



FARMER TO FARMER

podcast

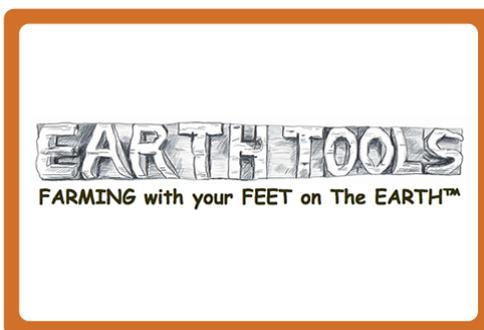


EPISODE 108

108: Michael Phillips of Lost Nation Orchard Provides a Primer on Using Mycorrhizal Fungi in the Field and Orchard

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Chris: It's the Farmer to Farmer Podcast episode 108. This is your host, Chris Blanchard.

Michael Phillips raises about three acres of fruit trees at Lost Nation Orchard in extreme Northern New Hampshire. While that's pretty cool and while Michael is well known for his excellent books on organic orcharding, today we dig into the subject of his new book, Mycorrhizal Planet. Michael started his orchard on imperfect apple ground, something that forced him or maybe it gave him the opportunity to figure out what he needed to do to make his apple trees tick. That led him to the fungal relationships between trees and soil organisms that transfer information, nutrients, and water, not just to individual plants but through a field or plant population.

In addition, mycorrhizae induce a systemic resistance to pest and to plants. Michael helps us understand how that works and how we can take advantage of it. We dig into how this amazing fungal network actually functions and how you can enhance and preserve its functioning on the orchard and in the vegetable field. Michael provides background information and practical tips on how to maintain and enhance mycorrhizal populations, even when we have to till the soil as well as how to make and use your own mycorrhizal inoculant for transplants and seeds.

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Michael Phillips, welcome to the Farmer to Farmer Podcast.

Michael: I'm happy to be here, Chris.

Chris: So glad that you could join us today from Groveton, New Hampshire, up in the Lost Nation region of New Hampshire. We were just talking before we started the show.



Michael: Yeah. We're up here above what people would know as the White Mountain National Forest where the Presidential Mountain Range is and there's another island of national forest. We're about 30 miles from Quebec. It's another part of the state that's quite different from down below.

Chris: About what latitude are you at up there?

Michael: Not too far north of us. You hit that 45 degree latitude. We're in a happy place. We're ready for the climate change as it comes. Going to have it be in a sweet spot, I think.

Chris: You own and operate Lost Nation Orchard. I'd like to have you set the stage for our conversation today. Obviously, you've got the book Mycorrhizal Planet coming out. We're going to talk a lot about that but I'd like to ground that in your farming practice, if you can tell us a little bit about your operation.

Michael: We have what would once have been known as a subsistence mountain farm. This was settled by an Irish family in the 1800s. When Nancy and I first walked down the driveway, there was a babbling brook and there were deer over in the field edge. That would come to be an issue but at the time, it was really beautiful.

Chris: It was very romantic, yeah.

Michael: Yeah. It was a farm that we could buy without losing ourselves in debt. It was a challenge, as it was. It was not picked as ideal apple ground. That's an interesting part of my path. I came to realize I really like trees. I wanted to plant an orchard. I was associated with an orchard down the road here in Lost Nation. That was in the 90s. I planted trees there and I planted trees here on our home ground.

Eventually, we lost that leased cider mill and my home farm became my one fender focus. That was a good thing. One can only do so much. I have three acres of trees here in three separate block. It's mostly apple. There's some pie cherries, some pears, some plum. We're pretty far north. Peaches don't quite survive here. You can plant a tree and it might make it for a year or two but then the cold comes. We've seen 30, 40 below. When we first moved here, we even saw 50 below. It's a cold place.

Besides the fruit trees, the other thing we do a lot with here are medicinal herbs. My wife, Nancy, is an herbalist and works to help people in the community and makes different preparations. We dry herbs and sell those through her work, usually at herb conferences. It's a good mix of different crops. Not every year is a bumper apple year. There's always plenty to do.

Chris: With three acres of apple trees, what's your market for that?

Michael: I primarily market out of our post and beam barn. In one sense, I have an advantage. Anytime someone is crazy enough to grow organic apples, you get a lot of people thinking, "I'd like to taste those apples. I'd like to tap into that." I'm really the only grower in the state doing this. Though I am a long way from the beaten path, I have a



big enough mailing list that enough people come on extended far weekends to buy the crop. It's working out. Part of it is, yes, I wrote the book *The Apple Grower* and yes, I wrote the book *The Holistic Orchard*. Sometimes, people will come up from Boston or down from Montreal but it's mostly a local market. That's what I set out to do. That part's really satisfying.

Chris: Are you making a living from the farm?

Michael: I am making the typical New England living of a little bit of this and a little bit of that. Some years, my farm income might be 20, \$30,000 but that's supplemented with writing and with consulting. For a long, long time, I did carpentry. My wife Nancy taught for a long, long time kindergarten and first grade in a private school. It's a combination of things and that, too, has its peaks. Each season, we get to do one thing versus another. There's a rhythm to it that's nice.

Chris: Tell me about how the medicinal herb farm fits in with the apple organic. I know that on a lot of farms, when you had a lot of different enterprises, it can become a challenge to manage of them because oftentimes, they have conflicting needs. Are those two enterprises that fit pretty well together?

Michael: At the scale that we're doing things, yes. You're right. There are peak moments in the apple orchard. Pruning in the winter, that fits readily. You're not dealing with green plant. Come the growing season, pretty much from green tip till about a month after petal fall and the blossoms come off the tree, there is a lot to do in the orchard. That's when you're facing down those insect and disease challenges and you're building up the fungal duff under the trees but there's a rhythm to the days and you get things done that you need to in terms of planting.

One of the advantages of working with medicinal herbs is they are not all annual crops, nor are they all necessarily perennial crops that we have growing in our garden. We have plenty of those but there's also many wild plants that we can harvest for medicine. A case in point and this one is actually probably one of the more extreme ones I have time conflicts with. There's a wild fruit tree called the hawthorn. Hawthorn has those long spikes on it. The blossoms and the young leaf clusters of hawthorn is a very valuable medicine for the heart. Going out to pick blossom clusters while you're studiously avoiding those thorns, at the peak of when things are happening in the orchard and I'm starting to thin the crop, that gets a little tight right then and there because I only have three to five days to get those hawthorn blossoms picked. That just means instead of maybe picking my goal of 80 pounds, I pick 40 pounds but those are the types of things you balance.

