



FARMER TO FARMER

podcast



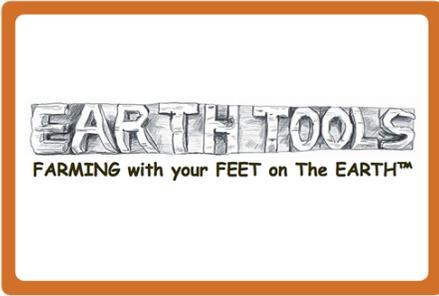
EPISODE 136

Sam Hitchcock Tilton of Michigan State University on Steps to Mechanical Weed Control Success

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Chris: It's the Farmer to Farmer podcast Episode 136 and this is your host Chris Blanchard. Sam Hitchcock Tilton studies weed control at Michigan State University where he went to study after two years of pushing a wheel hoe through clay soil on his own farm and more years of working for other farmers. His graduate student work on in-row weed control in vegetable crops has led him to explore the various elements going to setting up for weed control success.

Sam draws on his experience on farms, a visit to Europe to learn about and evaluate precision weed control tools and his work and his experimental plots to provide insight into more than just the cool tools that make weed control work. We look into the foundations of mechanical weed control starting with soil preparation and seeding the crop right through blind cultivation, flame weeding, tool carriers, and selecting the right tools for between-row and in-row weed control.

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Sam Hitchcock Tilton, welcome to the Farmer to Farmer podcast.

Sam: Thanks a lot. It's a pleasure to be here, Chris.

Chris: Sam, I'd like to start off by having you tell us about your background and how you got to the point where you were actually doing research on mechanical weed control.

Sam: It didn't happen overnight. I got interested in growing vegetables after college for various reasons. I worked a season on an Amish farm at Western Wisconsin. I was very interested in working with horses and that was just incredible not like I need to deal with the 21st century. I worked for Peter Seely over Springdale Farm north of Milwaukee. I grew up in Milwaukee. That was great.

Peter, he's traveled to Holland. He's got incredible family there, and they're quite mechanized so that was a really good introduction to me just about all the different things that need to go on a vegetable farm and a pretty mechanized scale too.

I met a partner there and we were really into doing it. For two years, we started a CSA and sold to restaurants. I spent a lot of time pushing a wheel hoe through our clay soil, and that really got me thinking about if there had to be a better way to do things. I think partly because we didn't know how to mechanize or just really the steps to take, so after two years, we stopped and I managed the educational farm for a little bit then went out to Vermont.

The whole time, we're just really enthralled with vegetable growing. I'd visit farms and write articles and just talk to friends about what they were doing. I felt like I want to approach it from a more professional standpoint and open myself up to getting jobs and having health insurance and whatnot. I linked up with a professor here at Michigan State University, Dan Brainard. We've been doing weed research for many years and reduced tillage research for many years. He had a grant and needed someone to look at in-row cultivation tools, tools that take out the weeds in the plant row. He was looking at it for reduced tillage systems. That was about two years ago now, I believe, and I've been here at Lansing since then.

I guess I should mention when I was farming in Wisconsin, a farmer gave me some advice. He said, "There's two things that farmers need to learn if you're starting out and no one will tell you this. It's not going to school or taking soil science classes. You need to learn how to weld and you need to learn how to fix small engines." I'm still working on the small engine one, but I did take welding classes and so that's been a real help to me in all the work I've done since.

Chris: Your research is on in-row weed control. In other words, that part of the growing space, that actually is the most difficult in which to do the weed control, but my understanding



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is also that you've had to learn a lot about the between-the-row weed control to really be able to explore the in-row weed control effectively.

Sam: Yes. The in-row weed control we started wanting to just dive in and realized pretty fast that it's kind of the Holy Grail of mechanical weed control which is to say a lot of other steps have to be done right for the in-row stuff to work. Obviously, the between-row, you need to do right and you need to set up the soil correctly, but then all sorts of steps before that we found and other people told need to happen so that the in-row weed can be pulled out without destroying your crop.

Chris: Let's talk about some of those principles for weed control. When you talk about the things that need to be done to set yourself up to be able to do that effective in-row weed control, what are we talking about?

Sam: The most important thing I would call the first prime imperative and Michael Smith over at Crest. He's been real nice and we've talked a lot of these things over, and he wants to introduce me to this. It sounds really obvious and I guess it is. It's that in order to do any in-row weed control your crop needs to be bigger than your weed. Whether it's the roots of your crop, if you're using a tool that pulls or whether it's the top of your crop whether you're using a tool that tills. That's the first prime imperative. These tools aren't magic and you need to set yourself up for success. The first thing is you need to have your crop bigger than your weed. If that's the case, then you can go forward, but you got to do things to get to that step first.

Chris: I love that because it's so basic but I do feel like it needs to be said. Part of that comes from the fact that the vast majority of vegetable seeds are at least a little bit larger than the vast majority of weed seeds, so the day they come up, they're actually bigger than a weed seed that germinates on the same day.

Sam: Exactly. Even when that's not the case for tiny turnips or what have you, there's a lot of things you can do to move the scale in your favor. I guess I'll just introduce the concept by saying I find it really helpful to think about it as a pyramid or an iceberg. The in-row weeding tools are the tip of the iceberg and that's what people see are these nice mechanical tools on YouTube videos. "Oh, man, they're going to really change my life." There's a lot below the water that's going on at the base of that pyramid, at the base of that iceberg that needs to happen to really set those tools up.

For example, I'd say at the base is plant health which is soil help. If you plant your vegetables in soil that is not conducive to them, there's plenty of other plants that are going to grow well on those soil and they're called weed. The first thing is you need to have soil that's going to allow your plants to jump off and really grow as fast as they possibly can, and that's really, I think, where you start taking care of that first prime imperative where you get those plants bigger than the weeds to start with.

I think the second step is besides your weed seed bank, and for example, you can have in a square foot of soil 10,000 weeds or you can have 100 weeds based on how you've been managing your weed seed bank. Let's say you have your cultivator just tuned in fantastically and you're killing 90% of the weeds or if you got only 100 weeds in that square foot, there's only 10 left; you're killing it. If you started with 10,000 weeds and you only killed 90%, you still got 1,000 weeds there. Reducing your weed seed bank is going to make a huge difference in allowing these tools to succeed. I've seen that here at the university research farm for various reasons. The field that we're on has a very



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low weed seed bank. I can grow carrots without ever weeding them. In fact, I actually have to plant weeds for us to do our research which is to say that through all types of cultural practices that we could get into, you can really quickly, over the course of just three or five years, you can drastically reduce the amount weed seeds in your soil. That sets you up for success in the future.

After that, before you've even plant your vegetables, there's tillage. When you do that, you want to think about what you're hoping to achieve. For example, let's say you're tilling in the spring, the previous fall, did you do a bad job on weed control that a bunch of lambsquarters go to seed. If you know that you have a whole bunch of weeds is on the surface, maybe you want a moldboard plow and bury them quite deeply so that they're not going to be a problem next year, especially if you're doing a crop that's not very competitive such as onion.

[00:10:00] On the other hand, if you're planting something like potatoes or corn, maybe you want to just lightly till to leave those seeds on the surface because you know that your crop will be able to compete with them and you can work them out of the soil. I'd say, after that, you're going to be preparing your seedbed whether you need a really fine seedbed for carrots or beets or something much rougher for those other crops we're talking about and even that starts to set you up for your mechanical weed control later on.

