

[Andy] This is the ag engineering podcast that rolls right into the details on tools, tips, and techniques that improve you, your farm, and our world. I'm your host, Andy Chamberlain, from the University of Vermont Extension and this podcast is sponsored by Northeast SARE. Thanks for listening. Today's episode comes to you from Orwell, Vermont where we're visiting with Becky Madden of Singing Cedars Farmstead. She also works for the University of Vermont Extension in nutrient management, specifically for vegetable farms. In this episode, we talk about soil steaming. She's on a project that is testing it out, seeing how well it works, what temperatures are effective or not at reducing weed populations. So that's what this episode's all about. Let's get right into it.

[Becky] My name's Becky Madden and I work for the University of Vermont Extension on soil health. And I also have a farm with my family in Orwell, Vermont that's called Singing Cedars Farmstead.

[Andy] How many years have you been farming?

[Becky] I've been farming pretty much since college working seasonally and then right out of college, I started farming full time at various operations. So that was 22 years ago.

[Andy] What's your growing area, acres, tunnels, that sort of thing?

[Becky] On our farm now, we have eight tunnels. They are various sizes, I'd say they probably average 2,500 square feet. So what's that, about 20,000 square feet of growing area? So my husband's been farming here for about 20 years and was very diversified doing CSA and a whole bunch of farmer's markets. And then, you know, a lot of climate related incidents on heavy clay led him down the high tunnel route. And also it's a simpler, I guess, market. So we mostly wholesale direct, I guess direct sales to co-ops and restaurants right now. So we don't do any farmer's markets. We deliver two days a week to Burlington, Vergennes, Middlebury, sometimes the Rutland area as well. We're in a funny middle place where we're sort of 45 minutes from Middlebury and Rutland. And then during COVID we built pretty quickly built a home delivery route, which was really wonderful. And we keep kind of revisiting that in our head as something that was really gratifying, but we just didn't have the labor to sustain that. We have a small beef herd as well. So that was a nice market for that product.

[Andy] She didn't wanna share specific numbers, but we'll say that their farm is making a full time income and have experienced significant growth over just the last couple of years.

[Becky] Largely that's due to going from three tunnels to five to eight in the past couple of years. So we've really taken advantage of the NRCS high tunnel grant program.

[Andy] That's a massive growth .

[Becky] Yeah, it is. It's, I guess was kind of unexpected from my viewpoint, but exciting.

[Andy] So are you planning to continue to grow or are you gonna level off here?

[Becky] Well, our lunchtime conversation included the infamous one more high tunnel question, but I think, I think it's actually quite exciting. You know, my husband Scott Green, has been farming for 20 years here and I think has really found a way of farming that he loves and we have a family and busy lives. And I think this style of farming feels very sane. We don't work 80 hours a week. I have an off-farm job and he does a lot of childcare and parenting. So I think having one more tunnel or even a couple more would help us really fulfill the market demand that we feel like we have. It's hard to have a consistent supply and not feel like you're letting people down when you have these gaps in crops. So I think it would be a good business move to have one or two more tunnels. And then we get a healthier crop rotation too. It's as everyone knows, like growing tomatoes in a tunnel year after year is pretty, gets pretty ugly after a while.

[Andy] So you're not done yet. Just a couple more, just a couple more.

[Becky] Exactly. Well and the prices have got, I think they've almost doubled since last year. I wish we had just gotten a couple more. We ordered from Harnois in Canada last year and the quote we just got back is two times the price.

[Andy] Ouch.

[Becky] Yeah.

[Andy] If you could describe your farm in one sentence, what would you say?

[Becky] I introduce it in a little bit of a back handed way. Like if somebody's applying to work here, I describe it as not your typical vegetable farm because the work isn't as physically demanding, it's pretty condensed. It's a lot of more intelligent kind of like plant horticultural work. So the one sentence I would use is Singing Cedar's Farmstead is very specialized and very modest. We don't do a lot of, we're not on social media and just incredibly beautiful piece of land. I think that's what's really been singing to me lately and very committed to organic principles.

[Andy] Do you feel it's unique because you're implementing research from your day job so much?

[Becky] It's awesome for me. I really love that. Just today, Scott and I were, he was like, what if 70% of your work could just be doing research here on tunnels? And I think there's a genuine demand for more high tunnel expertise. So it's been really cool to, I generally am doing research on our farm and then several others as a point of comparison. So this high tunnel study I'm doing, we are one of the 20 farms in it. The steaming is unique because it's such a big piece of equipment and it has to kind of just be on one farm. I feel really lucky to have a piece of land to experiment on. And I would like, a lot of my work is with soil health and cover cropping. I'd like to use some of our land that's now open because we're not growing in the field so much to do research on that.