All in all, the interchange is nice because when the herbs really come on, the ones that are growing in the garden, that's July and August. That's cruise time in the orchard. There's things you're doing but it's in anticipation of the harvest. Once fall comes, the herbs have been at their peak and they've been harvested and dried and made into medicine. Then, I'm focused on apples until we do root crops which come after the apples. That's when I plant the garlic. It's enough to keep you very busy but it also has a sequence to what each is asking of you to do so that it fits.



Chris: You indicated that when you came to what became Lost Nation Orchard, you weren't necessarily thinking that you were going to be an apple farmer. How did that happen?

Michael: I knew I wanted to grow apples. I was thinking more in the home orchard scale more, that approach. Then, we had this opportunity to lease this 100 year old cider mill. There was two acres of orchard associated with that. We planted five more acres. That really got me going. We were making products like Yankee Apple Butter and organic cider jelly and squishing and squishing lots of apples. It was fall and people loved it. I had a partner and we loved it. That business folded because there was a new owner. That's a complicated story. I'll just advice people out there, when you lease an apple orchard, don't have great expectations but other than that, the bug was lit under me. I wanted to do more of this. I had planted an acre here. It wasn't properly deer fenced while we ran that other orchard but I came back and prepared more ground, put up more deer fence.

The three acres now, in a peak year here, we're looking at maybe 12, 1,600 bushels of fruit. It's a fair amount... biennial-ism is something that occurs with apples. When you're doing this organically, it can be hard to thin enough so that you get a balanced annual crop. That's just the cycle of what it is.

Bigger challenge now is the way spring is playing out. When cold comes, even before the blossoms have opened, that's been affecting us here in New England and in the Midwest as well but it's just working with trees. I alluded to the fact that I was probably meant to be here, in that it's not perfect apple ground. By that, I mean my interest in understanding how trees, plant are healthy in nature, being able to take those insights and transfer them to a site where it's about as challenging as it gets. I know most apple growers will tell their site is about as challenging as it gets. It really put me on the spot in terms of figuring things out, being able to deal with weather patterns. Then, finding the word to convey those teachings so others could deal with the difficult challenges that are going to be on anyone's site.

Chris: What were the biggest challenges that you faced on your site once you fenced the deer out?

Michael: Apples are out there 12 months of the year. You got the deer and the vole in winter. You just have to follow horticultural basics. You wrap the trunk but it's the fungal diseases. It's fire blight which is a bacterial disease. It's also pests and how they cycle in and out each year.

At any given orchard site in the East, plum curculio, this little weevil that came out of the plum thicket, that was a vexing thing for organic growers all through the 70s, 80s, 90s. At that point, the Surround Kaolin clay came out. Every one of these has integrated components to it, when I get to teaching people about how you go about dealing with a challenge like curculio but the clay gave us a tool that helped repel them and push and pull them to untreated trees where you can put chickens underneath. That's one of the option to help capture a lot of that population.



Fungal diseases, that opens up an interesting story. I went to college and got a degree in civil engineering. I grew up in the suburbs. My grandparents were farmers. My grandfather had a market garden in Pennsylvania. My other grandfather had a potato farm just over the hill from where the Rodale research farm is located in Kutztown, Pennsylvania. Thought I was quite removed from the idea that someday, I'm going to get my hands in the earth and make part of my living by working with plants.

I approached it wanting to be organic and was reading the Rodale literature of the time, I started to meet a few other growers. We heard how difficult it was and the talk was you needed to spray sulfur 20, 30 times a season to deal with things like apple scab, which is a fungal disease. All that was fine. I was learning. Wasn't super succeeding and started to meet some more growers but the key pivotal moment occurred. That's when my wife, Nancy, decided to become an herbalist.

This is the story. Often, it's the lady who studies plant medicine. Meanwhile, back on the home front, there's what I call the herbal husband. The herbal husband is a decent guy. He goes about his life thinking he's doing okay but meanwhile, when the lady comes home with all this knowledge about healing plants and wants to try tinctures and salves and all these different remedies, she turns to her herbal husband. He's suddenly given remedies for all sorts of conditions he had no idea he even had.

But what comes out of that is this insight into seeing how the way to build health is to support the system, the body systems, the immune function. I took that insight and applied it to farming, to gardening, how I grow plants. That's what opened the whole world of what I call holistic orcharding. Today, I don't spray sulfur at all for fungal diseases. This is just a whole 'nother approach that I've undertaken based on the fact that I recognize how nature herself does health, how trees and the soil food web are meant to work in conjunction to do health. That, in turn, results in healthier apples for us.

Chris: Let's dive in and talk about that because I feel like that's really the heart of your book, the Mycorrhizal Planet, is about encouraging this environment and encouraging the plant health and the surrounding, what's the right term, fungal sphere, I know that's not the right term, but in a way that does fight off disease and helps your plants resist the pests.

Michael: One of the first questions I ask myself was where does a tree really want to grow? I'm talking about a perennial would-be tree. That answer keys to where the fungal biomass in the soil is 10 times greater than the bacterial biomass. All that kind of information goes out of Elaine Ingham and the soil food web and understanding all these microorganisms and how they work together to create minerals that plants pick up and so forth.

I started to learn about the fungal realm, that notion of fungal biomass greater than bacterial biomass points directly to the edge of the forest. When I talk about where do fruit tree want to grow, I'm looking to bring that forest edge soil ecology underneath my fruit trees. It isn't like I'm literally planting trees or berries on the edge of the



forest but I want to bring that soil ecology, that type of life to the ground beneath my trees. That's where I coined the term fungal duff management.

I'm talking about what are the right kind of fungal food to encourage both the saprotrophic fungi, those are the decomposers of organic matter and the mycorrhizal fungi which form this symbiotic relationship with the root of not just apple trees but in truth, 95% of the plants on this planet. Then, we're going to want to come back to that.

Anyway, fungal duff management starts with creating fungal condition. What I like to tell people is just take your mind's eye to the edge of the forest. What's happening there? Raspberry canes are falling over, goldenrod is falling over. Succession species of trees are selecting and some of them are falling over. All that cellulose and lignin material is being broken down by the fungi to increase the humus. What that means from a practical point of view is to bring that kind of organic matter underneath your fruit trees.

One of the things I love to use and I teach about is the concept of ramial chip wood. Researchers at Laval University in Quebec back in the 70s and 80s started this. They were looking at what can we do with the tops of hardwood trees left from logging operation for agricultural purpose? What they were doing, in truth, was tapping into the fertility basis of eastern soils because our soils are forest-derived. What they learned was that the tops of trees, smaller portion, two and a half inches in diameter or less is going to be that much more rich in mineral nutrition stored in the green cambium bark that is in all those twigs and all those tiny buds. When that mineral organic matter is returned to the soil, it's broken down by what are known as the white rot.

