

Project Origins: Exploring Plastic Mulching's Evolution with Directors Lisa DeVetter and Markus Flury

(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.

(00:01:05) Nataliya Shcherbatyuk

We have two special guests with us today, Lisa DeVetter, Associate Professor in the Department of Horticulture at Washington State University, and Markus Flury, Professor in the Department of Crop and Soil Science at WSU as well. I'm really excited to kick off our discussion by interviewing both of you together. You are the key leaders of the amazing national project, and it's a pleasure to have you here. Thank you so much for joining us today, Lisa and Markus. And without wasting any more time, let's dive right in. So, can you tell me a little bit about this project? What brought you to this project and what is your role in the project? Lisa, would you like to share your thoughts first?

(00:01:57) Lisa DeVetter

Yes, absolutely, well, thank you for inviting us, Nataliya. So, I joined Washington State University in 2014 and immediately started working on soil biodegradable mulches in collaboration with other scientists, and we focused primarily on evaluating biodegradable mulches [BDMs] in small fruit systems, including strawberry and red raspberry. I was interested in the research because I understand the important role plastic mulches have in horticultural systems through their role in weed suppression, which can help reduce herbicide use and optimizing soil and canopy conditions for improved growth and profitability. But I also recognize the single use nature of plastic mulches and the sustainability concerns regarding their use, end of life management and the potential for them to pollute both terrestrial and aquatic systems. So, my overall programmatic goal as a field scientist also working in extension is to help provide data-driven solution to growers that optimize their production efficiencies and help maintain the environmental conditions or even enhance those conditions within the surrounding agroecosystem by working with soil biodegradable mulches. And later on, exploring non-biodegradable polyethylene mulch [PE] film recycling opportunities was a very natural area for me to focus on and hopefully provide a positive impact to growers and the environment. So, that's a little bit about what drew me in, and presently I'm one of the project directors of this large multidisciplinary team project funded through USDA NIFA and their specialty crop research initiative program. It's titled "Improving End of Life Management of Plastic Mulches in Strawberry Systems". But I'm not the first person to take on this active

leadership role in this type of research as you'll learn later on from Dr. Flury here, and also, of course, in this podcast series. So, in addition to this leadership role, I also co-lead or play a participatory role in other project objectives focused around conducting field and laboratory trials, evaluating the horticultural impact of these new mulch technologies and strawberry systems and then disseminate information to stakeholders.

(00:04:09) Nataliya Shcherbatyuk

Nice. Thank you so much, Lisa. Markus, what about you?

(00:04:14) Markus Flury

Yes, thank you, Nataliya, and thank you for having us here for the podcast. I'm a soil scientist, so I'm working mainly with soils as a support medium for plant growth and also as a medium for cleaning up contaminants. So, that's what my background actually was. I was looking at how soil actually can be used to remediate contaminated sites. I've worked a lot with the Hanford site and radionuclides, and it turned out that some of the expertise that I acquired, you know, to work with contaminants and particularly with colloids, turned out to be very useful also for the work then with plastics. So, for the past couple of years I've been working on a previous SCRI project on biodegradable plastics that I worked basically as a soil scientist to look at how plastics affect soil quality, and then it turned out that this is an interesting topic because the plastics also tend to deteriorate in smaller and smaller particles. And, then become "microplastics" that it's commonly called - a very hot topic in general environmental sciences. And then also these plastics become "nanoparticles" as well. So, something very related to what we have been doing actually with radionuclides in the past: to look at the fate and transport of those micro- and nanoparticles as well. So that's how I initially joined the project based on previous work we have done with biodegradable plastics. And then this new project offered a great opportunity to continue that work and expand on our previous experience that we had with biodegradable plastics, and then micro- and nanoplastics as well. And that's how I joined the team that I'm leading. I'm co-leading that together with Lisa. So, Lisa has the horticultural aspect covered by her group, I'm looking at the soils group here, and I'm leading some of the soil groups that we have for the project.

(00:06:16) Nataliya Shcherbatyuk

That is super interesting, and clearly when we speak about plants and plant health, we cannot just ignore the soil, it's really, extremely important. So, to move on, Lisa, would you tell us more about the goal of the project and actually what kind of objectives it has?

