



> Need to discuss? Got something you need looked at? URI Extension: 401-874-2967/andy_radin@uri.edu, hfaubert@uri.edu

A SHOCKING DEVELOPMENT: Will electrocution of weeds be transferable to specialty crop farming?

Time to Zap the Weeds

At a conference I was “attending” (online) a few weeks ago, I was sitting through a gruelingly boring weed management presentation which concerned various herbicide options for weed control in Western NY’s giant fields of snap bean, cabbage, and table beet. The presenter, Lynn Sosnoskie (new weed science extension professor at Cornell, based in Geneva), used the last five minutes to mention a recently revived practice of what is essentially weed electrocution.

Seems like an interesting idea, right? Weed management is pretty much up there at the top of input costs, not mention environmental and human health costs, of farming. Herbicide resistance is also now being documented more and more frequently. And weed cultivation and tillage used in vegetable

farming, especially organic, clearly has a negative impact on soil health.

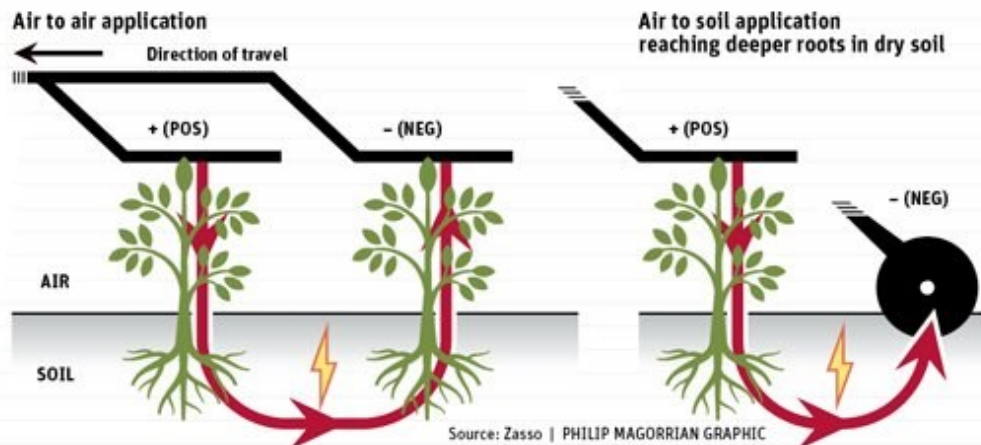
The mode of action is in the fact that plants do conduct electricity, though not anywhere near as well as a copper wire. Cell sap is water and electrolytes, so there is some degree of conductivity, but not a lot, which is important. With a high enough voltage (potential to ground), current can be forced through



Continue reading on Page 4

ELECTRICITY REPLACES NON-SELECTIVE HERBICIDES

German company Zasso has developed Brazilian technology that could one day replace herbicides such as glyphosate. Electricity flows from tractor-driven generators either with two pads or a pad and disc to any vegetation that comes into contact with it and the circuit is completed through the soil. Weeds are effectively electrocuted without the need for herbicides.



What do we want?



Plastic mulch that blocks weeds, warms soil, and holds in moisture!



What do we **NOT** want?



imgflip.com

What do we want?
REALLY

To have to pull plastic mulch out of the field and haul it to the dump (or pile it up in a muddy heap somewhere)!!



Biodegradable plastic mulch that actually breaks down in the field!



When can we have it?

Now! (unless you're certified organic...)



imgflip.com



Soil Biodegradable Mulch: Should you make the switch?

Why you should make the switch

By Shuresh Ghimire, UConn Cooperative Extension and Andy Radin, URI Cooperative Extension

Something important for you to consider: your use of plastic mulch in vegetable production. This is especially worthy to think about given that plastic mulch isn't just for tomatoes, peppers, and eggplant anymore. Most small scale growers use it for onions, lettuce, herbs, and more. You've no doubt heard about biodegradable mulch, but possibly not so great things. Here are some important questions you may have, and some real answers.

1. Can plastic mulch actually "degrade?" Yes, and No.

First, the NO.

Degradation caused by sunlight, heat, moisture, and mechanical stress results in ever-smaller fragments of plastic, ultimately becoming what are called "microplastics." According to a quick search on Google Trends, this word as a topic has increased dramatically over the last 5 years, which corresponds to an increase in our understanding of just how pervasive these pollutants are on land and in the oceans, and the possible and probable effects they have on species richness and diversity. It's a disturbing and inescapable fact that plastics are changing the planet for the worse.