One thing that we found here ... I told you that we wanted to start using these in-row tools and reduced tillage systems, and we found out that with too much residue in the soil or with a very uneven bed, we couldn't get the kind of precision that we needed. Even when you're preparing your seedbed, after I rototill, now, I drag a lawn roller over it just to make sure that everything is compressed that when the seeder comes through, the seed press wheels won't make little valleys so the whole bed is even, and so that there is not waves left by the rototiller or S-tine cultivator or whatever I'm doing for my seedbed.

What we've been figuring out is that just like building a house, detail matters at all the steps even if your till is in a single step that might be okay. Over the course of a few steps, things really add up. By the time you get to that final cultivation, it can really hinder you and then you start thinking about planting another step up. What's your spacing going to be? Are you leaving enough space in between plants so that they can be healthy and thrive and compete with weeds? Also, are you leaving enough space between plants and on the shoulders of your bed so that there is earth there that you can move up and down? If your spacing is too tightly, some tools won't fit. Even if they do fit, there won't be enough earth for them to, say, hill or to pull away.

Chris: There what you're saying is like maybe I got a bed top that's 40 inches that I don't want to have my two outside rows end up being spaced at 36 inches because especially I got a bed, I'm just not going to be able to move any soil from the outside edges of the bed into that row to be able to adequately control those weeds.

Sam: Exactly. Of course, it gets tempting to fit as many plants as you can, but as you've said before, the more rows you try and fit in, the more you're opening yourself up to diseases, and like you just said, you really need that spacer to be able to move soil around. Something might look right on paper, but when you've driven over a bed a few times with a tractor, a few inches off here, a few inches off there, you really want to leave yourself enough space to play around with.



- Chris: I know that some of the biggest weed disasters that I observed when I was out consulting on farms was farms where we're doing raised beds and didn't adequately control the weeds on the shoulders of the beds. I think for precisely what you're talking about there. There's that couple of inches of variability and it requires just that much more precision and a little bit of a fudge factor on the edge of those beds between the edge of the bed and the outside rows so that you can both knock some of that soil off as you're killing the weeds, but then also have enough that if you need to move some soil into the row to bury the weeds that you've got the room to do that.
- Sam: Yes. That's really a good point is the fudge factor. These pools can be incredibly precise, and at the same time, it rains and you miss a cultivation. You want there to be enough soil there that you can use really aggressively till.
- Chris: In this, you described it as a pyramid or a weed control iceberg. We got kind of everything that we do before we plant. What can we do at planting to set ourselves up for success with weed control?
- Sam: Speaking to the principle of doing everything right and not letting the mistakes pile up, one thing I noticed in Europe and Holland and Switzerland is they have a real focus on growing older crops evenly. For example, they wanted to be able to harvest everything at once. That's a lot easier than coming through and harvesting some heads today, and some heads next week. To that end, when they planted, they wanted to make sure, one, that all the seeds were at an equal depth. If some are deeper, they're going to take longer to come up, and of course, if they're shallower, vice versa. That just goes back to having a nice flat bed top.
- Similarly, you want to be set up right away to irrigate. If you're not set up to irrigate and you wait a few days, the moist spots of the field, they're going to come up sooner; the dry spots won't. Then even when you're irrigating, you want to do your best to do that in a very even fashion. These are things that I kind of thought I knew, but when I saw them in practice over there, it really impressed upon me the lengths that you can go to grow your crop very evenly. In that way, you can treat it the same when it comes time to those weeding machine.
- Chris: Right, yes, because you certainly don't want to adjust your cultivators at one end of the bed for inch-tall weeds and then have half-inch-tall weeds or two-inch-tall weeds at the other end of the bed.
- Sam: You got it. You're going to have enough cultivator adjustment to do. You definitely want to cut down on that.
- Chris: I think that's where making those investments in seeding tools can really make a difference making sure that you've got a seeder that's working the way that you expect it to work. I would imagine too even just thinking about having a good control of the depth of the seeds not just being consistent, but small seeds don't want to be placed deep in the soil. If you plant something too deeply, then you're going to be waiting for it to come up and that's an opportunity for those weeds to germinate ahead of your crop.
- Sam: Yes and that's another example where things can add up. If you didn't do a great job on your primary tillage, if you didn't do a great job on your seedbed prep, and all of a



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sudden, you have a cloddy soil and you're trying to put turnips in, that's going to be a pain.

Another thing I wanted to add about planting that I think is a pretty important principle for mechanical cultivation is you want to plant as many rows at one time that you want to cultivate at one time, which is to say there's a lot of people with just one seeder. Those dang seeders are pretty dang expensive and the Planet Jr. can be too and so you just plant one row at a time and mark the bed and do your best. If you do a great job, you have some marking tools right off the back of your tiller. It can work, but for the best work of those mechanical tools, you want this station to be perfect. Perfect. The best way to do that is to seed them all at once, so you know that on the toolbar everything is clamp height and you know the exact spacing, so you know exactly where the plans are to come up.

Chris: I actually do think construction is a really good metaphor for what we're talking about because I know that it's one thing if at the last step you have something that's a little bit out of square. When you're pouring that foundation or when you're laying out the post for your high tunnel, that first step of making sure that the corners of the building are perfectly square, if you get that right, everything else is easier. Everything else falls into place, but otherwise, you end up with these compounding errors, and like you say, with setting up doing the row spacing, if you're seeding by hand, you're setting yourself up for what I think of as ... what I call these compounding errors. Maybe you're a half inch off on one row and a half inch off on another row that means you'd actually got a full inch now between two of your rows that's unaccounted for in how you go about setting up your mechanical cultivation.

Sam: Absolutely. I don't want people to think that this out of their reach here or I have to buy a \$1,200 three-row setup; you don't have to. I think Eliot Coleman in his books talks about opening three Earthway seeders together. It's really as simple as that. These principles and these steps can be carried out at any scale.

Chris: I'm pretty proud of my ability to be appropriately although sometimes it's actually a little bit of a hindrance in my life, but I'm good at being really precise. I do remember back when we were seeding things by hand what was actually the most important process to follow the marks that we had made in the soil. Even if the marks curved, don't straighten out the row. Don't try to correct for it. If you're going to mark the rows and then seed them, you have to be really precise about following the marks that you made instead of trying to cut corners or trying to straighten things out as you go.

Sam: Yes, absolutely.

Chris: Getting that seeding done and doing it with a lot of precision being really important?

Sam: Absolutely. It's paramount, otherwise, if you don't do that, that's fine, but just expect to cultivate one row at a time.

Chris: Right. Actually, this is something that Barb and Dave Perkins talked about on their episode just a couple of episodes back and that I remember from working with Richard de Wilde at Harmony Valley Farm. These are people that started off with even tractor-mounted transplanters or seeders that would do one row at a time and then would just cultivate one row at a time. It took them a little bit longer, but it was still faster than the alternative.



Sam: That's a good point. I remember this from when I was pushing a wheel hoe is just the tiniest improvement can make a huge difference. Just a pair of sweeps on a tractor, one row of sweep, heck, that saves you how much time of pushing a wheel hoe. If you need to do that one row at a time, great, do it and start there. Then as you can build up doing several rows, it's going to save you even more time.

Chris: If we look back at the foundations of mechanical cultivation, some of the first tractors out there for cultivating were really designed as one-row cultivators. The Super As were offset. If you're trying to cultivate two rows at a time on a Super A or any other offset tractor, there's at least one row that you can't see. You're only looking at the one that's on the right-hand side of the tractor because the tractor body is offset to the left and that's not what they were designed for. They were really designed for doing that one row down the middle.

