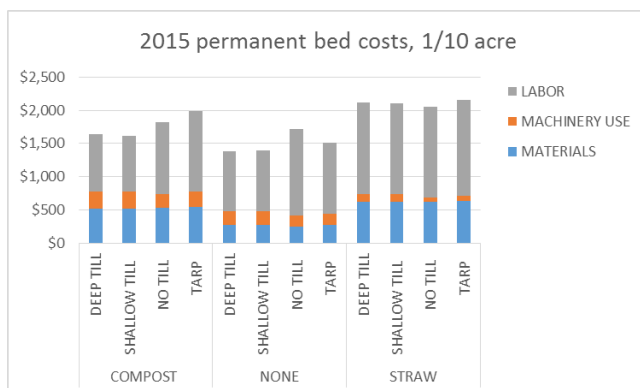
We are starting to look at how clear plastic can be used, but have no results yet.

Q: Can you cover the seed bed with a tarp and not your walkways between the rows.

Yes, but we feel it is easier to cover larger areas. We use tarps that are 25ft wide so rather than cut them into narrow widths, we cover 3 beds. Covering pathways with the tarps effectively suppresses weeds there. Weeds in the pathways can be a big problem in permanent beds, so we feel this is beneficial.

Q: What are the costs per acre on tarping including labor? Return on investment? How much labor was used?

The chart below shows our calculated costs **per 1/10 acre** for cabbage in 2015 for different permanent bed systems:



In the no mulch and straw mulch systems, the cost of using the tarp was very similar to tillage without a tarp. Same for the labor requirement. Since tarp yields tended to be higher, net returns and return on investment were somewhat higher.

Q: How long do the tarps last? I have found that 6mil tarps get brittle after three seasons. How do I prevent this?

We hear from other farmers that they last several years. They can wear as they are used multiple times in the season (more solar exposure) or are left in place overwinter. Deer traffic can make holes too. There may be differences among tarps in durability and UV protection, depending on manufacturers, but we don't know this.

Q: Can you use landscape fabric for tarping?

We are looking at this but no answer yet. Some growers are using landscape fabric with success. The big difference would be that landscape fabric is porous to water and air. We don't know yet whether this is an advantage or not to impermeable plastic.

Q: Have you tried using billboard ads instead of tarps?

No but have heard of growers doing this. Be careful there is not an ink or glue that can cause a contamination to your soil. Also, we don't know how long they last.

We know growers that are using them for 3-4 weeks, often in lower crop residue conditions or after tillage to make a stale seed bed. We are using them in a no-till system for late spring planting. The tarping window can be any time during the season; tarps can be left on over the winter too. We have a new experiment to look more closely at timing.

Q: Can you add irrigation to tarps?

Tarps trap moisture and we are applying in late fall or spring when soil moisture is generally high. We have heard of growers using overhead irrigation before tarps if conditions are dry to help germinate weeds.

Q: Do you bury the edges?

No but high winds can be challenging. We use sandbags to secure the edges or pile soil, much like row cover.

Q: What about using plastic mulch and then remove it after 6 weeks? Or do you think the plastic mulch is not tough enough to hold up?

We have done that as a form of stale seedbed preparation for direct seeded crops with success. Really neat to pull the plastic mulch off and see lots of white thread weeds and watch them dry-up. A 1.25 mil black plastic mulch will definitely not hold up very well.

Q: Why don't you use tarp/plastic on the beds during the growing season by cutting holes and transplanting into it? This system is used by a lot of commercial growers whether they till or don't till.

Standard plastic mulch is generally used with full tillage; we are using tarps as a substitute for tillage, or in conjunction with other forms of reduced tillage. We know growers that are using landscape fabric as a mulch with reduced tillage by cutting holes and leaving in place.

TARPING AND CROP MANAGEMENT

Q: Can you provide a schedule of the tarp system?

For us, basically:

1. Apply tarps for minimum 6 weeks in spring. Lay over top of mulches, weeds, and mowed cover crop residues
2. Leave in place until planting
3. Remove and grow crop as usual

Q: How long do weeds show up after tarp removal?