(00:06:33) Lisa DeVetter

Yeah, the primary goal of this 4-year long project really is to support the transition to more sustainable end of life outcomes for plastic mulches in strawberry systems. And we're doing this by evaluating the impacts of existing and emerging mulch technologies, like soil biodegradable plastic mulches, as well as recycling technologies on key horticultural, soil, as well as sociocultural and economic variables. And so, to address this goal, we've assembled what I consider an elite team of scientists: extension and communication specialists, as well as our industry advisory board members that span a multiple array of disciplines across several institutions and some of those institutions

include the University of California, University of Florida, Cal Poly, University of Nebraska Lincoln, University of Tennessee Knoxville, and of course, our own institution, Washington State University. And while we're focusing on strawberry, given the widespread use and dependency of the industry on non-biodegradable plastic mulches in both conventional and organic systems, I really believe that the findings that this team will elucidate and uncover will have a broader impact and implications in other horticultural systems around the world that use and depend on plastic mulches.

(00:07:50) Nataliya Shcherbatyuk

Nice. That's really a national project with a lot of pieces to put together into it. So, we're talking a lot about mulches here in this podcast. In the previous, actually, the very first episode that I've done, it's about mulch, but I like the audience to hear from you, Markus, what is mulch. Just overall, what mulch is and why it's so commonly used for plants and agriculture overall?

(00:08:18) Markus Flury

Yes thank you, Nataliya. Yeah, that's a very interesting question. If you look at mulching in agriculture, you know, we can actually go back in history and look at the very first mulches that have been used and probably some of the first mulches that have been used, were maybe rocks, you know, that, or gravel that have been placed on the surface of the soil to basically prevent water from evaporating and for water conservation. So, some of the very early civilizations, you know, used gravel on top of their soil to prevent water from evaporating. So, they actually could modify the water and moisture dynamics in the soil. And then later on in more modern agriculture, you know, people started to modify those types of mulches. And nowadays we use plastics as a mulch. And there are several reasons why plastic is actually a very good mulch and very useful. So, one of them is, again, water conservation. So, the plastic will preserve water by causing a kind of a barrier for evaporation at the soil surface and then another reason for using plastic mulches is that it helps to modify the soil temperature. So, you can actually modify the soil temperature. Usually, you warm it a little bit up if you have black plastic. So that means you can in colder climates grow earlier and have harvest earlier as well. And then you have also suppression of weeds, for instance, so weeds cannot grow that easily and pathogens are suppressed, so that's another big advantage of plastic mulches. For instance, organic agriculture uses plastic mulches as a substitute for pesticides because then you don't need synthetic pesticides anymore if you can control the weeds with a plastic mulch, for instance. So plastic mulches have turned out to be very effective in agriculture. And all those benefits, you know, in terms of moisture, in terms of temperature, in terms of weed suppression have led actually to an increase of yield. So that's the ultimate goal, of course, for the farmers, so that the yields have actually increased and have provided the benefit for the farmers. And that's why plastic mulches are now widely used, particularly in specialty crop production, so that the yields have increased and also the crop quality has increased to some extent. So, we see a big use of plastic mulches in Europe, in the United States, and particularly in China, which is probably one of the largest users of plastic. And they have shown that yields have increased by the use of plastic, maybe 20-30% in some cases.

(00:11:05) Nataliya Shcherbatyuk

Yeah, that's a big number. And Markus, just to clarify for our listeners, can we basically call anything that we would use to cover soil to get those benefits that you just mentioned, can we call it mulch?

(00:11:22) Markus Flury

Yes, in general, we can do that. Anything that we put on the soil surface in agriculture, we would be able to call it a "mulch". It can be a rock or gravel, it can be straw, for instance, so an organic mulch, it can be a plastic mulch or Lisa, for instance, uses a hydromulch that is kind of a component that's with water and then solidifies as a mulch that can be used. And as a matter of fact, there is also an interesting type of mulch particularly for the Pacific Northwest. So, in the eastern part of the state, it's called the "dry mulch", where the farmers actually go in and disturb the top surface of the soil to create a kind of a very mulchy soil layer with soil itself that causes an evaporation barrier and then prevents water loss during the hot seasons.

(00:12:24) Nataliya Shcherbatyuk

Interesting. Interesting. So basically, we can see that mulch has been used for a long time, but also, it's used widely now because when we walk by or drive by any landscape on the private property, we can see them using either plastic or any other mulch that you can pay attention to. That's quite interesting and very useful. And Lisa, I have a question for you. So, I know that for this project we are focusing on strawberry production and strawberry production systems, but which crops are actually commonly used to grow with plastic mulches?