Of course, anything that we would apply to seeding is really a process of getting plants in the ground whether you're putting garlic cloves in the ground or seed potatoes or seeds or transplants or whatever, the more precision that you can do that with and this idea that we want to seed as many rows at a time as we plan to cultivate at a time, that's going to be better, right?

Sam: Absolutely. A lot of people with water wheel transplanters which are great that punch a hole in the ground, everyone needs to be on the same page. If your crew doesn't know the process coming down the line and they think the job is just popping plants in the hole, you might get a wavy line, the lettuce transplants. Everyone needs to know that the plants need to be set in as great a fashion as possible and it really pays off.

Chris: It was actually something when we moved away from a water wheel on my farm that I became thrilled with. I was like all of a sudden all of the plants were in a straight line, and I could cultivate a much narrower band when I was doing that between row cultivation on my tractor.

Okay, so now, I've got the seeds in the ground or I've done my transplants. Everything is perfectly aligned with the way that I'm going to want to get cultivating job done, the weed killing job done, what's next?

Sam: Next is what people call blind cultivation, tools like a tine weeder, a flame weeder, or a rotary hoe. These are tools that we can use before the plants are even out of the ground. The goal here is to promote and maintain that prime imperative, that size difference between the plants and the weed.

For us here at the University, we're doing a lot of work on carrot. That's a notoriously hardest plant to grow with weed, and so that's where we wanted to test these tools on. Flame weeding to us is crucial and the payoff is obvious. For other crops, people will use tine weeders or rotary hoes, but the principle is the same and that's that the crop has not yet come up or it's very small, and so we want to just disturb that top layer of soil where any weeds may have started germinating. To that point, that's something where when you're planting, you want to think about your depths that you're planting to. If you know that you're going to use a rotary hoe or if you know that on your soil the tine weeder only works well when you can think those tines in an inch, you're going to want to keep that in mind in deciding on your planting depth.



- Chris: Right, so do you have ... Is that something where you might even change the planting depth even for doing something like flame weeding?
- Sam: Yes, we think about that. Right now, the timing is good. We put our carrots 3/8 of an inch deep, and we plan on flame weeding six to seven days later. Now, throughout this, you can kind of play the odds. Let's say you really want to push it. I know Nash Huber ... I think Nash is organic farm out in Washington State. He grows a lot of carrots. One trick he does is he oversees his carrots by 5% or 10%, and the reason is that he pushes off flaming until the last possible moment until about 5% of the carrots are up. When he flames, he'll kill some, but he's also assured of killing as many weeds as he can whereas, of course, if he flamed earlier, some of those weeds might still emerge after he flamed.
- Chris: I just want to make sure before we get too far into this blind weed control that we talk. How does this principle of free emergent flame weeding actually work? What are the dynamics that are at play with this?
- Sam: With a lot of crop, direct-seeded crops like carrots and beets, they're going to take a while to come up. With something like corn or beans, they pop up and you can see right away where the rows are, and pretty soon, they're big enough that you can run tools through them without pulling them out or burying them. For a lot of other crops, they're going to stay in the ground for a long time. If you were to wait a week or two or more without controlling weeds, you're going to have weeds start to germinate, and more than that, they're going to really get settled there in the soil. They're going to put down that taproot and they're going to start getting bigger than your crop.
- What flame weeding allows you to do is burn the soil, and you don't even need to go across the entire bed. You can just have a burn right where your rows are. You burn that soil while your crop has not yet emerged but while a lot of your weeds are emerging. That's the sort of beauty, magic, and terror of it is you need to hit that point where your crop is really close to coming up but not up but a lot of your weeds are up. That's why some people will over seed if they know they're going to flame. They'll add 5% to 10% so that they can wait until just the first few carrots erupt, flame and maybe kill 5% of them, but then they know that the next day, the main crop is all going to come up and they'll have killed as many weeds as they could have.
- Chris: For us, the way that we manage that at Rock Spring Farm was we used pelletized carrot seeds and radish seeds were almost exactly the same size as a pelletized carrot. We could put them both through the same seeder, and then when those radishes came up, we knew that's when it was time to start watching for those carrots. I'd actually go out and dig around with my knife and find the carrots and watch for them and observe actually how the seeds were germinating rather than over-seeding. That was my preferred method. I know other people that would actually put a pane of glass out on top of one row of carrots. You got a pane of glass over maybe a foot or two of row, and the day that the carrots came up in the pane of glass because it was hotter and moister under there, then you would start looking and paying attention to where was everything else in that planting, and that would be your guide for when you get in and do that flame weeding.
- Sam: [00:27:30] Those are great ways and I think some people get intimidated. They know there's going to be a million things going on in June and are you going to remember to look at the carrots. I think what seems helpful that I've heard of other people doing is



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just picking a day. A lot of people use six days for carrots, and it might not be the very best day, but it's something you can put on the calendar after planting and you know that it's going to be good enough.

Chris: I like that. Again, for me, what I did is I put in a calendar reminder the day that I see that the carrots so that I was being prompted on a daily basis to get out and start observing starting on day six.

Sam: Right.

Chris: Flame weeding is one way of doing what we call this blind cultivation. When we say blind cultivation, it's really that we're not paying any attention to the plants, to the crop. We're just killing weeds and we're not necessarily trying to steer or anything like that. What are some other ways of doing blind cultivation and where are those appropriate to use?

Sam: The two other tools that come to mind are flex-tine weeder if people are familiar with those. Those are just wires of spring steel that vertically in the soil, and as you pull them through, they vibrate. They describe a small circle in the soil and they'll uproot a small plant. That's popular mostly with crops that are a little more established or I should say that's popular but more so with crops that can be planted deeper. It's very hard to set a tine weeder to work just the half inch surface of soil or something like beans, corn, potatoes that you can plant deeper, and then you can work the top inch, inch and a half with the tines. I've had more success with that when I try and work just the very surface that you would need to with something like carrots or beets. I'm not able to get it to buy this month.

Chris: We use that tool a lot on transplanted crop. You put in your Brassicas or your lettuces, you wait a week, let those get established in the soil, and then come through with that tine weeder. As it's inscribing those little circles, if you got tiny little weeds in there, they get knocked out. They get uprooted and then their little baby roots are exposed to the sun, and it doesn't take long for them to die.

Sam: Did you have good success with the tine weeder? I've got to say I've spent a few days in the field just playing with settings in and really trying to see what works. Maybe it's our model or maybe it's our soil, but I've never been as happy with it as a some other tool.

Chris: I was pretty happy with it. What I liked about it was, well, you take this idea that you talked about of the weed seed bank. If I can do a 90% reduction each time I go through the field, pretty soon, I don't have any weeds left. Going through with that tine weeder, I certainly didn't expect to get 100% weed kill. I always knew that I was going to pull out a couple of broccoli plants too, but it was something that I could set up behind my tractor, and I could do the work really fast and get a lot of weeds killed in fairly short order. It was also something that I found I could delegate pretty easily to somebody who maybe I wouldn't want them on the cultivating tractor, but it was something that I could put them on so they're just operating a three-point doing the blind cultivation, a little less skill involved, a little less precision being involved in that.

For me, the other thing that we found was doing it on the right soils are heavier clay soils if we didn't have a good seedbed at all. It didn't work as well, but when we had a nice friable seedbed and something that hadn't gotten crusted over, it was really a great tool for us.



Sam: Yes. I think that's a reason that farmers love to have tools sitting in their fence rows. I often get made fun of for allowing to have too many cultivation tools. Like you just said, the tine weeder might be a great tool but once your soil crossover, all of a sudden you need something else. Again, when your soil is too wet, all of a sudden you want something else.

