Title: Down to the ground mulch talk with Dr. Deirdre Griffin LaHue

(00:00:00) Nataliya Shcherbatyuk
Hello and welcome to the Mulch Matters Podcast where we will explore the intriguing world of mulch and its impact on agriculture and the environment, as well as update you on the latest research about soil-biodegradable mulch and recycling options for plastic mulch. I am your host, Dr. Nataliya Shcherbatyuk, and I am a communications specialist for the project, “Improving end-of-life management of plastic mulch in strawberry system”. In each episode, we’ll dive into the latest research, trends, news, and insights on why mulch matters and how we can improve plastic mulch end-of-life options. We'll also branch out and discuss other plastics as well as talk to researchers, experts, and practitioners in the field who will share their insights and experiences on how to use mulch effectively in different settings.

(00:01:03) Nataliya Shcherbatyuk
It is my pleasure to have Dr. Deirdre Griffin LaHue on our podcast today. Deirdre is an assistant professor in the Department of Crop and Soil Science at Washington State University. Her research focuses on the impact of agricultural practices like, for example, cropping, tillage, rotation, and others on soil health and the soil organisms that facilitate many soil functions. She is also interested in how mulch is used and its incorporation impact the soil health and specifically she is working on assessing if and how mulch incorporation affects populations of soil microbes and the carbon and nitrogen cycling process that those microbes are actually driving, as well as soil chemical and physical properties such as soil porosity. But let's hear more from our guest. Deirdre, thank you so much for joining us today.

(00:02:13) Deirdre Griffin LaHue
Thanks for having me.

(00:02:15) Nataliya Shcherbatyuk
Oh, absolutely. So, were you always interested in soils? Can you tell us a bit more about your background and what actually brought you to crop and soil science?

(00:02:28) Deirdre Griffin LaHue
Yeah, I actually have an interesting past. So, I had a previous career as a ballet dancer, so a natural progression into soil. But through that, through ballet, I got really interested in nutrition and so, when I first started undergraduate, which was after my ballet career, I started in nutrition science, at the university of Maryland, and then realized through that,

that I was really more interested in how food was grown and so that's what led me into soil science.

(00:03:06) Nataliya Shcherbatyuk
Oh, that's so interesting. That's a pretty good switch. Yeah, pretty cool. And what is your role in this project that we're working on?

(00:03:17) Deirdre Griffin LaHue
Yeah, so I'm specifically looking at the impacts of the mulches and mulch incorporation on soil health, and so I work in soil health across many different systems and looking at how different management practices influence soil health, and so for this project, I'm looking at the impacts of the mulch incorporation. And just a little background by soil health: it's a popular term now, but we're really looking at a variety of functions that soils provide to agricultural systems and to the environment. Things like water movement and filtration, nutrient availability, biodiversity. So, we're looking at kind of a broad suite of important functions in the soil.

(00:04:06) Nataliya Shcherbatyuk
Yeah, that's pretty interesting. And that's actually so true that soil health now, you can, really hear it everywhere, before it was, what is soil health? What are you talking about? And now it's such a commonly used term. It's quite interesting. And now as a soil scientist, would you tell our listeners a little bit more why plastic mulches are used? And, can you talk a little bit about plastic pollution in the soil?

(00:04:34) Deirdre Griffin LaHue
Sure. Yeah. So plastic film mulches are commonly used, particularly in vegetable and fruit systems and they're used because they really can help increase crop growth and productivity. And they do this by affecting soil temperature. So, for example, in cooler climates, they can help the soil warm up more in the spring and really get a boost on plant growth, particularly in black, when black plastic is used. They also help retain moisture, keeping the soil from drying out, so it can help reduce water use. And then another really important thing is controlling weeds. So just having the space where the crop is growing, and all the other soil is covered with this black plastic helps to control weeds. So, they are very commonly used and have shown benefits for a lot of cropping systems. But it's, it's definitely, you know, there's agricultural plastic use can be a challenge and plastic pollution in soils is becoming more and more of an issue. It's estimated that plastic pollution on land is actually equal or higher than plastic pollution in oceans. But it's, it's

actually, we don't know exactly how much of an issue it is because it's It can be really hard to actually measure plastic particles in soil, because not only might they be kind of really variable across the landscape, but the size of the particles can also actually be very similar to the size of soil particles, and the organic matter in soil can interfere with some measurements the plastics because they're kind of similar chemically. So, there's a lot of work being done, including by scientists on this project, working to improve the ways that we sample and measure soil, sorry, plastic particles in the soil. But there's still a lot we're, we're learning.