Now for the YES!

Degradation of plastic by microorganisms, known as biodegradation, is very much a real thing, provided the plastic is made of the polymers that microbes can consume. Soil-biodegradable plastic mulch breaks down into CO₂, water, and microbial biomass.

But let it be stated right here up front: except for paper-based mulches, there are no biodegradable plastic mulches that are approved for use by certified organic farms in the United States. (See Box with NOP standards for reasons why.) If you are a certified organic grower, you cannot make the switch. You are permitted to use paper-based mulches, as long as they do not contain any synthetic materials. However, these do not perform well in our climate.

USDA National Organic Program Rules

Biodegradable biobased mulch film was added to the list of allowed substances in October 2014. However, it MUST:

- a) be 100% biobased (ASTM D6866);
- b) be produced without use of synthetic polymers (minor additives such as colorants and processing aids not required to be biobased);
- c) be produced without organisms or feedstock derived from excluded methods (i.e., synthetic or GMO);
- d) meet compostability specifications (ASTM D6400, ASTM D6868, EN 13432, EN 14995, or ISO 17088); and
- e) reach $\geq 90\%$ degradation in soil within 2 years (ISO 17556 or ASTM D5988)

Our (usually) plentiful rainfall and warm summer weather causes rapid breakdown of these materials.

But if you otherwise do use plastic mulch, please read on as we consider a list of potential issues with the use of biodegradable mulch (BDM.)

2. How much do BDMs break down during the growing season?

Shuresh Ghimire (UConn) and his colleagues at Washington State University and University of Tennessee found that among 4 products they tested, by the end of August, less than 10% of the soil originally covered became exposed, and that remained under 15% by the end of October. (This was in an area that averages 42 inches of rainfall, annually, versus RI, which is closer to 50 inches.) These mulches really hold up during the season they are applied!

3. How do yields on BDM compare to yields on polyethylene (PE) mulch materials?

Shuresh and colleagues have also looked at that over several years and found relatively similar yield results between BDM and PE mulch. Unfortunately, it's difficult to state this definitively because in a survey of



Continue reading on Page 5



the weeds, but the resistance to the current generates enough heat to boil the liquid (cell sap) in every cell, which results in plant death all the way down through the roots. A zapping unit, therefore, needs to have an electrode fueled with high voltage, and of course being electricity, there has to be a ground which is, of course, the ground itself. In order to complete the circuit, the tractor has to be grounded, which is done with coulter or in the case of a spot weeding unit, a grounding spike of some sort.



Technology dates back to late 1800s, when several patents were filed for units designed to clear vegetation to put in the railroads. There was more interest among agricultural researchers up into the 1940s. Clearly, the “better-living-through-chemistry” revolution kicked in and the weed zapping road came to a dead end.

It seems that in the late 70s, there was a flurry of research at Land Grant universities, and a company called Lasco revived this technology and began manufacturing The Lightning Weeder in Mississippi. This unit, which is actually still available after a change in company ownership, is an electrode bar that spans 8 or 10 rows and is really designed to kill weeds that are sticking up above an existing crop canopy (<https://youtu.be/lyjy3OgOJos>). The high voltage comes from a PTO-driven generator on the back of the tractor. The bar is not meant to touch the crop itself, of course, but if you are on uneven ground, who knows what you could accidentally hit.

RootWave is a British company that is developing several electrical weed control units for various set-

tings, including a spot weeder (which requires being tethered to a vehicle that hauls around the generator that supplies the voltage for doing the zapping.) Oddly, the company has trademarked the word “Electricide” as the name of their electrocution technology that kills weeds. (This word conjures up in my mind the wanton and violent killing of... electricity.) I don’t get it, but that’s their marketing scheme. The video for this unit (RootWave Pro: <https://youtu.be/Ow25sNK5ZF4>) shows a rather klunky piece of equipment which I’m not sure I could operate for more than 15 minutes at a time. It also requires a large yellow pair of ground-insulated boots.

The Weed Zapper Annihilator Series is a more modern take on the Lasco units. These, like the Lasco, are designed for larger scale field crop situations (though it’s useless for corn- too tall). I like that this company actually plainly states the prices of their units on their website. The smallest which covers 6, 30-inch wide rows, is 15 feet wide, has a 110kw generator, and requires a 120hp PTO. It costs \$42,000.