Chris: I agree having those tools available to you and the right tool at the right time and the right conditions especially if you're operating a farm that has soil on the ridge as well as fields down in the valley, if you're dealing with soils that crossed when it's rainy or soils, maybe you got soils that if you till them just a little bit too wet, behave very, very differently than if you till them a little too dry. Having a lot of different tools that you can rely on is really important.

What about the rotary hoe? That always felt to me like something that my corn and bean farming neighbors used, but I don't actually have any experience using that on my farm. Is that something that you see very many vegetable growers using the rotary hoe?

Sam: No, not very many. Tilmor company is just coming out with some rotary hoe units that I think are going to be a little more adaptable, smaller units instead of a big 8-foot gang of them. You're right in that it's mostly corn and beans people using them. I believe the reason is that it's more aggressive so you need either a plant that are anchored or a seed that's planted deeper so that you can work the soil to a greater depth above it.

Chris: In my neck in the woods in the Driftless region, my neighbors mostly used it for beans when they had crusting in the soil then that was the tool that they would use to go out and breakup that crust and allow those beans to emerge through it.

Again, that blind cultivation being something that is suitable for some crops, not suitable for others, so what's next because we're kind of working our way up this cultivation pyramid or this cultivation iceberg?

Sam: [00:33:30] Sure. Now, our plants are up. They're up enough where we can physically see them and more than just walking by and thinking about how nice they look. They're big enough that we can see them from the seat of a tractor when we're moving two, three, five miles an hour.

Next comes our between-row weeding. As far as I know and for most of the crops that I'm familiar with, you can't do in-row weeding as soon as the crops emerge. You don't need to wait until they are better rooted or taller so that they can withstand that. Then comes your between-row weeding, and here's where I would bring up the third prime imperative of mechanical weed control. That is the knowledge that 90% of your weed seed germinate in the top inch and a half of your soil. On the face of it, it might just seem like another academic fact, but I believe that it's very important. What that says to me is that if I do not disturb the soil deeper than one and a half inches, most of the weed seeds will have germinated and I can kill them. If I start disturbing the soil below that inch and a half, now I'm bring up new weed seed.

I like to keep that in mind when I'm thinking about tools for between-row weed control because whatever I use I want them to work shallowly just an inch and a half. If I can continually just work that top layer, I'll exhaust that layer of weed seeds without



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working deeper and bringing up more weed seeds. Of course, there's other benefits to that like not going too deep and pruning your root.

I think the third prime imperative to me describes the kind of tools that I want to use them in-between-row weed control. When a lot of people go to auctions or pull things out of the fence rows from 50 years ago, you fill big sweeps, right? They've got a real steep angle on them and they're really meant for digging. If you're looking on Craigslist and an auction listing, they're going to call those things cultivators and sure, they might be a cultivator for corn and beans 50 years ago, but that's really not what you want to be using now, at least, on your tender vegetable crops and at least when we had better tools available.

Chris: What do I want to be using for my between-row weed control?

Sam: I would suggest a few things. I don't want to put down sweeps; sweeps are fantastic. One thing that we saw a lot of in Europe were sweeps with a very shallow angle to the ground. Think of instead of a shovel moving through the soil, it's more like a knife. It's very flat to the ground. What those shallow sweeps allow you to do is move much less soil. Of course, they come in many different sizes. You can get the traditional V- sweep and you can also get L-blade what people call beet knife. I know they're handy because you can have the vertical side of that knife right next to the plant when it's small, and later when the canopies out, you can switch those around so that the long end is reaching underneath the foliage.

Chris: Those L-blades I almost think of it as it's like having half of a stirrup hoe blade. You got the vertical part that is running next to the plant and then you got you got the sweep that moves out from there that's horizontally slicing through the soil.

Sam: That's a really good way to put it. I think also similarly with wheel hoe blades they can sometimes be ineffective when the soil is very moist. I know our clay soil in Wisconsin I could go through it with a stirrup hoe when it was wet enough and it sure seemed like that ribbon of soil would just drop right back down and the weeds would root right back in.

Chris: I think that comes to the whole timing issue. What you're talking about that's not going to happen with the weed that's a half inch tall. That's going to happen with a three-inch tall weed. It's going to have enough reserves and energy to be able to put out more roots once you slice most of it off.

Sam: That's right. I think another factor that can help there is the number of sweeps that you're using. For example, let's say that you're on a 15-inch rows and so your sweeps are, say, 12 inches wide. You could run one 12-inch sweep or you could run three 6-inch sweeps that were offset, one in the front, in the middle, and two on either side kind of like making the shape of an arrowhead. That's something that's going to allow you to move a lot more soil. Now, you're not going to be moving a greater depth of soil, remembering our prime imperative about only an inch and a half deep, but the soil that you do move in, that top inch and a half, you can really tumble around. Any weeds that are in there instead of just being lifted up once and drop, there's a much better chance that the soil will get knocked off of them, et cetera. That's what we see in a lot of the commercial cultivator setups is you don't just see one sweep, one large sweep, between row. You see several smaller sweeps between row that can really get that soil boiling.



- Chris: Right. That makes a lot of sense, and I like that image of the soil boiling and those weeds really getting tumbled and turned around so that you're not just lifting it up and dropping it back into place. We talked a little bit about wheel hoes here. A lot of the people listen to the show, that's what they're using for weed control. If you're operating on a small scale, a lot of folks don't have a cultivating tractor or anything fancy. Would this be an appropriate time to talk about tool carriers?
- Sam: Sure. I always love talking about tool carriers, Chris.
- Chris: Again, when I say tool carriers, this is that the wheel hoe. That's a tool carrier. You've got the wheel. You've got a thing that you can mount it to and you got some handles, but then that's what's going to carry that U-shaped blade or the stirrup blade or whatever other tools you're going to use towards carrying that tools, tool carrier. Same thing with an Allis-Chalmers G or an international 140 or my favorite tool carrier of all was my Kubota L245H. I love that tractor. Talk to me about tool carriers.
- Sam: I would say number one that goes across tractors and wheel hoes is you want to suspend your tool between two sets of wheels. Of course, in the tractors, I don't really need to mention that most things are belly mounted. The reason is that it makes steering much easier. You want to do the same thing for a wheel hoe and the solution of that is a wheel hoe with four wheels, not one or two. When you have one or two wheels, you are holding the handles and the height that you hold the handles sets the depth of the tool. You know what I mean?
- Chris: Yes, I do. Because the carrier part of that is on the back of that front wheel and so if it's ... Depending on how you're carrying those handles, that's going to determine the relationship of the cultivating tool to the soil.
- Sam: Exactly. It's very hard to get precise depth in that way because when you take a deep breath and stand up tall or you get tired and you go lower. You're always bouncing up and down. To me, the idea of a four-wheeled wheel hoe seems insane until I saw one and then it made perfect sense. There's a man out of New Zealand, Charles Merfield, and he designed a four-wheeled wheel hoes. Imagine an Allis G with the two wheels in the front wheels, two wheels in the back, the tool suspended underneath the belly, and just shrink that down factor of 10 and imagine a little rectangular frame with two wheels in the front and two in the back. All of a sudden instead of you needing to push it forward and maintain the angle of the tool to the ground, now with the four wheels, all you do is push, and just like someone with their fancy tractor or their fancy cultivator where were you can really tune in the depths that your tools are running, all of sudden, you can do the exact same thing on your wheel hoe.
- Chris: Have you actually used one of those or is it just something that you've seen?
- Sam: I've just been. Charles has plans for these, and so I've talked to him about the pictures and how to build them and what kind of materials. I haven't used one, but if anyone wants to construct them, they should get a hold of me or Charles and we'll set you up.
- Chris: What's next after the wheel hoe? What's my next step up in terms of tool carriers?
- Sam: The really exciting next step up that's just starting to get recognized is walk behind tractors, two-wheeled tractors. I just think that's so exciting because it's too easy to



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think, well, I have a wheel hoe but I'm not going to be able to spend \$4,000 on a G and I'm not farming the 10 acres that a G could do and so I'm stuck here at the wheel hoe. I think that two-wheeled tractor is just a very exciting intermediate scale that people can run cultivators at and almost any tool that you can run on a tractor or I should say at a wheel hoe you can run on a walk-behind tractor and someone probably already is.