(00:06:36) Nataliya Shcherbatyuk
Yeah, that's pretty interesting. And now there is a lot of talks about biodegradation and biodegradable plastic mulch and what they can do, how they can help. So, we know that, or at least we heard a lot, biodegradable mulch has been proposed as a more sustainable alternative to plastic mulch, to the classical, I mean, plastic mulch. Could you explain more about how biodegradable mulch differs from conventional plastic mulch and maybe what its benefits to, for the soil?

(00:07:13) Deirdre Griffin LaHue
Sure. Yeah. So conventional, like polyethylene plastic films, when they're used in agriculture, they have to be removed from the soil, from the system after they're used, and that can be, you know, very labor intensive and cost intensive because of the time and cost it takes to remove them, and there's not great ways of disposing of them. So, biodegradable plastics are an alternative where they're designed to be broken down by microbes and other organisms in the soil. And the goal is that they eventually end up with just two end products and that would be microbial biomass, so, you know, microbial cells that have eaten up the plastic, the biodegradable plastics and then gases that they respire like CO2 and methane. So just like we eat food and then breathe out CO2, microbes eat food and breathe out CO2 and methane. And so, the goal is that these biodegradable plastic films would be completely broken down by the microbes. Microbes are always breaking down organic matter in the soil, things like plant residues or, you know, compost so, they're used to breaking down these types of organic materials. And so, the idea is that they would also be able to eat up the compounds that are in biodegradable mulches. And so instead of having to physically remove all of the plastic, the polyethylene film and, and landfill it, the ideal scenario would be to incorporate the biodegradable plastic mulch film into the soil at the end of the season, and then it would slowly break down by those microbes and, and become just kind of part of the soil.

(00:09:11) Nataliya Shcherbatyuk
Oh, that is, that is so cool. I can imagine microbes running around, breaking down.

(00:09:16) Deirdre Griffin LaHue
They're doing a lot of action in the soil that we don't get to see. It's fun to see evidence of it.

(00:09:21) Nataliya Shcherbatyuk
Yeah, there are a lot of things going on above the ground and below the ground if you don't even know. And you know during this podcast we'll be talking a lot about biodegradable mulches and also a lot of our listeners might be interested in what if they want to adapt those biodegradable mulches instead of classic plastic films. So, would you mind talking a little bit about challenges and limitations which are associated with the adoption of biodegradable mulches and how these challenges can be actually overcome or addressed?

(00:09:56) Deirdre Griffin LaHue
Yeah. So, one of the main things is just, are these biodegradable plastic mulches breaking down in the soil? We definitely see that they're breaking up, you know, they're breaking up into smaller pieces and, you know, but we need to continue to look at how much they're actually degrading into that end product of microbial biomass and CO2. So, that's a lot of the work that we're doing on this project: is actually measuring that complete degradation and then also measuring the amount of particles that are left, those microplastic particles that are left in the soil over time. Some other, you know, things that, that we've heard from when farmers that are using plastic mulches were asked about their interest in biodegradable plastic mulches is, you know, they had questions about durability. So, particularly in perennial systems like strawberries where they need that plastic mulch to be on the soil surface for quite a while, you know, are the biodegradable plastics going to be able to last throughout the season or even for multiple seasons? And then also, you know, when they are incorporated, how long is it going to take for them to degrade? And there's a lot of variability that degradation timing based on what mulch it is, how thick it is, the climate and the soil type. So those are some things we're looking at too. And then there's also some, you know, considerations about cost. Biodegradable plastic mulches tend to be higher cost than polyethylene, currently. And then also questions about color. So, there's a lot of biodegradable plastic mulch products that are black, but some growers like in California prefer green mulches. So, can we create biodegradable plastic mulches that mimic the color of the plastic mulches? So yeah, there's a lot of variability in what biodegradable mulches are made out of and how thin or thick they are that can affect that

durability and degradability. So, we're testing out different mulches for these properties and to get more information to growers and also to the companies that are working to produce these mulches.