The white rot are the fungi that are really adept at creating humic substances. There's a lot more to learn about ramial tip wood. There's a paper on my website at groworganicapples.com, there's one of the buttons is biological curriculum. People can get a lot of information there but the point here is that I am creating the very kind of soil that a tree wants to grow in. I'm utilizing brush from clearing along fence lines and under power lines, even utilizing the prunings from my orchard because that is hard wood and it's small in diameter. It's mostly bud and twig wood.

The whole goal here is just to get that fungal thing happening. When there's lots of humic substances and happy decomposition fungi, you're also going to have happy mycorrhizal fungi. Here's where things really turn toward the cool side. Mycorrhizal fungi are basically two types. There's ectomycorrhizae that have a relationship with the trees of the forest, both hardwood and conifers. Then, there are endomycorrhizae that have a relationship with fruit trees and berries and potatoes and winter squash and onions. The list goes on and on. This is where we start to touch on the concept of what I call fungal gardening or fungal farming as well.

Endomycorrhizae, actually penetrate into the cells of the root. They do this in order to exchange mineral nutrition and nitrogen and carbon and phosphorus and potassium and all that for carbon sugars because fungi can't synthesize carbon but plants can



through photosynthesis. Plants and fungi evolved with this mutual relationship of providing for each other.

What happens when mycorrhizal fungi penetrate the cells of the root of the plant, the plant in turn respond with an immune response not directed at the mycorrhizal fungi but which stimulate the stems and the leaves and the buds and the fruit of the plant to be on a higher alert in terms of potential pests and pathogens and herbivore. This is where phytochemicals come into being that make the plant taste a little more bitter. Phytochemicals that volatize and attract beneficial insects to the plant to protect it. It's the fungi that are one of the initiators of what is known as induced systemic resistance.

I build on that principle with my holistic sprays but the way all these things tie together is just so magnificent and beautiful. We have been missing that boat for decades and decades. It is really neat that now we have both the microscopic insight and also a much finer-tuned awareness of how plant physiology work in terms of standing up to disease and pest pressure.

Then, there's one more little bit. That's the bonus for us. When apples, or whatever produce you want to talk about, are grown in a living soil system and all this is taking place. By that, I also mean a touch of environmental reality. There are some insects chewing on the arugula. There is some scab spotting on the apple. All of that means that those plants that are growing the food that we eat are going through those phytochemical processes to deal with that reality. Those phytochemicals in turn are what we as a species grew up with when we were out there eating the nuts and the wild apples and the occasional mastodon, whatever the hunter gathering society would find, we grew up with food that was laced with all this goodness in terms of helping our bodies ward off degenerative disease. That full circle, having real food grown on farms really emphasizing soil health is where our health comes from.

Chris: It's really interesting to me what you just said that it's the mycorrhizal fungi that are getting into the roots of the plants. That's actually causing an immune response in the plants. Is immune response the right word to use there?

Michael: Immune response is fine. I call it green immune function because it's not like our immune system with red blood cells and leukocytes but it's a phytochemical process. We can think of it in terms of immunity the way our bodies work in that there's an immediate response to pest and disease but there's also this adaptive immune response. Mycorrhizal fungi, the endomycorrhizae in particular, the ones that penetrate into the cell, stimulate that response.

Chris: But they don't stimulate it against themselves. They stimulate it against other things. How does that work?

Michael: Some disease organisms, fungal in nature, when they penetrate the cell of the plant, there's a direct immune cascade that takes place phytochemically to try to resist that. Mycorrhizae have made a deal with plants because they evolved together. In that co-evolutionary pact, the plant doesn't try to shut down the fungal presence of



mycorrhizae but in turn, it's stimulated to produce the compounds that goes throughout the sap and into the produce and into the leaf to prepare the plant for whatever come. You know, as a grower yourself, that many things can come.

We can enhance that induced systemic resistance that the mycorrhizal fungi kick off. That's where we just get into plants that are healthier and healthier. This is what I do when I talk about holistic sprays. It's primarily about kicking in that phytochemical response and also creating a competitive microenvironment on the surface of plants.

Chris: When you talk about those mycorrhizal fungi actually penetrating into the roots of the plant, are they moving through the inner cellular spaces? Are they going through the xylem and the phloem where the water's getting moved or are they actually going into the cells themselves?

Michael: This is where we need a nice picture, Chris. They penetrate through the epidermis cells into the next couple rows of cells in the root cortex. They're not actually going into the center where the xylem and then the fluid flow is. They're both going between the cells. Then, they form these little tree-like structures. In truth, when you look at a picture, at an arbuscule, which is the nutrient transfer mechanism of the mycorrhizal fungi, it looks like a tree or it looks like the feeder root system of a plant or, if you have a medical viewpoint, you would see the alveoli of our own lung.

I like to say in herbalism, there's something called doctrine of signatures. When you recognize something in a plant, the way that it grows, the way that it forms, it gives you a hint as to the medicine. When you look at endomycorrhizae, inside the root cell itself, you see a tree, you see life. You realize there is this incredible connection, life between these soil fungi and the plants that give us oxygen, that photosynthesize that sunshine to produce carbon sugars. This whole underground economy is what makes the lives of you and I possible.

Now you got me up on my pedestal but it's such an amazing gift that this fungal membrane, throughout the soils of the Earth and even in the ocean floor itself, which is getting into a slightly different type of fungal realm. This is what holds life's sacred trust. This is what keeps it together for us. Once you recognize that, the way to farm, the way to garden, the way to orchard, the way to respect the living forest all becomes so clear to me. That's a big part of what I'm hoping this book is going to do because we've all heard great teachers, many different books, many different lectures, many different podcasts. The message is often the same but it's not quite as defined as, "My god, we got to honor these fungi. We've got to learn how to do growing without disturbing the soil." Once we get that part and we really get fired up about it, that's ...

We're now coming into the big talk, the talk about what's going to happen to our planet given the current course that it's on. Mycorrhizal fungi go beyond this immune function stimulation to curing glomalin, which is a protein substance where 30% of the carbon in the soil gets locked in place. Mycorrhizal fungi have a big role in forming soil aggregates, which again is where organic matter is stored for the long term where carbon is put back in that soil. The more we all get going as a culture, as a society, as



individuals to work to regenerate the land, to heal the land and do that because we understand that the fungi matter, we have a chance. That in itself is exciting.

Chris: I always get charged up when I hear this but one of the things I run into is, as vegetable farmer, I tilled. We till. This is what we do. We need bare soil to succeed. We need disturbance to succeed. How do you run a functional vegetable operation while still respecting and honoring the role of the mycorrhizae?