Chris: That walk-behind tractor though, that's a two-wheeled implement. How is that different than a wheel hoe in terms of supporting the rear end of the implement?

Sam: That's really good question, Chris. What you'll notice on those two-wheeled tractors for the cultivation setup is that they have a toolbar right behind the hitch of the two-wheeled tractor. Extending a few feet back on either side from that toolbar are gauge wheels. The gauge wheels sit in the ground. Oftentimes, they're a wavy coulter like you'd see on a plow or it could be wheels. The whole point there is that they act as a rudder. They lock the back end of the tractor into the ground, and they also provide that depth control. All of a sudden instead of two-wheeled tractor acting like a wheel hoe where you're holding the handles up or down and the tools going up or down, all of a sudden you've got those gauge wheels set in the ground. All you're doing is holding the handles and steering. The front wheels are pulling it forward, and again, the tool is suspended in between two sets of wheels and that allows for a lot more precision.

Chris: These two-wheeled cultivating tractors, tell me more about these. Is this something that I can just go online and order?

Sam: You can't order a new, Chris. Hopefully soon, enough people will be clamoring for them that someone will get into it. Mostly, people find them on Craigslist, on auctions. These are tools that are 50 to 80 years old. I talked to Jeff Lauber in Iowa who's been collecting these things for years. He told me a little bit about the history which was before the Allis G came along in the late '40s, these tractors, these two-wheeled tractors were what a lot of vegetable growers were using. You could get them in 10-horsepower models that could pull a plow and people were growing ... Whole truck farms were just using two-wheeled tractors. They're not being made anymore and so a lot of people find one on Craigslist and then the engine is 50 years old and so they get a new Honda engine for it, then the bearings run out, and then you have to worry about finding bearings. They're definitely around but you do have to put a little time and often to get them working for you.

Chris: Why not just hook something up to the back of the BCS or the Grillo that I might already own?

Sam: You can do that. I've got a friend, Paul Huber in Wisconsin, who's doing that right now. He can tell you how that's working out for him. In a sense, that sounds great because you've already got the tractor. You're already using it for a rototilling, et cetera. The only thing is the BCS and God bless them, they're just not made for cultivating and the clearance is very low. Sure, maybe you could run through your carrots or beets when they've just emerged, but these older walk-behind tractors have 8 inches of clearance that you can run over, say, a 10 or 12-inch plant that bends underneath it, so they're just a lot more conducive.

Chris: It really is that they're designed to do that job rather than being designed as a tillage tool and a mowing tool.



- Sam: Yes.
- Chris: If I feel like now, I've done what I can do. I've exhausted or my scale isn't right for this two-wheeled Planet Jr. other antique cultivating tractors, these other antique two-wheeled cultivating tractors that I maybe put a new engine on, but now it's time for me to make that next step is I'm scaling up my farm or if I've already got a larger farm, what am I looking at now as we start to look at a G or 140 or a Super A? What am I want to consider what I'm getting into these four-wheeled belly-mounted cultivating tractors?
- Sam: There is a heck of a lot options out there. I've had a lot of fun talking to farmers and salesmen and hunting the Internet just trying to get a handle on this. It seems like a few things you want to identify before you jump in is, one, of course, how much money do you want to spend on this? Two, how long do you think you're going to have it for? Do you imagine yourself growing in scale even more so in a year or three or do you think you're going to use his tractor for some time? Also, how much you like working on machine? Those are going to give you an idea of whether you want to get a 60-year-old Allis-Chalmers G which can be a fantastic tractor but also notoriously finicky or do you want to try and pay more money for something newer, say, one of the cultivating tractors that they made in the '80s mostly for tobacco?
- Chris: A thing like a Kubota or it's a Kubota 245 or the L245 and then there was a case IH model that was similar to that.
- Sam: Yes, that's a 265 and then you have the John Deere 900 High Crop.
- Chris: [00:48:30] Leaving aside the issue of whether I'm a good mechanic or a bad mechanic or whether the engine is reliable or not on that particular model of the tractor, what would I want to look at when I'm looking into a cultivating tractor? What are the important things to consider there because there's a lot of different models? There's a lot of different ways you could go with that.
- Sam: Yes. I guess the big question is what do you want to do with it? If you want to do between-row weed control on something like corn and beans, you don't need to be able to go that slow. I know that something people complain about what the Super C is that it can't go very slow.
- Another consideration that's probably more important is how much space is there under the belly. A lot of these tractors were built to have just single sweeps underneath there. Now, people are learning about these tools coming in from Europe that require more space. If you have a tractor that doesn't give you that much space, you're not going to be able to use those tools or you're really going to feel like you're packing them in there.
- Chris: Right. Then I remember the first G that I used on my farm we had a set of basket weeders underneath it. There actually wasn't enough clearance front to back to be able to lift those basket weeders off without running into the bottom of the of the G. There just wasn't enough overhead clearance then that became a real problem for us.
- Sam: [00:50:00] You got it. There's a lot of neat pictures on the Internet of people who have chopped up their Gs or other tractors to make more space. That's something when you look at the European tool carriers, you just hit your forehead an say, "Duh, why didn't



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we do that?" They have these tall soaring steel beams 5 feet above the ground and 6 feet long. This give you as much space as you'd want for a tool.

Chris: All right, so I think we're going to take a break here and get a word from a couple of sponsors and then we'll be right back with Sam Hitchcock Tilton talking about weed control.

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All right and we're back with Sam Hitchcock Tilton talking about weed control on the vegetable farm. Sam, I want to dive in now and talk about the actual tools, the things that we're going to use to kill the weeds. We've talked a lot about the principles and setting up to get ready to kill weeds and how important that is and how that forms the base of this iceberg or this pyramid for weed control, but let's talk about some tools.

Sam: I like to illustrate that with a joke if I could. A guy walks into the doctor's office and he's got a carrot sticking in one ear. He's got an ear of sweet corn sticking in the other ear, and he's got a whole piece of celery sticking in his nose. He says, "Doc, you got to help me." The doctor says, "This is obvious you're not eating properly." Similarly, we might have that finger weeder or we don't want to stick it in our nose. We have to mount it correctly. If you just amount the finger weeder directly to a toolbar, you might complain, hey, this isn't working the way I thought it was. We really need to give the tools the flexibility that they need to move the soil appropriately.