(00:12:23) Nataliya Shcherbatyuk
That's super interesting. And you already spoke quite a bit about the difference between the biodegradable mulches and plastic mulches. But do you think you can expand a little bit more in terms of soil effect? What are the key [points], like main key difference between, uh, fields that are using classic plastic mulches and those today adopting biodegradable mulches?

(00:12:50) Deirdre Griffin LaHue
Yeah. So, there's been some research done on this, particularly in annual cropping systems, and actually in a lot of cases there are not major differences in the soil when the plastic is on there. And that's actually a good thing because we want these biodegradable plastic mulch films to have the same positive effects that polyethylene plastic mulches are having. So, this, again, when it's going to be one thing that we're looking at with this project, measuring fruit yield and fruit quality and looking at how the soils differ between these different mulch treatments. So, I'll have more information on that for this project in a year or two. But a lot of past research actually shows that there are not major differences in terms of crop productivity, which is a good thing. We want them to be performing similarly. There have been some studies that have looked at the effect on microbial activity, and there were some slight differences, maybe a little bit higher microbial activity in the, in the ones with the biodegradable plastic mulches incorporated, but not huge differences.

(00:14:12) Nataliya Shcherbatyuk
Interesting. That's fascinating. Yeah. Very cool project. Well, and I'm biased because I'm also working on this project. So, we hear enough everywhere about plastic pollution. At least I think that we hear more and more and it's becoming a global concern. Question for you from the perspective as a soil scientist. What do you think? What are the long-term consequences of plastic mulch use and specifically the residues of the plastic mulch on the soil ecosystem? And what do you think we can do or what can be taken to mitigate these impacts?

(00:14:54) Deirdre Griffin LaHue

Yeah, this is a really challenging topic, and there's definitely concerns about, for example, effects on soil physical properties. I mentioned earlier, you know, water movement and filtration are a really important function of soils and there are concerns about how, you know, if plastic fibers or particles are getting into the soil, how that might influence the pore space in the soil and, and therefore influence water movement into the soil and through the soil, as well as, you know, affecting things like root growth. There's some recent work done by Dr. Yingxue Yu and Markus Flury who are, Dr. Flury is part of this project as well and, and they looked at the effects of microplastics including polyester fibers and microbeads polyester fibers might come off of our clothing when they're washed and end up in In the environment and then microbeads are in a lot of cosmetics, and so they looked at different concentrations of these microplastics and effects on soil physical properties. They actually found that at lower levels, there were not major effects on these physical properties, but when you get to really concentrated, you know, if there's a really polluted soil, then they did find that there's more water repellency of the soil, which can affect the ability for the water, the soil to soak up that water. And it may also slow water movement into the soil. But it can also reduce the amount of water that the soil can hold on to, which is something that we need, you know, for crops to grow or other plants. We want the soil to be able to hold on, you know, act like a sponge and hold on to some water. So, there's, you know, there's definitely concerns there, particularly as we get to higher levels of pollution, and then there's also been some work done on effects on microbial activity and the soil microbiome and showing that particularly at higher levels. You are seeing effects on the, you know, changes in the microbiome and reduced microbial activity in some cases, in some cases, there's actually increased microbial activity because they're maybe working on trying to degrade those plastics. But, you know, that's still going to change the microbes that are there, which could have other implications for soil function. So, yeah, it's definitely a complicated thing. I think, you know, focusing more on these biodegradable plastics is really going to be an important step to mitigating the impact of plastic pollution. And so, I think the work that this project is doing to, you know, optimize these biodegradable plastics is really going to be valuable. And also working with other end of life uses for plastics, you know, are there recycling options for plastics that are used in agriculture and in other systems?

(00:18:07) Nataliya Shcherbatyuk
And while you've been talking about microbes, I just got a completely random question that came up about the microbes. So, can you tell me, and our listeners: are there things like good microbes and bad microbes for soil?