[Andy] Playground.

[Becky] Yeah.

[Andy] Today we wanted to talk about soil steaming. So could you just tell me a little bit about it and how the process works?

[Becky] Yeah, so soil steaming, I first learned about it at a Vermont vegetable and berry growers conference or meeting, annual meeting. Andre Cantelmo spoke about it. And then I know Jericho Settler's Farm, Christa has been talking about it and the Arnolds have been using it for quite a while. So a lot of experienced growers have been doing this for probably a decade or more, and I was intrigued and as our chickweed problems advanced here on our farm, I think it's, you know, generally like five years into growing, if you're not like totally on top of it, you start to see these problems. And specifically in winter greens. So simultaneously I was receiving a lot of questions in my role at Extension about soil steaming. So we wrote a specialty crop block grant for the state of Vermont to investigate the soil steaming and specifically to look at this question of soil, the impact on the soil ecology, and also just developing a few standardized best practices and a few kind of economic kind of understanding it economically, because it's a very expensive piece of equipment. It takes a lot of time in the fall when you know, we're trying to flip the tunnels into greens right now and it's just like, eats up an extra week of that precious time that you never make up on the, you know, winter end of things, on the harvest side. So we were trying to address a lot of those questions and we were awarded the grant thanks to the state of Vermont. It's a two year study and we set up some replicated trials here on the farm in a couple tunnels where we're monitoring soil steaming temperatures, taking samples of the soil microbes, pre steaming, and then post sequentially for the next year. And also looking at the soil nitrate because that kind of, anecdotally, a lot of growers notice this burst of nice green growth after steaming. So trying to understand what's happening with the soil nutrients after steaming. Like many studies, I think I'm learning in a more scientific way what a lot of growers already know.

[Andy] Getting some data to back it up.

[Becky] Yeah, exactly.

[Andy] Which works too, because it just proves the point of the observation.

[Becky] Yeah, exactly.

[Andy] What are some of the early findings or your hypothesis that you're looking to prove?

[Becky] Yeah, last year's research was really interesting partly because we had bought a soil steamer, an old one, and it took us a lot of work to get it set up. So our first round of steaming wasn't technically part of the study, but it was just sampling to figure it out. And some of those temperatures were really low, like way lower than the literature suggests like 120, 140 degrees. And I was surprised how good the chickweed control was in those plots. So, and it didn't carry over. It didn't sustain as long. So I don't think, you know, you're killing the seed bank. You're exploding the seeds, you're injecting steam into the soil and like basically cooking them. So I don't think we had as sustained a control, but it still was kind of like interesting. On the cost side of things, the trial plots like very quickly paid for themselves for the soil steaming. I was amazed once I broke down the cost per square foot of, you know, depreciating our

steamer over the course of five to 10 years still feeling like the cost. And this is with the chickweed populations we have, but the cost of hand weeding or controlling it versus soil steaming was, you know, a huge difference. Something that really surprised me was how good our damping off control was after steaming. So we've adjusted our seeding rate as if we're gonna lose 50% to damping off and the plots after steaming every, we had like 90% germination and good growth. So that saves on seed and offers better yield.

[Andy] Hand weeding sucks. Does this completely eliminate it or just--

[Becky] It did last year

[Andy] Cut it back.

[Becky] Yep.

[Andy] Awesome.

[Becky] We had no hand weeding. Yeah. I mean the embarrassing truth is we'd let it go so bad in one tunnel that the year before we almost didn't even harvest. We were just like, it was just like carpeted chickweed, and you'd go in there and spend like three hours weeding and then look at your little area and you're like, and it just comes back and comes back and comes back.

[Andy] Comes to point, yeah, it's just not worth it.

[Becky] It's kind of a miracle, yeah. And I'm really interested to see, I feel like there's a couple emerging soil management techniques like tarping and solarization and anaerobic soil deinfestation, which are all kind of conceptually manipulating the soil health in different ways. And I'm curious to kind of, at the end of all this, and there's several other studies happening on those techniques, to kind of sit down and compare notes and be like, what's, you know, what fits where in terms of like managing a farm.

[Andy] What do you think the next steps are for your research and steaming after this year?

[Becky] Yeah, so the study actually officially ends our grant funding, which has really only paid for my time on the study. So that chunk of funding will be gone. I'd like to continue to look at it, kind of track the tunnels we've steamed here, just tracking the soil microbes and the soil nutrients and the chickweed populations. But I'd also like to understand better, like what amendments can help feed back the soil microbes quickly after steaming. So, you know, for instance, would you steam and then immediately do a top dressing of a high quality compost or high quality Verma compost or root shield or some kind of inoculate the soil back into good health.

[Andy] Compost tea.