Michael: Growers have been learning a lot about non-tillage techniques, or, in truth, organic growers reduce tillage techniques so the work of Jeff Moyer at the Rodale Institute has introduced the notion of growing rye and vetch and how you can crimp those crops and then plan into it. That works for certain crops. Then, you have work of people like Jean-Martin Fortier up in Quebec. He's using tarps that can breathe, that can let air and moisture pass through to burn up the weed seed and then plant. There are power implements for something like the BCS tractor that, one is the flail mower where you can cut and chop up a cover crop without disturbing the root system. Then, there's this power harrow which, rather than vertically tills, horizontally stirs.

The more you can limit your cover crop planting to an inch or two of disturbance at most, you're holding your own. I realize there are fine-seeded things that you need to get into the ground. There are tools that you can limit how far down the disturbance goes.

Then, we get into the notions of more diversity in the market garden, having what I would call mycorrhizal refuges. That might be raspberry planting. That might be asparagus bed, perennial crops where you're definitely not needing to disturb the soil but they're next to where you're growing annual crops and so the mycorrhizae have a springboard, so to speak.

I write about a lot of this from the home garden and market garden perspective and get into some of the gist of how I, myself, and others are going about minimizing disturbance in the soil.

Then, you have the work of Gabe Brown and working with cover crop cocktails. There are ways. We're ruffians, so to speak, in learning how to discern how we can do better but that's really what I want to fire up in people. We can do better. There are people already achieving this reduced till agriculture. That's also important to say. If you get it down to maybe you till only every two or three years and you utilize concepts like biological tillage, that's using cover crops that winter kills. Things like tillage radish that fills down deep and oats that winter kill, leaving you a mulch to plant in in the spring, as far as transplanting goes. You use decomposition tillage, the ramial wood chip idea on perennial beds, breaking down over time.

There's many ways to go about it and hopefully, I'm going to inspire a more fungal conversation around that with Mycorrhizal Planet.

Chris: Let's back up just a little bit here. If I've got a field full of vegetables. I've got some carrots. I've got tomatoes. I've got peas and green beans. They're all out there in the



soil. Then, what does the mycorrhizal population look like underneath there, all that stuff that we can't see. Tell me how that's structured actually in the soil.

Michael: Mycorrhizal networks form and, as I said earlier, 95% of plants have this. The things that broccoli, anything in the cole family, things like red beets, Swiss chard do not but most vegetables do. Most cover crops do. Something like buckwheat does not have a mycorrhizal affiliation. We think of it initially in terms of one plant gets colonized by a fungus, there's penetration in the root cell.

In truth, any one plant can be colonized by 20 different species of fungi at the same time. That's what starts to connect plant of one type to plants of other types. This network builds that passes nutrients from one end of the field to the other according to where the need is greatest. Plants announce that need by saying, "I have some good carbon sugar to trade. Do you want to do a deal, man?" That trade is just mind blowing when you get into the nuance of minerals getting to where they need to go.

The fungal network also helps plant in drought situation. The fungi are invested in keeping photosynthesis functioning because that's where they get carbon from. Water is distributed through a mycorrhizal network. Communication is facilitated through this fungal network in terms of telling that row of beans. "Cucumber beetles down on this end. Let's get prepared." Many fascinating connections are taking place.

As growers, we have our assortment of crop. They come into harvest at different points in the season. Ideally, we try to manage the ground, though any given time, there really isn't bare ground. I don't mean that radically like there's never a fallow period but those fallow periods are seriously limited. Over the winter, there is a cover crop in place. That is carrying forward the fungal connection and the fungi carry forward in both root fragments and as spores.

But the real neat thing is just once you start to understand that at any given site, 20 to 50 species of fungi. Then, when we get into the forest, this goes up to a couple hundred species of fungi are forming this interconnected web to which nutrition and chemical signaling, warnings and water are passing to where it needs to go. The simplest way to think about that is know their ground. The more we can maintain that, the more it carries forward to the next crop and the next crop. I can't emphasize enough how important healthy plants are when we're talking about some kind of fungal disease coming on the scene in a big way.

In the orchard, I might talk about apple scab or cedar apple rust or powdery mildew. In vegetable garden, something like late blight is a fungal pathogen. It was about, I don't know, eight years ago or so that all these plants from the big box stores were produced down somewhere in, I believe, South Carolina. That supplier passed along plants that carried late blight fungal spores which in turn infected home gardens, which in turn bred in the air and infected market gardens throughout New England and the Northeast. Late blight is the cause of the Irish Potato Famine.

It was interesting to hear the advice coming from the advisors and the extension people how organic growers, you really had only one choice. That was to spray



copper. Then, next week get out and spray copper again. If the next week, if your plant still weren't dead, maybe try copper one more time but just pull up the plant because you needed to interrupt this cycle.

That's the way we think when we are in that mode of pathogen bind to toxin to take care of the symptom which is the disease which is so different than what nature wants to do both through the mycorrhizal networking and through plant immune function. When I spray the orchard with the holistic sprays which include things like liquid fish and seaweed and pure neem oil and effective microbes. We can get into that a little more if you want to. I am putting fatty acids out there and competitive microbes on the surface of my potatoes and tomatoes at the same time I spray my orchard. I am boosting the immune function of my potatoes and my tomatoes. That, in turn, prepares a plant for when that lake blight spore comes. It's a much different story. Mycorrhizae tie into this as well.

As you start to see how all these things come together, it's just so exciting. I'll tell you right now, I'm still in my 50s, Chris. In truth, I have about four months to go on that score but how great it would be to a young farmer again, as we're just starting to discover things that are going to make us so much better at growing foods for ourselves and being healthy overall.

Chris: I think one of the challenges to the approach you're talking about. Just to take that example of lake blight is that if you find out that there's a disease outbreak heading your way, you already better have some of that stuff in place. This really is a long-term strategy. Building up the mycorrhizae in the soil, building up the health of your plants. It's not like the day that you see a disease on a neighboring farm. You can say, "Oh, I'm going to change what I'm doing now." It's something that you really have to play for the long haul.

Michael: Oh, absolutely. I'm glad you bought that up. No. It's very preemptive. When you're taking this holistic approach, those connections are not bought in the local store and inserted the next day. This is something you build. The fungal networks are something that we, through wise farming, through cover cropping, through that principle of no bare ground, through inoculating certain crops, through inoculating not just the vegetables, sometimes the cover crop, depending on the cycle of our tilling. When do we really need to recover this? I use the term biological compromise. Sometimes you face this decision. I need to kill. I need for this particular disease event, the way it played out, I'm going to use sulfur again just as an allopathic touch to get through this time.