(00:18:26) Deirdre Griffin LaHue

Yeah. So, a lot of times when people think about microbes, they might think about pathogens. So, there are pathogenic microbes, pathogenic bacteria and fungi that can cause disease in plants. But there are also very beneficial microbes. So, there's microbes that are able to really break down organic material and turn it into stable soil, carbon and organic matter that's going to really help with soil functioning. There are microbes that form relationships with plants and can help with things like water and nutrient uptake. So yeah, I'd say I'm biased maybe, but the vast majority of microbes in the soil are beneficial, and are doing a lot of good work, and may also help out compete some of the pathogens. But that's really a ripe area of research right now as well is looking at the microbiome and right now the tools that we have to really understand what's going on are somewhat limited, but we're learning more and more all the time.

(00:19:39) Nataliya Shcherbatyuk
Well, and the reason why I asked, because lately it's been a big boom on the human perspective about the gut bacteria, you know, so there are good and bad, and they're heavily depending on what food you're giving to them, so basically on what we eat. So, I just was thinking if that depends on what you put in the soil, and specifically we're talking about classical plastic mulches versus biodegradable mulches. Is there any effect on the activity of what we call good or bad bacteria? So, I find it quite fascinating.

(00:20:07) Deirdre Griffin LaHue
So, I think that there definitely can be changes in what microbes there are based on what you're adding to the soil and how you're managing it. And, you know, adding biodegradable plastic versus not, or versus conventional plastic. The challenge we have right now in the microbiome world is: it's really hard for us to know, like, okay, this is a good microbiome. Because it's hard, a lot of pathogenic microbes are closely related to good ones. And so sometimes it's hard for us to be able to tell very closely if that is a pathogenic or beneficial microbe. So, that's where the kind of analytical technology needs to progress as well, so, we can understand a little bit more about, you know, what, is there a good microbiome for the soil and how do we identify those kinds of good actors.

(00:21:11) Nataliya Shcherbatyuk
Wow. This is extremely interesting. I think I'm going to try to invite you for another episode, just to talk about microbes and for our listeners, you guys already probably used to that. I like to ask some fun questions and for Deirdre, I would like to ask if you ever worked with soil systems somewhere outside of the United States of America. And if you did, did you find anything interesting or anything different or something that really surprised you?

(00:21:45) Deirdre Griffin LaHue
Yeah, I've been fortunate to work in a few different places, when I was doing my graduate work, I got the opportunity to go to Malawi and do a short-term project with farmers in Malawi and then I also was in Colombia for four months at CIAT, the Center for International Tropical Agriculture, doing some research there. So, you know, I mean, I think in both of those cases, I just really enjoyed seeing the huge variety of soils that we have in the world and also talking with the farmers about, you know, what they're seeing, what challenges they're facing, how they think about managing the soil or measuring the soil, you know, how they get to know their soil. So that's always really interesting to me. I think I had one of my most interesting soil sampling experiences when I was in Columbia. I was doing a project looking at Silvopastoral systems. So, the integration of shrubs and trees into pastures. And I was out there doing some soil sampling, and this was actually an actively grazed area, but we had thought we'd timed our sampling so that we weren't going to be in the paddock with the cows. But we showed up in the morning and it turns out one of the cows had been bitten by a snake overnight and had been found dead, and so they had moved the other cows into the area that we were sampling. So the whole day we were kind of trying to avoid these big bulls, and they were very interested in our sampling equipment and coolers, but they, they left us alone for the most part, but it was probably one of the more interesting sampling experiences I've had.

(00:23:33) Nataliya Shcherbatyuk
If you, you can call it interesting, I would call it scary. Did you take any pictures?

(00:23:40) Deirdre Griffin LaHue
Oh yes, yeah. We have some photos of us trying to shoo them away from our coolers that were storing our samples. And trying to avoid that whatever snake had killed the other cow.

(00:23:54) Nataliya Shcherbatyuk
Yeah, yeah, definitely scary. Well, Deirdre, thank you so very much. It's, it's extremally, I am super pleased that I invited you for our episode. Very great.

(00:24:06) Deirdre Griffin LaHue
Yeah. Thanks so much for having me.

(00:24:07) Nataliya Shcherbatyuk
That's it for today and until the next episode. You can find more information by following us on Instagram and LinkedIn by @mulch_matters and going to our websites www.smallfruits.wsu.edu and choose mulch technologies. This work is supported by Specialty Crops Research Initiative Award 2022-51181-38325 from the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed on this podcast are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

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