(00:13:00) Lisa DeVetter

That's a great question. Well, many crops are commonly grown with what we call non-biodegradable polyethylene mulch or "PE mulch". These are primarily annual specialty or horticultural crops like strawberry, melon, sweet corn, pepper, tomato, and so forth. Overall, this type of plastic mulch though is increasingly being used both nationally and internationally, given how inexpensive and effective it is at suppressing weeds and optimizing growing conditions for that enhanced yield and improved on farm efficiencies. Interestingly, more and more perennial crops are being grown with plastic mulches, which I find really interesting as a horticulturalist that specializes in fruit crops. For example, florican raspberries, which we are leaders of here in the Pacific Northwest - more and more growers are starting to use plastic mulch during the establishment phase when they're using delicate tissue culture transplants because it means less herbicides they have to use, less hand weeding, and improve growth and production. And other perennial fruit growers are using them as well, like woven plastic mulches that we call "weed mat" which is very similar to landscape fabric. So, in short, it's a really long and increasingly longer list of crops that use and are benefiting from plastic mulches.

(00:14:19) Nataliya Shcherbatyuk

Very interesting. And I can only imagine having an orchard, or a vineyard, or something, a big plantation with the permanent crop and plastic in it. It's quite interesting. I'd like to see that. So, we're talking a lot about plastic mulch and overall plastic. It's a little

bit of a sensitive topic, but I would like to ask you, Markus, about any environmental impact that plastic mulch has.

(00:14:47) Markus Flury

Yes, that is also a very good question, Nataliya. As I mentioned before, you know, the early mulches were actually natural materials, right? Like gravel materials or straw that has been used as mulches. But then with the advance of plastic, you know, the problem with plastic mulches is that they are synthetic, they do not naturally degrade, right? So, straw mulch, for instance, would just degrade over time, plastic mulch, however, will not do that, right? Particularly with the conventional plastic mulches, they are made out of polyethylene, so a material that is not degradable in the environment very easily. So those plastic mulches have to be removed after the cropping season. So, you have to remove those and then you have to dispose of those as well and so that has caused a lot of disposal problems because you use a lot of plastic mulches and then furthermore, it's not always possible to remove all the plastic from the soil because some of the plastic will tear because it's partially buried under the ground. And then, you have residues that remain in the soil. That has been particularly a big problem in China. China not only being the largest user of plastic mulches, but in China, the plastic mulches have also traditionally been very thin, much thinner than in Europe and the United States. And so, it was very difficult to remove those plastics, they tear apart very easily, and a large fraction of the plastics have actually been left in the ground. And in China, even there was a term that was coined, it's called "white pollution" because a lot of the plastics in China are transparent and they kind of look whitish and then they cause a kind of a whitish color of the soil after the growing season. So that has been a very big problem with the pollution of those particles and as I mentioned also at the very beginning, those polyethylene mulches, they will, when they deteriorate, they will become smaller and smaller. They fragment into smaller particles, into microparticles and then potentially even into nanoparticles, which are very difficult to remove and potentially can actually move through the soil, and then contaminate waterways as well. So, these are some of the issues that we have with the conventional polyethylene plastic mulches and that's then also where our project comes in by trying to replace those with soil-biodegradable plastic mulches, not with the original mulches, the straw or gravel, but with biodegradable plastics that could actually then degrade into the soil and then provide potentially other benefits as well to the soil health.

(00:17:35) Nataliya Shcherbatyuk

Yeah. And that's, that's quite an important topic. And it's important to mention to our listeners, the plastic mulch have a lot of benefits, but we are also working on how to basically optimize the end of life of the plastic mulch, or like you say, to replace it for something that is biodegradable and that actually leads me to the next question that I have for both of you. What do you overall hope to accomplish in this project?

(00:18:06) Lisa DeVetter

Yeah, well, I think we're scientists, but we also want to have an impact on our stakeholders. So, you know, I really hope to advance the science and practice of soil biodegradable mulches as well as polyethylene mulch recycling. There's a lot of key

questions that are needing to be addressed that are currently barriers for adopting both of these technologies. For example, soil biodegradable mulches, growers and the broader agricultural industry as well as regulators want to know the fate of these soil biodegradable particles in their soil. For example, what is their residence time? What is their impact in the soil and the soil health? And so, these are great questions for soil scientists like Dr. Flury and his team to really dig into, no pun intended. This type of science driven knowledge can also lead to what I refer to as data driven recommendations and informed policies that help not just our environment, but also help farmers transition to more sustainable tools when it comes to mulching and from a farming perspective, I hope that, you know, there's multiple tools or end of life options that growers can use that are cost effective and contribute to less waste generation and promote soil and environmental health while maintaining that crop productivity and on farm efficiencies that those farmers need. So, I really think it'd be great if there'd be a lot of tools that emerge from this project because I've found that growers are diverse, just like people, and the more tools that we have in the toolbox and associated information, the more informed they are in choosing new tools or the more informed some of those policies can be. And then also we train students, and we train new scientists. So I also hope that, you know, we can train the next generation of scientists that work to support agriculture and also support our environment through impactful collaborative team research.