Every one of those stories has a lot more nuance to it but there'll be times when we need to recover where we were but ideally, as we learn to work things, concepts like biological tillage, winter-killed cover crops, occultation, that power harrow is an incredible tool once you see it in operation and how little it disturbs the soil. There are ways that we can make this work. There are ways that we can do fungal things better and better.

You're right. That means that when the diseases spore lands from the sky and collects,



you are the one who's going to get this now. We are more prepared than not. The plant, the soil are ready to do environmental reality as only they know how to do.

Chris: I oftentimes say about whether it's learning how to manage employees or have better relationships with people or even to get on top of your farm finances, when I'm teaching classes, I talk about when's the best time to learn TaeKwonDo, right?

Michael: Uh-huh.

Chris: It's before three guys jump you in a dark alley. I guess that's really what you're saying here is that you have to be ahead of the curve on this, that you need to be building up your soils, the mycorrhizal networks, the mycorrhizal population in general, the health of your plants that results from that before your plants get jumped by three guys in a dark alley.

Michael: Yes, absolutely. You can see health. You can see the vibrancy in green leaves. Any grower knows when that vibrancy is there, pest pressures tend to be more ... I don't want to say, "Under control," but more nudgeable. They're not overwhelming.

Similarly, there's growers who go out and read the brix of plants and check the plant's sap to see if those valuable sugars, if complete proteins are in place because there are many insects that can't digest complete protein. Similarly, fungal pathogens, when they tap into the cell, the sap of a plant, they are looking primarily to absorb valuable amino acids. If, in turn, we have really ramped healthy plant metabolism into gear through both fungal networking and in holistic method, we're going to see plants able to stand up to that pressure. It's going to make it possible to have a whole lot less need for intervention to make up for the fact that pathogens are here.

There's a new pest throughout this country as of six to eight years ago called spotted wing drosophila. Spotted wing drosophila is the Japanese vinegar fly. It's a fruit fly but unlike the native North American fruit fly, it reproduces every eight days. It starts in unripe fruit. Fruit can mean the tomato, it can mean the cherry, it can mean the blueberry, it can mean the fall raspberry. This is a very aggressive pest but on the other hand, when we're working with healthy plant metabolism which mycorrhizal fungi play a role in, that means that plants in turn don't have the same seed attractant that boost those populations. A nudging spray of something like spinosad, which I don't go to quickly but I will utilize, can knock those numbers back in check if they start to get out of hand whereas if you're looking at not just three guys in an alley but hundreds and hundreds of thousands of fruit flies, you're facing a scenario that's almost impossible to get an upper hand on.

Chris: Michael, I'm a little bit of a control freak. We'll say, I try to temper that but I want to be in control. When I see a problem, I want to respond to it. It seems to me that it must take a lot of faith not to panic when you're relying on these more holistic systems of plant health rather than relying on a pest and response situation or pest and response strategy.

Michael: I'll probably be answering that question mostly in an orchard context but no, certainly,



you do respond. Certainly, common sense horticulture still rules. You have a tomato patch and late blight strikes on one end, you don't wait a few days to see if the fungi will come to the rescue but plants that are more than 20% infected, you pull them so that they're not a source of pathogens to keep spreading down the line because things happen. Even for us as a family eating a lot of our own food that we grow, that the free-range chickens and all that eating my holistic apples, it doesn't mean something won't happen.

I have a nice sidebar in the book about how we do what we think is right. We stand by our principles. Yet, it isn't about being pure. It's about recognizing you do the best you can and maybe every morning you do yoga and you drink nettle tea. That's great but still things can happen. Something can happen to any one of us. That doesn't mean we suddenly go to the far side of the extreme and necessarily chose radiation or chemotherapy. Some people, that might be the right choice for them because your belief tie in here as well but it means that we still do what we think is the best thing to do but we do take steps. We've been affected. Our plant have been affected. There's things we need to go and consider.

But to consider them in a context of is this an allopathic choice, by which I mean a toxin for the symptom or is this something that builds system health. Once you get things going, you've gone through that biological transition. You get those fungi back in your soil. Once you get arboreal biology on your side. That's where effective microbes and compost teas come in.

Once you get balanced mineral nutrition which the fungi play a fantastic role in making happen. Once those things are in place, that's what you still support, even when we realize, okay, let's take fire blight. Fire blight's this bacterial disease that gets into the blossom of an apple or a pear tree wherever there's an opportunity. The wind whips chute, driven by hard rains, they tear, aphids chew. All of those are opportunities for bacteria to get into. Integrated pest management orchards, what we call conventional orchard, they use synthetic antibiotics to deal with that.

I, on the other hand, and I can't see any of this, know that if the conditions are right, it's going to be in the 80s, there's a moisture in the air. Those are the right conditions for bacteria to spread quickly and find those opportunity. When I go out and make a holistic spray during bloom, the recipe changes a little bit but it's primarily microbes. Whether those are yeast or bacteria, they colonize the surface of the plant which in turn means one of three things is going to happen for that blight bacteria landing in the flower. One, the blight bacterium itself gets consumed because microbe eating microbe is what microbes do. That's the whole soil food web working its magic. In this case now it's up in the air. It's on the surface of the plant. That's why I use the word arboreal food web.

Secondly, there may not be the food resources needed by that bacterium to launch itself into the vascular system of the plant because the other microbes are consuming it or, and this is beauty, those other microbes, the bacteria in particular, are producing antibiotic compounds right there at the source of the challenge and dealing with the bacteria. Different researchers have found that my probes can outcompete bacteria.



There's spray products.

Now, you could buy Blight Ban, which is a Pseudomonas bacterium or you can buy Blossom Protect which is two strains of yeast to do this colonization. Others will use compost tea but it's still about timing. It's about knowing that this is an opportunistic organism and rather than reaching for the approved synthetic antibiotic medicine, which we can't use in certified organics anymore, anyway, you go to the microbe. You realize how the source worked.

I think and hopefully that example's helping you and your listeners to see this, we're supplementing working with the way nature does it and it works. Our notion of medicines and coming in with those toxins, whether they're natural substances and approved by OMRI and organic or not, that's the last choice but it isn't necessarily wrong that we eventually are forced to that or in a transition situation, we ponder that scenario more often but it's a choice. Once we start making these healthy choices and we build it and we see how it comes together, that magic, that greenness, that energy, it works. As we learn to just see our role as a steward of this incredible team of microorganisms and get these networking communities of fungi, not disturb them, not break them up but do as much as we can to usher them into the next planting, to usher them into the next growing season, we'll just see less and less of the problem. That's what I've seen in my orchard. It's the message that I just really have to emphasize to every grower out there. This works. Do fungal things. This works.