So we are not going to be using these large units in RI, though an interesting application would be for killing cover crop, which could possibly improve the possibility of no-till without herbicide. [Unfortunately, the roller-crimper has been shown to not really do a good job without also using herbicide.] It would also be interesting to see a unit that could be easily customized to vegetable rows. Could electrocution be a solution to controlling weeds between plastic mulch-covered beds which wouldn’t damage plastic nor leave pools of herbicide to drip down planting holes in the mulch? Innovations will eventually abound, no doubt! Meanwhile at Cornell, evaluation of units such as these are ongoing- at least on soybeans. It looks like further engineering will be required in order to put this kind of weed control modality into use in specialty crop settings.





comparative studies, Martín-Closas et al. (2017) found better performance, worse performance, and equal performance between BDM and PE. But these were in a wide range of soil and climate conditions. The chances of BDM performing better than PE in an exceptionally wet summer in eastern North Carolina are slim- the stuff will break down more rapidly, so you do take something of chance there.

4. Will last year’s mulch bits disappear by the time I am prepping beds this coming year?

Shuresh and colleagues found that traces of several tested products could be found 2, 3 and even 4 years after use. This longevity was strongly influenced by soil texture [see footnote], climatic factors (annual rainfall, annual average air temperatures), and product formulations. As you might expect, biodegradation is more rapid in warmer, wetter climates and in medium textured soils which have the benefits of good water-holding capacity as well as decent porosity.

Yes, there is differential breakdown among the products, and some of it remains for up to a few years.

Products that perform the best within a season also probably leaves residues for longer. These are often thicker. But that doesn’t mean it leaves behind microplastics. The limits of instrumentation make it nearly impossible to document the final-most end-stage of decomposition of soil biodegradable plastic, whereas microplastics are actually detectable.

5. Isn’t BDM more expensive than PE mulch?

Yes, it really is more expensive to purchase the material- two to three times more, depending on thickness. Plan to lay out more cash on the front end of the season. BUT: don’t forget to calculate how much you can save on the back end. There’s an easy to use calculator available for download here. [Note: this link will take you to an Excel spreadsheet on your browser tab. You can download it by clicking on the “File” menu in the upper left-hand corner of the spread sheet and then click on “download.” After doing that, make sure that you enable the macro features.]

Below is what the calculator generated based on using 3- three thousand foot rolls of mulch on an acre.



Continue reading on Page 6

Per Acre Cost Comparison

	PE Plastic Mulch	Biodegradable Mulch
Mulch Installation		
Machinery	\$435.00	\$435.00
Material	\$405.00	\$1,050.00
Installation labor	\$240.00	\$240.00
End-of season		
Mulch removal	\$682.50	\$0.00
Mulch disposal	\$15.59	\$0.00
Mulch tilled into the soil	\$0.00	\$244.50
Total Cost	\$1,778.09	\$1,969.50
<i>Difference in Using Biodegradable Mulch</i>		<i>\$191.41</i>



There are many assumptions built into this output, and the spreadsheet allows you to adjust all of those. But going with what they filled in for default estimates (labor rates, tractor time, dumping fees, and more), take a look.

In this case with all of the default values they started with (again, which you can adjust), it costs 11% more per acre. In case you're wondering, many of the dollar values they used are on the generous side, so this may be an over-estimate. Over-estimating is always good in enterprise planning, at least to a point.

Other factors not accounted for in the spreadsheet:

A. Aggravation/Procrastination factor: there's nothing like an un-fun job to persuade you to do other things that seem less aggravating. But pulling out the drip tape is the only thing stopping you from disking over your plastic-mulched beds.

B. Interference with timeliness of cover crop planting: getting those beds cleaned up speeds you towards getting your cover crop seed planted. Getting deep into the financial analysis, it's entirely possible that the earlier cover crop planting recovers more nutrients and increases organic matter in your soil, which are things you can take to the bank.

C. If you grow into the fall and winter, you have tunnels to clean up but also fall planting deadlines to keep. Deadlines like that can easily cause a delay of field cleanup because every day of waning daylight in mid to late September reduces fall tunnel crop growth.

D. You are putting less polyethylene mulch onto the land and eventually, into the ocean. Hard to calculate costs associated with that, but they are real.