- Chris: Same, this was actually, for me, a prime source of frustration on the farm. We'd buy a cultivating tractor, but then figuring out how to get the tools connected to the tractor just maybe want to go beat my head against the wall.
- Sam: Yes.
- Chris: What are we looking for with this?
- Sam: The first step and the easiest thing to do that is the least desirable thing to do is to get some clamp and just bolt that thing right to the cultivator frame. That's how a lot of these cultivators, again, you get them in an auction 50 or 60-year-old corn cultivators. They're just bolted right to the frame, and that gives you zero flexibility as your terrain changes or as the soil type changes. You really want to let that tool move with the ground, move with the soil condition.
- Let me describe the spectrum of linkages that can be more and more successful. The first thing is bolting right to the frame. The second thing is tools that are connected with the S-tine. That S-tine allows the tool to move. If it hits a rock, it can bend around it. People also see are parallel linkages, and those are just fantastic. Each parallel linkage has a wheel that follows the ground. With that wheel, you can very precisely set the depth of your tool, and as the wheel hits a rock or goes over a hump of soil, the tool is going to do the same thing, and so you can maintain that inch-and-a-half depth. A lot of parallel linkages, if they're well-made, they'll have a spring on them where you can adjust the down pressure.
- Let's say your soil is hard and crusted and you want your tool pressing into the soil with more force, you can adjust that spring. Likewise, if your soil is more sandy and you don't want to move as much soil, you can adjust that spring to have less down pressure. That's a similar principle that these floating arms work with. If people have seen pictures of these on steerable toolbars that are mounted in the back of a tractor, many of them have the finger weeders or other integral elements mounted on the floating arm. Those also have springs on them so you can adjust the down pressure with which the tool will engage the ground.
- Chris: Again, this is going to allow for any variation that you may have, say, in your bed if your bed formation wasn't exactly perfect and then make sure that you're always cultivating an inch deep instead of sometimes cultivating an inch deep and sometimes being at two inches and sometimes being out of the ground.
- Sam: Exactly. We're talking about precision and we're talking about the steps all adding up, and this is just another piece of the puzzle here that gives us the precision that we're aiming for.
- Chris: Are parallel linkages something I can just go out and buy now?
- Sam: Not that I know of. What I'm always looking for is corn cultivators from the '60s or '70s. Once we started up with roundup-ready corn, the people stopped cultivating. If you can find an old row crop cultivator, say, a six eight-row cultivator, you can take that apart and there's so many parts there that you can really do what you want. The only thing is for our purposes with vegetables those parallel linkages can be pretty big and heavy especially for using narrower spacing. Some companies are importing these now from



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Europe, I believe, Sutton Ag in California is bringing in the Steketee brand. Michael Smith is importing the Kress brand and so there are available European models for these smaller, more vegetable-focused parallel linkages.

Chris: Once I got, if it's appropriate for the tool that I'm using hopefully a parallel linkage or another way to connect this thing to the toolbar, let's talk about the tool options for doing the actual weed control. Let's get down to killing some weeds here.

Sam: yes, let's do it. We talked about sweeps or the beet knives and those are great for rough between-row weeding. Every half inch, quarter inch that you can shrink that in-row space drastically reduces any time needed for hand weeding. You want tools that can get as close to the row as possible. The classic example that is a budding basket weeder invented here in Michigan; the fantastic tool. The only thing about it I'll say is that the baskets can till soil into the row. I find the closest that I can get with that tool is about a three-inch wide, uncultivated band. Again, it's a great tool especially for keeping good tills in between the rows.

I think something that can get even closer to the row is what are called cutaway discs. Just imagine your normal large tilling disc for throwing soil in. These cutaway discs are generally a lot smaller, maybe the size of your hand. Alloway used to make them for sugar beets and Crest imports a model now.

The way these cutaway discs work is just the opposite of a hilling disc. If you take your hand and you imagine it's a hilling disc and you're moving it forward through the soil, the heel of your hand would be pointing in and your fingers would be pointing outward and that's going to move soil in. These cutaway discs are just the opposite. The front of the disc like your fingers is now pointed into the row and the heel of your hand is pointed away. As it moves forward, you're cutting soil away from the row. I found that you can set these very close down to about an inch and a half on cultivated band. The thing I like about them is because they are solid discs unlike the baskets of the budding, there's no soil that will spill into the crop row. Even when your carrots don't even have their first true leaf, the cutaway disc acts as their own shield keeping dirt out of the row. Other popular tools would be the Spyder Weeders from Bezzerides always are options just to get as close to the row as we can.

Chris: Yes, those cutaway discs are really fantastic, really fantastic tool. Because essentially, any tool that you're using the slice horizontally through the soil is going to result in some side-to-side movement of soil. Those cutaway discs actually make ... They not only can protect those plants serving as a rolling shield for the plant, but they can also actually create a little furrow that then that soil that's moving from side to side is able to fall back into.

Sam: You got it. What I've seen when I use those cutaway discs perfectly is there's that narrow uncultivated band. Other than that, there is no difference in the soil surface because the soil on the side just falls right back into that little furrow.

Chris: I think this also plays into what we were talking about earlier of setting things up for future success. Obviously, if you hill your carrots, you're day-old carrots, they're going to die. If you end up leaving a big mound of soil next to your day-old carrots on either side of them, you're going to be really restricted in your ability to come back in and cultivate again, because until the carrots get big enough to handle the soil that was left, you're stuck.



- Sam: That's a really good point. You always got to think about the next step and you've got to think about soil movement and the soil surface. In terms of the next step, something like those cutaway discs leave you with a really nice little mesa for lack of a better term, which is to say you've got the top of your uncultivated band. Let's hope it's about two inches wide, and then you've got a depth downward that those discs cut out. Let's say that's about a half inch on either side. You've got the disturbed soil where your between row sweeps went, and then you've got that half inch up, two inches across, and a half inch down that hasn't been touched. That, if it dries out to the right moisture level or if it's wet, you can really manipulate that when you start using your in-row tool.
- Chris: I think this might be a good spot. We talked earlier about the sweeps. We talked a little bit about basket weeders. We're talking about this cutaway disc. All of this is coming up to this point where now we can get to what you've really been focused on with your research which is how do we get in there and start to manage the weeds that are in the row, the ones that just kill our pocketbooks. We have to send a crew out and do the hoeing.
- Sam: You got it. We've got the narrowest uncultivated band that we could manage, and now it's time for the in-row tools. The four that I've been working with and really the only ones I think are available are the finger weeder, the torsion weeder, you're flex-tine which we talked about for blind elevation, and also hilling which is the oldest in-row weed control there is. Maybe we could just go through those and talk about what they are and how they work.
- Chris: Yes, let's do it.
- Sam: Okay. Finger weeder. I imagine a lot of people have seen picture of this or videos on the Internet, and it's easy to see the bright plastic fingers moving through the plant row. What you don't see underneath the plastic are metal drive tine. If you take your hand and curl your fingers up like you're holding an apple and point them down, that's these metal drive tines and they run in the ground. The finger weeders were originally invented by budding. Like a lot of the budding designs, the way they work is one part engages with the soil at ground speed as fast as you're driving and that moves another part even faster just like in the basket weeder. We've got the front baskets that move at ground speed and with the chain and the gearing difference. They move the back basket even faster to give that nice crumbling. That's what's happening with the fingers. Your metal drive tines are moving at ground speed and they drive your fingers even faster.
- Of course, you can get the fingers in different sizes. Generally, the larger they are, the more aggressive. The smaller they are, the more detailed work they can do. You can also get them in different durometers or hardnesses. I think Steketee also offers some brushes you can get for really fine detail work.
- The main adjustments that you want to make on the fingers are two. They are relatively simple tool. One is the distance between the rubber fingers as you can imagine closer together or even overlap, they're more aggressive. The other thing is the down pressure on them. The more down pressure, the more aggressive they'll be and the less aggressive they'll be. The fingers can have two different actions depending on how you're using them, but that thing is pretty neat. One is they can flick soil away and out of the row, and they do that best when they're angled forward into the direction of travel and when the soil is drier.