Chris: Awesome. With that, Michael, we're going to take a break and get a word from our sponsors. When we come back, I want to talk about how to do fungal things.

Michael: Okay. Sounds good.

Chris: The Farmer to Farmer Podcast is sponsored by Farm Commons. I had a great attorney while I was farming but in a town surrounded by a sea of corn and soybeans, he often didn't understand the ins and outs of what we were up to on a legal front, whether it was dealing with intern housing, in-kind wages, land leases from my market farm or putting my CSA on a strong legal footing but Farm Commons gets it. Once more, Farm Commons turns that understanding into practical, accessible and easy to understand resources to put the law into plain language without oversimplifying things. Did I say they were free? Free. Even my great attorney didn't do that. With an ever-growing selection of free guides, model documents and video tutorials, Farm Commons understand that a strong, resilient farm business is built on a solid legal foundation. Visit the Farm Commons website or watch for their interactive workshops held around the country. Farmcommons.org.

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We're back with Michael Phillips from Lost Nation Orchard in the extreme northern New Hampshire. He's also the author of Mycorrhizal Planet.

Michael, it's my understanding, when you've got a field full of crops that underneath the soil, you've developed what I think of as a mycelial web. You've got these hyphae, these root-like structures from the fungi running every which way in the soil. Is that a fair thing to say?

Michael: Yes. Fungi, their hyphae can anastomise, which means that it can actually fuse into the same species of fungi to form a new highway, a new route to go and that's what builds the network. The different fungal networks based on fungal species come together in the roots of the plant. That's where cooperatives in the sort are formed in terms of trading nutrients and one fungal system delivers to another fungal system through the plant.

This whole fungal networking takes place in the top inches of soil in the humus layer. In those top four inches, it's far more dense than it is in the next four inches below and so forth. However, that fungal network can extend to three, to four feet deep or even deeper in the case of forest mycorrhiza, very different type but knowing that of the greatest density is higher up is where we get into one of the principles behind what we know is gentle tillage. By not flipping four, six, eight inches of soil to achieve a more amenable surface but rather flipping one to two inches to the extent that we can or flipping it in the context of incorporating a cover crop or rough compost, all of that keeps those tines from going deeper and deeper and chopping up more and more of the fungi.

It's that vertical tillage and plowing where we break those fungal networks. The more efficient the tiller, the more you shatter it into bits and go back to square one. There'll be some recovery in the fungi themselves. We can choose plants and manage these hyphal networks so that they are ongoing.

One key point here to understand is mycorrhizae form a relationship with plant roots. When I talk about no bare ground, it's because there's no plant roots there then and there's no top of the plant to photosynthesize and put carbon in the soil. It's that bringing together of fungi and root that create possibility of a mycorrhizal network.

Chris: Periodically in market farming, we do create a bare soil situation. If we're leaving a space without mycorrhizae, there still other funguses that are surviving in there. How long do the mycorrhizae actually hang on? How quickly is it necessary to get something established before we lose the network of mycorrhizae that was there?

Michael: Mycorrhizal fungi carries forward in three ways. One is through existing networks expanding so that's what we see during the growing season. That's why when I talk



about mycorrhizal refuges, there's an existing network that bred the hyphae outboard. If the other plants are close enough or are replaced, replenished soon enough, then there's that connection.

Chris: How close is close enough?

Michael: Mycorrhizae, depending on the species, the type, some, it's a fraction of an inch. Others, we start to get into a longer reach. One way of understanding what's called the mycorrhizosphere is it's basically three times more reaching than the rhizosphere, the root zone itself, the roots that we can see. That doesn't sound like much but again, it's through this fusion of hyphae to the next plant over and the next plant over.

When you introduce diversity and there are perennial plants and some of those species have ectomycorrhizae affiliation. Those are the ones that have longer runner hyphae. That's why, again, it's not just a question of a monocrop. It's a question of diversity and lots of different plants but that means lots of different fungal species having an opportunity to come together in what I call passage plant to build that network further and further out.

Back to the propagation aspect. Mycorrhizae fungi will carry over for six months in root fragment. That's an important concept because we all know there's a dormant season, a fallow season. You can grow a cover crop. Winter rye is going to over winter, oats are not but in those crops where mycorrhizae had enough time to develop spore mass and vesicles which is a lipid storage structure of the fungi in the root cell. When there's enough time for that to take place, and that's on the order of three to four months, then, you have something that's going to carry over for six months till the next growing cycle when plants are going to be put back in there.

There's actually some leeway here. It's just when we chop it up, we always go back to square one. When gardeners pull those plants out by their roots, they're removing the ability of that fungi to carry forward in root fragments because they've been pulled.

Then, the final way is through the production of spores. Now, all of us who are mushroom hunters know, we look for the fruiting bodies in the woods of chanterelles and boletes and morels and all these different types of visible mycorrhizal fungi. In the forest, the ectomycorrhizae form mushroom to sporulate but ectomycorrhizae do it in the soil, either in their mycorrhizosphere right around the root or in some cases, within the root itself. Those spores hold a viability of one, two, perhaps three, four years. Again, it's a question of having enough spore density, so to speak in a given field so that plants that are planted inches away. I know this sounds really small but nature has us covered if we're doing it right. Mere inches away to get that connection and start it all over again.

We can facilitate that as well. We can take, for instance, a raised-bed planting where you get *Allium* vine more or less along the edges. Then, you're putting tomatoes down the heart of it. That's not for every market garden design but what you're doing is you're allowing two few months of mycorrhizal establishment on *Allium* than it's right there next to the tomatoes when that time comes. Those connections get made to



carry forward to really launch the tomato ecosystem.

Similarly, just inoculating potting soil with spore, with these different mycorrhizal inoculant products available from companies like MycoApply and BioOrganic. That's a great way to get a fungal networking going in your small potting space and your soil blocks. It takes two, three weeks to establish. Once established, you have plants that are more resistant to damping off disease because you have competitive organisms in there protecting those roots. You have plant that are going to experience far less transplant shock because they have this network to help them take hold, to get rooted in there. There's many ways to preserve that mycorrhizal connection. That is the goal.

Chris: When you talk about inoculating your potting soil with mycorrhizae, is that necessary, if you're using a compost-based potting soil?

Michael: The answer is yes. Again, we have to go back to that fundamental definition of what is a mycorrhiza. Myco means mycology, the fungal realm coming together with the rhiza, the root of a plant. It's that union of fungi and plant root that is a mycorrhiza. Mycorrhizae are in soils where living plant are. Compost, we've taken organic matter and people have done a great job in terms of thinking about bacterial, fungal balance, it's not overheating the pile, adding the right kinds of organic matter.