[Becky] Yeah. I'd like to understand what kind of recolonizes. I, you know, anecdotally, one farmer thought that pithium recolonizes really quickly, so you get this initial control of it. And then after a little

bit of time, that's kind of what he thought was coming back in. So, you know, looking at it. And another cool outcome of this research so far has been bringing together the farmers who are doing this research. So I've just learned so much from them and a bunch of farmers jumped on the webinar we offered last year. And that was just so cool, like this group of people who all have refined the system and have all these tricks and tips. So I learned a tremendous amount from them and I'm looking forward to sharing more with that group. And we built a little like email list serve that we've been using.

[Andy] Nice.

[Becky] And it's really cool. I think the coolest thing about Extension is like, not that I'm gonna develop best practices within two years of doing this, but that I can actually answer questions. I have the time and capacity to answer the questions that farmers who have been doing this for a long time and do know the best ways to do it still have, you know?

[Andy] Yeah, the big questions.

[Becky] Yeah.

[Andy] So what's the process of soil steaming?

[Becky] Yeah, so the steps to setting up a soil steamer are first, very first thing is really good bed prep. So having the soil exactly as you want it for planting or direct seeding. After you're done steaming, you don't wanna disturb it afterwards. Second step is to water it well, you know, as you would basically water for a typical irrigation is about right. So not too wet, not too dry. And if you conceptualize it, you're trying to get you're blowing steam, hoping it goes down into the soil and then moves through the soil profile efficiently. So a too dry or too wet soil won't transfer the water and the heat efficiently. Step number three, I guess, I'm gonna lose track of my steps, is to lay down the steam delivery hoses or socks as they're called. So you evenly spread those on the soil surface. And then the next step is to put a tarp, either a used piece of greenhouse plastic or the skrim fabric, which is a more durable, Dura Skrim, I think is one of the trade names for it, on top of the steam socks and spread that out evenly for the area you want to steam, we're doing about a thousand square feet. I think sometimes less is a little more efficient. Ideally you could do more at once. Then the next step is to weight down the sides very well, very evenly. We're using chain for that. You could probably use lay flat drip line filled with water, but it has to be quite heavy. Any leakage out the sides is not good. Bruce at Piccadilly Farm had coached us on walking on the chain afterwards. So you're really pressing it into the soil. It's like a little balance beam. And then the next step is connecting those socks to the steam delivery hoses off of the steamer. So threading the coupling on, and then also coupling it to the steam delivery hoses to the steamer. You wanna make sure you have plenty of diesel or whatever fuel you're using in the steamer. This one's nice cause it has a 65 gallon tank. So it was delivered to us full. They stopped at a gas station and filled it up. But we've had to refill it a couple times. And that means all our little five gallon fills. You have to fill the tank with water to have enough water supply in there. We have a pretty low pressure system here. So we try to fill it up pretty well before we get going. Because otherwise it'll cut out if the water level gets too low, it cuts out. And then just checking to make sure this steamer especially wants to be pretty level. So we try to, you know, once we park it, make sure it's like relatively level, there's a little leveler or

bubbler, bubble on the side. And I think that's it for prep. And then we fire it up, which on this, you know, you just plug it into regular. What was it, 110 outlet. And it's a switch. It's very easy, switch it on. I've been closing the delivery, the output hoses so that they build up a little pressure ahead of time. And then when it's around five PSI, opening them up about four cranks and try to run it around three PSI for steam delivery. And then I hover for a while. Make sure everything's good. And then I start checking temperatures after about 45 minutes of running and ideally we're done in an hour and a half. Sometimes it takes a little longer, we're aiming for 160 degrees, which I think is the place a lot of farmers are coming to in terms of like an effective steam temperature, two inches down into the soil and then it's hot afterwards. So you wanna put on gloves if you're gonna move it right away.

[Andy] That's a good point.

[Becky] Yeah, gloves are good.

[Andy] 160 plus degrees .

[Becky] Yeah, and that that's the soil temperature, the air temperature's quite a bit hotter. Last year I ran a, I had a temperature probe recording just the air temperature. And that was like 200 and I feel like it was 210. So, it's hot.

[Andy] Scalding temperatures for sure.

[Becky] Yeah, it's good, Probably good for your skin. I know we were always like, maybe we should like make it a sauna out of this situation or something.

[Andy] There you go.

[Becky] And the other cool use of it, which we haven't done yet. But you can sterilize like potting, you know, trays.

[Andy] Oh yeah.

[Becky] Pots. During COVID actually, the company Sue that makes this on their website. they were advertising steam cleaners for like park benches and playground equipment when everyone was worrying about COVID spreading on surfaces. So it's a great chemical alternative to sterilizing things.