In the first year and in some plots we had improved season long weed control but we did not measure the time until weeds showed up. We generally started hand weeded plots 3 weeks after removing tarps.

Q: Can tarps go on top of straw? Compost?

Yes, and we have found they increase spring soil temperature when applied over these mulches.

Q: Is tarping linked to a higher initial soil temperature when planting seedlings?

Not after the tarps have been removed, in our data. However, the higher average temperatures under the tarps previous to planting may cause more nutrients to mineralize and less leaching, leaving soil nitrogen in place before the crop.

Q: Would tarps work with crimped cover crops?

We have used tarps over fall cover crops and also crop residue. It is likely that there would be suppression of weeds and cover crop regrowth using tarps. That would delay crop planting by several weeks. We think that tarps will help farmers who wish to incorporate cover crops into their permanent bed systems. Without tarps, the heavy biomass from many cover crops may be hard to kill and manage.

Q: Have you tried fall cover crops followed by spring tarping?

Yes, one of our shallow till treatment had oats and tillage radish in fall and tarp in the spring.

Q: If you have a cover crop can you just put a tarp over in the spring and not till?

Yes, if you are willing to plant through a layer of residue. The amount of residue will depend on the cover crop. A spring tarp, in our experience, will not completely remove oat-pea cover crop residue, though it may reduce it.

Q: Are you mowing the cover crop and when you mow, are you cutting as close to the ground as possible?

We mowed the oat-pea cover crop before winter-kill in the tarped treatment, about 2in above the soil surface. In ME we did not mow prior to applying tarps. In all cases the cover crop winter killed.

Q: Are you applying the compost and tarping over it or are you tarping and then applying compost after you remove the tarp?

Generally, we are tarping and then applying compost after removing the tarp. However, when we tarp we are tarping over the compost that had been applied the previous year. We added compost in the fall

of 2014 to establish the treatments and each spring, a new layer of compost mulch is applied before planting.

Q: Is there a suggested timeframe between removing tarps and planting? Why?

We have waited at least one day, but are not sure it is necessary. In ME, the researchers have noted the smell of ammonia when removing tarps, but not in NY.

Q: Have your experiments included fine seed crops (carrots) or not transplanted? What is your strategy for direct seeded crops?

At this point only transplanted crops. We have a new tarping experiment looking at timing and not-ill vs shallow tillage in tarped systems with beets. We know that growers are using tarps with fine seeded crops in situations where they have done tillage before tarping or using very shallow surface tillage after removing the tarps.

Q: How is the cabbage planted into the tarped no-till beds?

All the plots, tarped and untarped, were transplanted by hand in this experiment. Though we have used a mechanical transplanter also.

Q: Have you ever planted directly into a clover cover crop?

A clover is typically a perennial or at least a biennial. This crop can cause too much competition to your crop, of course depends if you have plenty water (irrigation) or how dense the clover. Although clover is a legume, most of the N is not available to the crop until it starts breaking down, after you terminate it and turn it in.

TARPING AND SOIL BIOLOGY

Q: Are there disease issues associated with the reuse of tarps?

We have not reused them with enough frequency to have an answer, but there is a possibility of problem emerging. It would not be good to use a tarp on a crop after using it previously on the residues of the same crop.

Q: How do tarps affect worms? Fungi? Bacteria?

We have anecdotal evidence that there may be an increase in worm populations. More research needs to be done here.

Q: Have you found that tarps kill off beneficial organisms?

We don't know. The opaque tarps we use do not raise soil temperature nearly as much as clear plastic. Duration of tarping and maximum soil temperature may impact soil organisms, positively or negatively. If some are killed, we suspect that these populations will bounce back with input of organic matter or recolonized from soils below.

Q: How do you limit rodent activity under tarps? Snakes? What about in the straw treatments?

We have not had problems with rodents, even in the straw treatments. This may be because our plots are surrounded by frequently-mowed grass, and the experiment has a 6' tilled strip around its perimeter.

COMPOST AND STRAW MULCHING

Q: Do growers who rely on mulch report any increases in pest pressure?