One of the things I love about Vermont Compost, which is one the products I use here. I'm all approximately about two hours away from where this is made. They put yellow birch bark and other ramial chipped wood materials into their compost, which is going to create that dynamic for the white rots I've talked about, the saprotrophic fungi, the deep composition fungi. It just creates far more diversity but even the very best compost does not come with mycorrhizae because we're not growing plants. There are no root in order to create spores in compost. That's the reason for inoculating seedling.

Chris: Does having an existing hyphal network or the existence of saprotrophic fungi in a compost, in a potting soil, or in the soil, does that help the mycorrhizae to get established if you're using an inoculum or an inoculant?

Michael: I would think so. I guess I'd have to take the other extreme here. That would be hydroponics and growing marijuana. Those other species are not there and yet mycorrhizae benefit those plant. You and I probably share an opinion about hydroponics is not quite as good as the living earth, as real soil. That's where you tie into these saprotrophic fungi and you tap into all sorts of bacteria. There are damp dynamics. There's interchange between rhizobacteria and mycorrhizae. It's a much more complex picture than we humans, who tend to want to separate and compartmentalize, would assume but yes. Again, it's the more diversity of life, the more nutrient dense the food that we grow are going to be.

Chris: If I'm going to use mycorrhizal inoculant, say, in my transplant production because that seems like a logical place where I would want to do that with my onions or my tomatoes. I'm in the greenhouse. Is it something that I'm blending into my potting soil or is it something that I want to sprinkle on top? What are some ways to get the most



out of doing that?

Michael: I do a lot of my plants with soil blocks but when I start the tiny seedlings in a seedling tray, go out ... In truth, actually inoculate that soil, too. It doesn't hurt to launch the connection as soon as you can but I just have a bin of soil where I'm going to take the soil blocker. I do a dusting and then I stir it in so that the spores are ideally, uniformly spread throughout. Those soil blocks are made. That connection is now made for the tomato plant that goes in there. That connection is made for the four onion seeds that sprout in the soil block and become four plants together when you plant them out in the garden if that's your method. Yeah, it's as simple as that.

In truth, if you're going to have a day where it's all broccoli and kale and cauliflower and cabbage plants that you're doing, don't waste your money on inoculants. Those plants do not make that connection. That's simply a fact that through co-evolution, through extreme habitat, and maybe because George Bush didn't like broccoli. I don't know why but they lost this affiliation with mycorrhizal fungi.

On the other hand, nature's so adaptable and sometimes it comes back but that mere act of taking a quality inoculum. One of my favorite potting soil is Fort Vee, again, from Vermont Compost. It's such a simple step to do. Then, you've launched it. Those spores awaken. It's going to take two to three weeks but in the process of growing out that tomato plant, let's say, and you pot it up, that carries along with the root system of that little tomato and then extends out into the soil but the soil that you pot up with, you might inoculate but if you did it right from the beginning, it's already there with the root system.

Similarly, when I plant a bare root fruit tree, I know that most fruit stock comes from a place that is not very fungal, a big root stock farm, fumigate the soil. It's not managed that way. Organic nursery would certainly introduce mycorrhizal connections but for the most part, fruit tree roots don't come with the inoculum. BioOrganic makes this root dip. I dip that bare root system every time I see that gel and crystallizing on the surface of the roots. When I plant that tree and spread the root for the duration of its life in this Earth, I know that I have launched it with the right kind of connection.

This whole fungal thing is a lot like making sourdough bread. If you're a baker, you've got the concept down that you keep a little bit of the dough for the next batch because that will inoculate the next batch with the yeast. Similarly, you just need to get a little bit of inoculum to launch an incredibly beautiful realm of fungi.

One of the things that growers can do as well is you can actually make your own inoculum. Rodale did some research on this. This was the work of David Douds. What he did was use plants like annual rye grass or bahiagrass, grew them out in sacks over the course of the summer with indigenous fungi taken from a healthy, wild ecosystem. Over the course of three to four months, many species sporulate. By the time the grasses died back in the fall, the soil itself and all the root fragments in those sacks is displaced with spores. That inoculum is what you can mix into your potting soil. There's many ways you can go about this.



It's just understanding. It's really, really important and especially when we are recovering from a disturbance situation, be that tillage, be that years and years of herbicide on a conventional corn field that the young, idealistic organic farmer is now going to convert, be that the suburban house lot with a bulldozer is scrape the top soil. Be that where you grew broccoli all summer long or you went in with a buckwheat cover crop but not a diversity of cover crop plant. There are situations that call for remedial action and bringing back the inoculum.

Chris: In those situations, a lot of market farms are very heavy on the brassicas. Buckwheat's a great way to do a catch crop for getting something in that can grow fast and really does a nice job with loosening up the soil. When you talk about reestablishing the mycorrhizal networks in those soils, how much stuff are we talking about putting on? If I've got a sack full of soil where I've made my own inoculum, are you spreading that out on that field or are you just thinking that maybe if you stir that up with the seeds that you're putting in your seed drill, that's going to be enough there. How are we talking about getting this re-establishing where we've taken it away?

Michael: We haven't so much taken it away as we haven't supported it for an interim period. There's very likely to be spores of some species that are still in that ground unless it's a heavily disturbed, abused soil situation but really, growing broccoli and cauliflower, what have you, even on bigger and bigger plots doesn't necessarily remove it all but it lessens the spore density. The carry over may be harder to find that connection, come back as quickly.

What you just mentioned about the seed drill is an excellent way to inoculate cover crop seed. I'm still going to use a buckwheat cover, particularly when I prepare my garlic ground from whatever I harvested in mid-summer because buckwheat just fits that window so nicely. Ideally, I might grow some other cover plants for people who put oats in that planting and then plant the garlic into the remaining oat, the buckwheat. Winter kills can be mowed down but the oats will grow back but that affiliation carries forward fungal connections in the garlic bed and then the winter kills the oat, leaving you with a nicely mulched bed.

Different plants have different natures that we can work with to do this but inoculating a cover crop cocktail in a very heavily-abused situation gets you back up on your feet whether you've grown broccoli or cauliflower or cabbage or red beets or Swiss chard. Also, just the neighborliness of if that planting is let's say a 10-foot plot and there's other plants that have mycorrhizal affiliation nearby and then you plant a cover crop because it's winter and that reaches back into the cover crop, you're not necessarily buying inoculum at every turn.

There's a few basics to understand here, that it takes three to four months for a cover crop to get to the spore stage. Root fragments hold that viability for six months. Once you start to see those pieces and the plants that you're working with, you can recognize, "Okay, if I do it in this order and it's not a monoculture of 40 acres of broccoli, I can keep this connection going."