6. Can it be applied in the field just like PE mulch?

Yes, more or less BUT three caveats:

A. It is more delicate than PE so it has to be handled a little more gently.



Your Input is Welcome

Everyone wants to hear from YOU

A paragraph or two in an email is all it takes. Also, please submit suggestions for articles, meeting topics, and research needs from us at URI.

News from a Middletown Farm

Once again, thanks to the Garmans for letting us into their farm operation. ALL are welcome to share experiences, new knowledge, and eternal quandaries that make farming so... interesting.

We are finally done for the season here. We admire those of you who keep it going all year round, but we've sold all our storage crops and it's time to think about 2021. Winter is our numbers time as we evaluate what we sold and what we didn't sell, what crops ate up high levels of labor, and what we need to do to keep sales strong.

We have no complaints about product sales in 2020. Our restaurant accounts went into the dumpster, but our direct sales to consumers through CSA and grocery sales more than balanced those losses. CSA membership was as high as it's ever been, perhaps because of pandemic fears and stimulus checks. But once you have those members, how do you retain them, other than by offering great produce and friendly service? One trick we've learned is to ask for a nominal deposit for next year at the end of the season. Balances are then broken into two payments in March and April. People are generally in a good mood and sentimental when the CSA winds down, and 82% of our members put those deposits down, leaving less need to market the CSA in the Spring.

The commodities that brought us the most revenue (note: not the same as the most *profitable*





commodities!) included honey, standard slicing tomatoes, cut flowers, and squash/zucchini. We are a small market farm, so it is a little discouraging to look at those top crops and think, why do we grow fifty different things? But we still need the kohlrabi and the watermelon and the Hakurei turnips to keep the CSA members intrigued, so we will continue to do so, although in more efficient ways. Transplanting beets is a good example – certified organic beet seed is ridiculously expensive, and the labor saved in thinning big stands of them is significant.

Finally we tend to follow the Pareto principle of doubling down on what makes us money. [Editor’s note: Whuh? Didn’t I go to high school with someone by that name? From Wikipedia- The Pareto Principle states that “roughly 80% of consequences come from 20% of the causes.”] So we are looking at ways to streamline production for those crops at the top of the chart. A big part of that effort is seeking out disease resistant varieties to cut down on spraying time. We also look at things that were near the top 10 in sales, but didn’t require as much labor – sweet potatoes are a good example. We are kicking ourselves for not planting more in June, because we’d still be selling them if we had stock.

We hope you had a terrific year. We are grateful we survived having an infant outside for 14 hours a day, and we are looking forward to even better times in 2021.

[Editor’s note: I was assured that this photo was not staged. I’m pleased to see the best type of hoe that money can buy is being used by Freya!]



B. If it does get damaged while laying it down, decomposition will be accelerated

C. MOST IMPORTANT- it should not be applied as tightly as PE mulch because it continues to tighten as the weather warms. If it is installed too tightly at first, it will split as it tightens up, and this will allow early summer weeds to take over.

Think it over- it could change things for your late summer-into-fall transition... for the better. For a video testimonial from a Connecticut farmer, watch this [video](#).

Footnote: Shuresh and colleagues did not specifically look at the relationship between soil texture and mulch biodegradation rate. However, a study from Brazil https://www.actahort.org/members/showpdf?booknrarnr=1242_2 reports that the CO2 production was much higher when a biodegradable mulch was tested in sandy-loam textured soil compared to clay and sand-textured soil. In general, degradation rate would be higher in the soil where there are greater populations of microbial communities, the soil is not too dry or not too wet (balance of water and air in the soil pore/capillaries). This probably means greater degradation rate in sandy loam or silty loam soil than clay or sands.

Join us for our first of four LIVE Webinars on January 14, 2021

Pests of the Year, 3:30 to 5pm with:

Ann Hazelrigg, UVM Diagnostic Clinic

Andrei Alyokhin, UMaine Faculty

Ethan Grundberg, Cornell Cooperative Extension

1.5 Pesticide Recertification Credits available

Learn about the biology and management of some emerging pests and diseases from recent years, along with newer strategies for managing our perennial pest problems. Refreshments will be served (as long as **your** fridge is well-stocked...)

Agenda available here: ag.umass.edu/vegetable/events/pests-of-year

Registration: [Click here to register for this meeting.](#)