[Andy] Are there any nuanced things to note about soil steaming that one might not know, you kind of mentioned it's expensive to get started because of the cost of the equipment. But other than that, why might somebody not want to do it? Assuming it doesn't take away the good stuff?

[Becky] Yeah, that's a good question. I mean, I think if you don't have any problems, then I wouldn't steam. It takes a lot of time and the fuel consumption is really abysmal. So six gallons an hour of diesel or kerosene and it takes about an hour and a half to steam. What's that like 120 so 1200 square feet or a thousand square feet. So that would be my number one reason is don't bother if you don't need to.

Some of the nuances to it involve the prepping of it. Having the bed exactly as you want it for planting ahead of time is a big one and figuring out ways to set it up so you're not walking on it either as you're setting it up or after. Last year we had, because we were using all of our own gear, we had actually set up several quadrants and had enough plastic. We were using greenhouse plastic. So we were able to just lay it all out ahead of time. And then you could just move the hose around. And that saved us a lot of trampling and fussing. The other thing, take home I got last year, which is probably logical to some people, but it's to really not disturb the soil if you're putting transplants in afterwards. So coaching whoever's planting and like as little disturbance as possible, really just like parting the soil instead of you know, digging.

[Andy] That's true, you wouldn't necessarily think about that and like you're right, you just want to plunk it in.

[Becky] Yeah.

[Andy] Don't mess up the bed.

[Becky] Yeah, and it really fluffs it up. So walking on it afterwards, the compaction is intense. It has this like totally different texture after steaming.

[Andy] The really tough nut to crack through research is what actually is the impact on the soil.

[Becky] Like at the very least, that's the question everyone asks like even people who don't know anything about farming or greenhouses, I think the number one question is like, well, what happens to the life in the soil? Like hopefully we're killing some of it and hopefully we're not killing all of it.

[Andy] Right. How can you steam and effectively kill what you don't want, keep what you do.

[Becky] Right. I think the trick is saz. The next step in my kind of research process is figuring out what we're gonna add back in to help. So, you know, is it Verma compost, Is it compost compost? Is it root shield? Like what is it that's gonna feed it back. Yeah, and I'm curious about future tillage activities after that, if we can kind of adjust, so we're not doing any deep tillage.

[Andy] Right.

[Becky] Or the counterpoint to that is just like flush out that first, that top 18 inches, just keep tilling for like five years, steam every year and then maybe you're good.

[Andy] Yeah, maybe kind of reset. Give you a fresh start.

[Becky] Yeah, I mean Paul and Sandy Arnold, they were super helpful when I was investigating this in the early days of the grant. And at that point I think they said that they were steaming every year and they felt like they needed to, and then just this fall, they said, we actually think we've kind of got things under

control for a little while and don't need to steam. I think they might've hit that point after several years of doing it. I might not have that totally right.

[Andy] Knocked it back, they knocked it back. They knocked it back. They finally got on top of it.

[Becky] Yeah. You can't steam every house every year logistically I don't think. The other thing I should mention, one of my curiosities was the capacity for shared, a shared piece of equipment. So this steamer we're using this year is from the Cheshire county conservation district in New Hampshire and they have all sorts of cool soil health conservation equipment that they share to farmers primarily free or for very low rental costs. I love the work they're doing. And when they bought this steamer, the hope was to share it among farmers collectively. I'm always sort of in the back of my brain, thinking about these key pieces of equipment, like a smaller scale no-till drill, soil steamer, the trick is making sure the windows of usage, you know, they're almost--

[Andy] Everyone needs it on the same sunny day.

[Becky] Yeah. I'm still like have that in the back of my head is there a demand here? So as we like wrestle up more attention around this, if the demand is there, maybe we wanna look at some funding for a shared piece of equipment.

[Andy] Or a handful of them.

[Becky] Yeah.

[Andy] Regionally, just pass around.

[Becky] Exactly.

[Andy] Is there anything I didn't ask that you wanted to share?

[Becky] I don't think so. Just a big thank you to the Cheshire County Conservation District for loaning us this year. And they're generous letting us keep it for a couple weeks and filming this. And then the Specialty Crop Block Grant of the State of Vermont for the funding and all the farmers who shared their information with us to get this going. So there's still a lot to learn.

[Andy] It's a pretty cool piece of tech.

[Becky] Yeah, it's been great.

[Andy] Thanks for listening to today's episode. I hope you enjoyed it. If I can ask you or direct you to do one thing that is to go to the website for this podcast, AgEngPodcast.com. That's A G E N G P O D C A S T dot com. There you'll find the show notes. You'll find links to the farmer who we chatted with today, as well as photos or videos from the call when I visited the farm. If you've got some feedback to share, my contact information's on there, or you can leave me a voicemail and you can do that right from the link

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