Chris: You talked about getting your inoculum from the wild. You said that Rodale did these experiments growing the annual rye grass to create a mycorrhizal-rich soil that that was done in bags filled with soil from nearby forests. Is there additional value in using my native mycorrhizae as opposed to buying something in a bag?

Michael: The sack idea is really useful to market gardeners who want to have root fragments in their inoculum. When you buy a product, the root fragment portion probably has spent it's six months waiting for you to be ready to use that product but when you have that sack filled with spores and root fragment, that launches seedlings sooner because out of root fragments, that connection can be made in as little as a week but there's some relevance there, particularly for plants that maybe have damping off problem.

On the other hand, when you go out to a healthy, wild ecosystem and that's something I tell people in home orchard to consider. You take some soil, you take away maybe the top inch or two of mulching matter and get some soil where you know roots are because you have to have that affiliation with roots nearby to be picking up mycorrhizae. You bring that back to an apple tree that you planted but you didn't do the root dip thing I talked about earlier. I'm not saying to you, "Okay, you made a mistake. Dig up that tree. Let's wash off the root systems and dip it in the gel and then get it back in there."

No, what you need to do is just simply remove an inch or two of mulching matter and get closer to where the roots of the fruit tree are and put that wild inoculum. I call this Ent soil. I love the tree shepherds in the Lord of the Rings and Tolkien fantasy world of Middle-earth. Ent soil introduces the 20 to 50 mycorrhizal species that are in that wild ecosystem to where you're planting your fruit tree.

In this case, your fruit tree may be in a lawn setting where there's one or two species of endomycorrhizae going but there's not the 9 or 12 or 20. These species of fungi have different principals. Some are really adept at getting going early in the season when the soil is cool. Others are there for the transition until the plant is more firmly established. Some have an expertise in bringing in manganese, let's say or they're all phosphorus go-getters but they have different nutrient specialties.

You want that diversity. That's where the commercial inoculums have value because different fungal species have different levels of sensitivity to disturbance. We don't really know the big picture. I think we've named something like 5% of the fungal species on the planet. We mostly don't know much about this realm but when we want to re-establish these connection, bringing in the key players, the 9 or 12 species that are in these different quality inoculum can be an important step to recovery.

Again, it's really about what's the history of that land? What is your cover crop cycle? Did you have bare ground? Was that followed by broccoli and then buckwheat? Then, did you plant cabbage again? You start to get bigger and bigger distances and time from where spore inoculum is going to carry forward. That's where you need to come back and do things like inoculate sudangrass which has affiliation with about 50



different species of mycorrhizal fungi. You'll get the most bang for your buck.

Then, in rotating your cover crops and chopping the organic matter, utilizing more surface decomposition, just integrating more reduced-tillage thinking into how you go about your farming, you'll find very economical ways to carry forward mycorrhizal connection. There's time for inoculum and there's times when it isn't necessary but all along the journey, we have to be thinking fungally.

Chris: On that note, I think that's a great place to wrap up here, Michael. We're going to get a word from another sponsor before we go to our lightning round. We're going to be right back with that in just a second.

This lightning round and perennial support for the Farmer to Farmer Podcast is provided by Vermont Compost Company, helping plants make sugar from sunshine since 1992.

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All right. we're back and ready for the lightning round with Michael Phillips. Michael, what's your favorite tool on the farm?

Michael: Oh, tough call, Chris. I love my broadfork from Meadow Creature. Big, heavy, broad fork which is my way of aerating the soil and part of how I go about no tillage and yet being able to incorporate organic matter. I also love my wheel hoe. I just enjoy running down that row. I can shallow cultivate in a small garden setting between herb beds where there's just one row planting to get into cover. It's very easy to incorporate cover crop feed with the disc harrow attachment that Hoss Tools puts on their wheel hoe. I call a lot of this stuff biological equipment because if it works to maintain that fungal connection, it's sweet. That's what you want to be working with.

Chris: I'm going to take it that apples is your favorite crop to grow but if we took apples away, what would be your favorite crop to grow?

Michael: If I didn't have the trees going, I really enjoy garlic. Garlic's a good medicine crop and it has these fungal connections that a plant that I utilize for so many different conditions, tough guy conditions but also just makes for great eating. I grow these about eight different varieties. I get cloves the size of Brazil nuts. A part of our income is selling seed garlic to pass on these varieties so other people can adapt them to



where they are and we can all grow more garlic.

Chris: Here we are in late winter. If you could tell every farmer listening to this show to do something this spring to enhance the mycorrhizal environment on their farm, what would it be?

Michael: The whole notion of making that inoculant connection at the point of growing out seeds and getting your transplants ready. That's an opportunity that shouldn't be missed. Look at your rotation plan and maybe there's two moments of tillage in the season that you are looking at doing. Can you cut one of them out? Is there a way to start to get into more non-disturbance techniques that are going to carry the fungal thing forward? Then, when you plant your potatoes, your spud, inoculate them. You're going to have really happy potato.

Chris: Finally, if you could go back in time and tell you're beginning farmer self one thing, what would it be?

Michael: I'm sure I idled away 10, 20 years learning how to work with fruit trees to understand the fungal connections or the beginning and the end point. To accelerate that would be wonderful because it is such a long wait. The more north you go, the more true this is, to get that apple tree to have enough wood structure to be into bearing years and up and running, I realized that I probably have, in truth, 50 or 60 opportunities to get it right each new spring. That's not a whole lot to base your learning on when you really get into it but I love the wisdom I seem to think I have right now. I would have loved to have had that earlier on so I can just get that much further along on the learning curve but all in all, I'm doing okay. It's the good life and it's fun to be able to share a lot of these teachings with people and our collective learning curve, that's what I think is really kicking into gear in these new days.

Chris: Awesome, Michael. Thank you so much for taking us on this fungal journey today.

Michael: It's a pleasure, Chris. I look forward to catching up with you again someday when I get out to teach in the Midwest.

Chris: Great. Me, too. Thank you so much.

Michael: All right. Bye.

Chris: All right. Wrapping things up here. I'll say again, this is episode 108 of the Farmer to Farmer Podcast. You can find the notes for this show at farmertofarmerpodcast.com by looking on the episodes page or just searching for Phillips. That's P-H-I-L-L-I-P-S.

The transcript for this episode is brought to you by Earth Tools, offering the most complete selection of walk-behind farming equipment and high-quality garden tools in North America and by Growing for Market where you can get 20% off your subscription with the code podcast at checkout.

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Finally, please let me know who you would like to hear from on this show through the suggestions forum at farmertofarmerpodcast.com. I'll do my best to get them on the show. Thank you for listening, be safe out there and keep that tractor running.