(00:20:01) Markus Flury

Yes, maybe to follow up on what Lisa just mentioned, you know, I think the project is a science-based project, you know, we want to provide sound, scientifically based solutions for the problem of plastic in agriculture in general. So, we don't want to pollute the environment, right? So, we want to have sustainable agriculture, but at the same time we want to promote food production and increase the yields but be sustainable. And we see biodegradable mulches as one potential solution for this. And we need just to make sure that when we make recommendations on the use of biodegradable plastics, that we make those on a good scientific basis so that we don't have unintended consequences later on.

(00:20:48) Nataliya Shcherbatyuk

Yeah, that's extremely important. And, you know, to twist it a little bit away from the serious scientific work, I do have some fun questions for you. And, Markus, you have big experience of working with mulches, but do you have any examples to bring up what was the most interesting or challenging crop that you got to work while you've been working with mulches?

(00:21:18) Markus Flury

Yes, I think one of the most interesting things is that I noticed a lot of similarities, you know, when working with plastic mulches compared to other work that I've been doing in the past. So, there's a lot of research that is not related to plastic mulches that actually is very relevant to the plastic mulches. And so, the nice thing, particularly about this SCRI project is also that we bring in a lot of different disciplines, um, economy, social sciences, material sciences, all those things, they bring their own expertise from previous research. And then we can kind of put those together, bring those together and all focus on one

specific topic, in this case, plastic mulches, microplastics in the environment. So, I think this is one of the nice and most challenging things here of this SCRI project.

(00:22:02) Nataliya Shcherbatyuk

Yeah, yeah, that's pretty cool. Thank you so much. So, you mentioned previously, Markus, that, we know that the plastic mulches are actually known for their ability to conserve water. And now, Lisa, if they were able to share any water saving tips, and I'm talking about mulches, what do you think, what kind of advice would they give to growers?

(00:22:40) Lisa DeVetter

I think plastic mulches and mulches in general help reduce evaporation from, uh, the surface of the soil. So, they would say: "Engage in practices that reduce evaporation so you can conserve and maintain that water in the soil."

(00:22:56) Nataliya Shcherbatyuk

Nice, and before we're wrapping up, Markus, of course, I have a question for you. One more, what do you know, what is common between plastic mulch films and sunscreen.

(00:23:14) Markus Flury

That's a fun question. Yeah. So, the question is how, why do we actually put on sunscreen, right? We want to protect our skin from UV radiation. Uh, so UV is a very aggressive radiation that causes cancer and a kind of tissue damage. And the same thing actually happens with plastic mulch too. So, plastic mulch is on the surface where it's exposed to UV, but it also should be intact, right? We don't want to have the plastic mulch deteriorate right away when the sun shines on, particularly if we have regions where we have a lot of sunlight. So, what is done for these plastic mulches is actually that they contain a UV protectant, and the same thing that we have in sunscreen. So, for instance, the white plastic mulch that we use contains titanium dioxide nanoparticles, and titanium dioxide is also used in sunscreen, uh, when we put that on to protect UV radiation. So, what happens is that the titanium dioxide absorbs basically the UV radiation and then transmits it into heat. But it removes the dangerous radiation effect that UV will have. So, one of the common things between sunscreen and between white plastic mulches is the titanium dioxide that's added to the mulches.

(00:24:39) Nataliya Shcherbatyuk

Wow, it's a quiz question. When they put on sunscreen.

(00:24:42) Lisa DeVetter

I'll think of plastic mulch [and sunscreen together], Markus, because of you.

(00:24:46) Nataliya Shcherbatyuk

Yeah, now me too. Well, I really want to say a huge thank you to both of you, Lisa and Markus, for joining us today. It was fantastic. It was a great discussion. Thank you so much.

(00:25:02) Markus Flury

Okay, thank you for having us, Nataliya.

(00:25:04) Lisa DeVetter

Thank you so much.

(00:25:09) 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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