We haven't heard reports of increased pests necessarily. Straw mulch has had pest problems for us in NY, including slugs and cucumber beetles, regardless of the tillage approach we used. The ME location has not experienced either of these issues.

Q: How much compost mulch is used?

If we mulch the beds to a depth of about 1.5", but not the pathways, we use about 70 fresh tons per acre.

Q: When are you applying the compost, before or after planting?

Compost is applied before planting and we then hand transplant below the mulch and into the soil.

Q: Will it take compost beds a few years to "kick in" and get better and better in terms of soil microbial activity and moisture retention?

We may have seen this in the second year of the experiment, when compost mulched treatments yielded more than the others, regardless of tillage. That did not happen in our first year. After many years of heavy compost applications, some farmers have reported that the top layer becomes hydrophobic and seeds or transplants struggle if they are planted in that layer.

Q: Is it correct that the deep till compost treatment has more soil P? Is your phosphorus building up?

Yes, in the tillage treatments the compost was tilled in and is accumulating in the root zone. Phosphorus in compost is building up in all compost mulch treatments and until now we have only been sampling the soil below the no-till compost mulch. This is an important issue in long-term sustainability.

Q: Have you measured soil organic matter changes?

Yes, in NY soil organic matter has risen a full % point per year in the deep-tilled compost mulch treatment. When the compost mulch is left on the surface and not tilled, soil OM has gone up much less. There is organic matter on the surface but until now, we have only been soil sampling below the compost mulch in the no-till system.

Q: Can you use woodchip mulch?

We haven't yet but it is an interesting alternative, low nutrient mulch. Chips can be difficult to plant through and limit cultivation options. We know of growers in peri-urban areas using leaf mulch with success.

Q: Has anyone looked at peat moss as a mulch?

Not that we know of. Cost and the potential for wind blowing it away may be negative issues.

Q: Is it possible to use straw from my duck coops as a fertilizer?

You will want to apply this straw with manure at least 120 days to do this before day of harvest, as per NOP or GAP food safety rules.

Q: What is the form of fertility you use?

We apply additional fertility only when we have no mulch and straw mulch. We have been using mixtures of commercial organic materials, including a 5-4-3 composted chicken manure product.

PERMANENT BEDS

Q: How scalable are permanent beds?

The largest scale organic vegetable farm we work with has 13 cropped acres of permanent beds.

Q: How do you set up your permanent beds so you're always hitting the same place with your tractor tires?

We just use the same tractor and always drive in the same wheel tracks. Since we are not discing or harrowing the tracks are always visible. We also use drive stakes on the ends of the beds, staking distance between beds according to a fixed point on the field edge, so they don't "drift".

Q: Planted vs unplanted aisles? Clover? How does this affect insect pests?

Many permanent bed growers have either given up permanent beds or renovated with tilled pathways after growing cover there. Clover in the pathways is an invitation to perennial weeds. In Maine, we have used it in a different permanent bed experiment. Ability to irrigate becomes important, because the clover uses water in addition to the crop. We don't know how it would affect pests.

Q: Can you trim weeds instead of cut them?

This is a good point, and why, in Maine, we are trying to manage weeds in the pathways by mowing. Using the flail mower we're getting quite low. Any perennial weeds in permanent beds should be removed as soon as possible.

Q: Are the beds raised?

Are beds are not raised using any bed forming equipment. However, the compaction of the pathways and lack of it beds, and annual addition of mulches, raises them in practice.

Q: Did you maintain the same conditions on the same rows from year to year? In that case could it be that 2 years of compost had a cumulative positive effect?

Yes, we think.

Q: Given the difference in results between the two crops, do we need to have a till/tarp plan per veggie type we are growing? Or will you be recommending one combination as the best?

We don't know yet. If tarps are changing soil fertility, it may be that different crops will be more responsive to tarping. If fertility is not limited, they could have less of an effect.

Q: How do you define deep till vs. shallow till in terms of tillage depths?

Deep is equal to as deep as the rototiller will go, ~6-8", and shallow is half of that, ~3-4"

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2014-51300-22244.