People describe this to me in Europe, and I didn't really get it. Then I saw it this summer on some dry sand just flicking soil and weeds out of the row. The other thing they can do is hill soil. For that, you'd want to adjust the shank of the finger slightly backward at a backward angle to the direction of travel, and it will pull soil into the row and fill up very precisely. Now, to do that best, the finger and a lot of these other in-row tools want to be used with between-row tools, so people will set sweeps or shovels to run right in front of the finger and loosen the soil so that if they're trying to hill the soil sitting right there ready for the finger to follow and push it into the row.

Chris: I think something is really important to talk about here that's not immediately obvious if you haven't seen the videos. Those fingers are actually going into the row where the plants are, right?

Sam: Yes. This gets back to our first prime imperative about that size difference. Just to say again, these tools aren't magic. If you imagine giving your carrots a little tug, let's say by now, they're three weeks old and they have two true leaves and then so you give that tiny little cotyledon of a mustard weed to tug next to it. Now, we're going to hope that it takes less force to pull our mustard weed out.

Now, where the magic comes in is we want to set that finger weeder so that it's applying enough force to pull out or bury that weed but not enough force to displace our carrot. That's where that prime imperative comes in where we can really exploit the difference between the crop and the weed.

Chris: How hard is it to adjust these finger weeders?

Sam: I got to say it's pretty easy. A lot of these models have a single bolt. That's one thing you're going to want to look for is that all the bolts on whatever you're buying should be the same size. You don't want to have to carry five different sizes in your back pocket I'll tell you that.

Chris: Been there, done that, yes.

Sam: A single 18 or 19-millimeter bolt, you can loosen and allow you to drop your finger weeder up or down and then likewise another bolt on top where they mount horizontally, can move them in and out to adjust your overlap. They're very easy to use if you have them mounted correctly.

Chris: I didn't realize when I first saw this is the disc of fingers is sitting at an angle to the soil. I want to save 30 degrees off of parallel from the soil, but then fingers themselves actually bend and run. They're rubbers so they're soft rubber. They actually bend and run pretty much parallel to the soil.

Sam: Yes. What people were telling us in Europe is that generally you want to have those fingers adjusted until the rubber, just like you said, is flat against the ground. That's also a good way as you develop your knowledge of your soil how close and how far apart you want the fingers to be on different crops on different growth stages. It's nice to just always measure that distance when they're flat.

Chris: Right. The finger weeders are really designed as a tool to uproot the weeds which I know doesn't work on every weed that's out there.



- Sam: [01:08:30] You got that right, Chris. It can also be set to hill. I just visited with a grower out in Western Michigan who is doing organic dried beans. He was using his fingers to hill.
- Chris: How much hilling was he able to do with those fingers?
- Sam: Probably about an inch no more.
- Chris: I do think that one of the things that is often times overlooked is that you can hill with sweeps and shovels as well. If you adjust those between row weed control tools correctly, you can actually move a significant amount of dirt into the row and bury the weeds which works really well with things like corn and beans and brassica transplants.
- Sam: You got it and likewise with those cutaway discs, you can just turn them so instead of cutting away they're hilling. That's another good way to hill. I prefer that just because they're moving soil. They're crumbling it. I think it does a little better job.
- Chris: [01:09:30] Right. It is the way to get into something without having to have something super fancy.
- Sam: Really good point.
- Chris: You can do a lot of really good in-row weed control. I feel like it's an opportunity that's really missed and something that can be a weakness when you're using a wheel hoe, for example, because there aren't a lot of tools for the wheel hoe that actually do a good job of moving soil into the row.
- Sam: Yes. They're coming out with nicer models that straddle the row and you can use hilling disc to hill then. It's really interesting, I think, is that if you look at wheel hoe models from 50 years ago or anything from the Planet Jr. catalog, they made not only seeders but they made cultivation tools for anything. They made this stuff that went on the Allis G. They made this stuff that went on the walk behinds. They made the stuff for the wheel hoes. If you look at their old catalogs, they were making this kind of stuff 67 years ago, cutaway discs, hilling gangs, low angle sweeps. They really had it figured out. We just forgot about it.
- Chris: I think that's probably the case in a lot of market farming right there. What other kinds of tools? You mentioned several others that would be useful for in-row weed control.
- Sam: Yes. The other tool is not as popular maybe for a good reason. It's called the torsion weeder. If you imagine a piece of spring steel or imagine a thick coil spring and you flick it with your finger and it goes "boi-oi-oi-oi" and then it returns to right where it was. These torsion weeder are made out of a piece of wire that springs steel like a flex-tine and they sit in the ground parallel to the ground. There's two of them and they cross right across the plant row. As you move forward, the resistance of the soil against them spreads them apart. Just like the flex-tine weeder when you set them right, they get a really good vibration to them and they'll dislodge the weed roots without disturbing your crop. When they work well, they're phenomenal, but they take a lot of adjusting to get them to work well. I found they're not as consistent through different soil types as you're moving as the fingers are.



Chris: Again, I think it's worth going back and saying this is also when we're talking about in-row weed control, this is where something like those flex-tine weeders, things like the Lely tine weeder or the Einbock or the Williams toolbar carrier features these flex-tine weeders. That's something where those fingers are doing in-row weed control. It's a different sort of action than what we're talking about with the finger weeders or with the torsion weeders. It's still that same idea of trying to reduce the number of weeds that are in the row before you have to go in there with a hand hoe.

When we're looking at these adjustments, I'm thinking about on my farm. We grew 40 different crops, 50 different crops, relatively small amounts of each even though we had 20 acres of vegetables every planting. It's not like I could spend 10 feet or 20 feet or 30 feet figuring out how to adjust something so it was going to kill the weeds and not till the plants. How do I go about making those adjustments quickly well and consistently?

Sam: There's definitely going to be a learning curve, Chris. I can't say that you're going to be able to do it quickly from the outset or that you won't have to kill some plants at the outset. Every grower I talked to talked about needing some time to really get to know the tools. As you go, it sounds like growers can develop rules of thumb. A lot of people know that when they put a transplant in of any variety, a week to 10 days later, they can run through it with the fingers. With their soil, they get a good feel for generally what's that tip distance between the fingers or if they're overlapping them. They can run to go through the plants.

For other crops, direct seeded things, you can get rules of thumb over time that's your best guess, but you are going to have to spend some time in the field responding to soil conditions. The grower in Western Michigan who had a large 12-row finger weeders set up for his dried beans, he would spend five hours tuning in that machine every time before he used it. Every time it got less and less, eight hours, five hours, three hours, but he knew it was going to take him a while to tune that machine in. Like all these mechanical tools, once you get it tuned in, it's worth the time. They're going to save you time once they're working well.

Chris: I think that's such an important point just with any tool investment. My friends, Jacob and Amy, out in Washington State just picked up a finger weeder setup. I love that they picked it up in the fall because they're going to get a chance to figure stuff out now. Then next spring, they're going to be able to hit the ground running having that tool set up and knowing how it actually works. Whereas I feel like a lot of times, you're coming in the spring and the time pressure is so severe of the wet spring and you've only got a limited window to get in. Sometimes those tool adjustments are enough to make a guy cry.

Sam: You got it. You'll hear people say, "Oh, yes, fingers weeders I've tried and they don't work." Then you want to ask, "How are they mounted? What kind of tractor were they on? How much time did you give it to figure out how to use them?" Just like the guy with the carrot up his nose, Chris, you might have the right tool, but if you're not giving yourself enough time to use it right and using in the correct manner on the right tractor at the right speed, you can't expect it to work well.

Chris: Anything else that's not going to be immediately obvious about using something like a finger weeder or a torsion weeder or the other weed control tools that we've talked about?



- Sam: Yes. Something to think about when you're getting frustrated with the tool is your soil moisture. Obviously, something is not going to work in the mud, but likewise, it's not going to work very well when things are dry across that are even powdery. Here at the University, I've often thought to myself, "Man, I'd really like to run the irrigation just for 45 minutes to make these tools run better and give a better result." I can't do that. That's not something a farmer would do. The more growers I talk to, I find that, no, some people will run the irrigation for a little bit before they cultivate and it's worth it that extra time to them because and they know that the cultivation is gonna to be that much more effective by having the right soil moisture. Of course, that also gets back to the very bottom of the pyramid which is soil health, the more organic matter, the better drainage that you have in your soil, the easier it's going to be to cultivate it. Everything really is connected.
- Chris: It does lead me talk about everything being connected to this other really important point which is it's one thing to get excited about the tools, and it's easy to go out and spend a bunch of time and a bunch of money and a bunch of energy getting the right tools and the right setup and geeking out on all of that because that is the fun stuff. So often weed control really does just come down to an issue of timing.
- Sam: Yes. I talked to an older farmer about how often I should cultivate. He said, "Whenever you think about doing it, do it." He said, "You'll never regret it." A lot of people talk about you want to run through this field every 7 to 10 days and that makes sense. That's a good rule of thumb in terms of keeping weeds down, but people know that you never know when it's going to rain. You never know when the tractors going to break. I think it is a good rule of thumb when you have time and the conditions are right, just do it. Get up before the help comes and do it. They laid after the outcomes and do it, you're never going to regret it. Again, if you're doing everything right, if you're running your tools to deep and pruning roots, yes, you might regret that. If you do a nice shallowcultivation, that's not something that you can do too much of generally.
- Chris: All right. Then before we turn to the lightning round, I did just want to get you to say a word about the Midwest Mechanical Weed Control Field Day that's coming up here at the end of September.
- Sam: [01:18:00] I couldn't be more excited to go to different farming conferences and there's a few tool vendors and you see a tough-build cultivating tractor or you see Crest salesman and you think, "That's nice but is there something better out there? What's the price comparison? Is it going to work for me?" The whole point of a field day is to have everything or as much as we can mechanical weed control-related in one spot so growers can really talk to vendors and compare things.
- There's going to be a whole slew of cultivating tractors from older American ones, the newer European ones, the newer American tractors. They're going to be all sorts of weeding tools. A lot of the stuff that we use here at the university, farmers from around the Midwest bringing in their setup, and then the tool vendors both that are making things in the States and that are importing them from Europe are to have things there. More than that, Jean-Paul Courtens from New York, a very experienced vegetable grower is going to talk about the principles of cultivation, how to use the tools, how to set yourself up for success.



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Again, more than that and something that I never see at a winter conference, we're going to have about an acre of field demos. People from the MSU Weed Control Team are to be talking about how they use the tools, what we found. Growers who are using the tools are going to talk about them and how best they've learn how to use them. Also, the vendors who are making and importing these tools and cultivating tractors are going to run them through the field.

Already, we're having about 100 growers from around the country come and so more than just being all the tools and talking to vendors, I think it's also going to be a great opportunity for growers to talk to each other about what's working and what's not so I'm very excited about that. I think it's going to be a great resource for people.

Chris: Tell us the date that it's happening and where that's going on.

Sam: Okay, that is Tuesday, September 26th, 10:00 AM to 5:00 P.M. in Lansing, Michigan on campus of Michigan State University.

Chris: I'll put a link in the show notes for registration so the URL for this if you want to go directly to it. It is kind of crazy but if you Google Midwest Mechanical Weed Control Field Day, MSU, it's going to show up. I'll also put a link for the field day webpage in the show notes for this episode.

One more thing before we go to the lightning round. We're doing this conversation that we control in September. Everybody's thinking about harvest, but if you're in the northern part of the country, what should I be doing now to set myself up for weed control next year?

Sam: I'd say let's hope you have a little bit of time on your hands so you're not going full bore. Take a walk around the field with a notebook. Every farmer should know off the top of their head, Lord knows I didn't, but I can tell you now you should know off the top your head what are your three most common weeds. Then your winter work is look up what are their life cycles? When do they drop their seeds? Did they spread by seeds or by their roots? Really get to know how those weeds work. The samurais would say know your enemy. That's the same thing with weeds. Go out to your fields now and see what's out there and learn about it over the winter.

Chris: With that, we're going to turn to the lightning round. First, we're going to have a quick word from one more sponsor and then we'll be right back.

[01:21:30] This lightning round his brought to you by Store It Cold's CoolBot. Way back in 2000, the year I started Rock Spring Farm, the manager of the local food coop complained that the lettuce from local producers lasted for just days in her cooler while the lettuce from California lasted for weeks. What's that about 2,000 miles pressure? I later found out that none of the local growers had a walk-in cooler. 17 years later, this is still the number one complaint I hear from produce buyers. You have got to get your produce cold. The difference between then and now is it now there's CoolBot. You can build an affordable walk-in cooler powered by a CoolBot and a window air-conditioning unit saving up the 83% in upfront cost and up to 42% on monthly electricity bills compared to conventional cooling units. Use the code FTF at checkout to double your CoolBot warranty at no charge, StoreItCold.com.



Sam, what's your favorite tool?

Sam: I would say I am kind of a Luddite and I really enjoy Amish culture, and I think it's fair to say that my favorite tool since working with all these cultivating machines is my little Stanley 12-foot tape measure. It's always hooked to my pocket. I flip it out all the time to see how big is the carrot, how big is the weed, how deep is my tool running, how far apart are my fingers. It's really allowed me to make the observations that give me some certainty about how these tools should be used.

Chris: [01:23:00] We actually got to the point on our farm after a couple of times were clamps had wiggled loose where we had as part of our setting up to go seed checklist was to check the spacing on the seeders to make sure everything was at exactly 15 inches and to do the same thing on the cultivating as well. What's your favorite crop to grow?

Sam: Of course, I'm partial to carrots because I've been growing them for two seasons straight, all carrots all the time. I guess at this point I'm pretty attached to them. I really enjoy popcorn too. It's such a fun plant. Carrots are just such a challenge, and at the same time, they're just so damn tasty.

Chris: Finally, if you could go back in time and tell your beginning weed control self one thing, what would it be?

Sam: I'd tell myself two things. I remember early on getting very frustrated with these tools. I'd tell myself as I've said throughout our conversation they're not magic and that I need to do all the steps to create success. I can't just pop these tools in the field and expect them to work. I need to have a perfect seedbed. I need to have healthy plants. I need to have that size differential and to really concentrate on those basics.

More than that, I'd tell myself to take the time to really observe. At least me, I'm too quick to look at something and say, "Oh, it's not working," and blame something else. It's really been good for me to take the time and stop and scratch my head and say, "Why isn't this working. Let me try this. Damn it. This isn't working either. Let me try this," and giving myself the time to make those adjustments which I know can be hard to make that time, but it really seems to make all the difference.

Chris: Sam, thank you so much for all of this great information about weed control today. Thanks for being part of the Farmer to Farmer podcast.

Sam: Absolutely, Chris. It's been great talking to you. Thank you.

Chris: All right, so wrapping things up here. I'll say again that this is episode 136 of the Farmer to Farmer podcast. You could find the notes for the show including lots of links for all the things that we talked about at farmertofarmerpodcast.com. You do that by looking on the episodes page there or just searching for Tilton. That's T-I-L-T-O-N.

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