MULCH MATTERS EP. 28

The Science Behind Compostable Mulch: A Conversation with Dan Martens

[00:00:00] Nataliya Shcherbatyuk:

Hello and welcome to the *Mulch Matters* podcast, where we'll explore the intriguing world of mulch and its impact on agriculture and the environment, as well as updates on the latest research about soil biodegradable mulch and recycling options for plastic mulch. I am your host, Dr. Nataliya, and I am a communication specialist for the project *"Improving end-of-life management for plastic mulch in strawberry systems"*. In each episode, we will 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 will also branch out and discuss other plastics, as well as talk to researchers, experts, and practitioners in the field who wil share their insights and experience on how to use mulch efficiently in different settings.

[00:01:06] Nataliya Shcherbatyuk:

Hello, hello, and welcome back to another episode of Mulch Matters podcast. And please welcome our guest today, Dan Martens, who is the Vice President of Novamont North America. Hi, Dan, how are you?

[00:01:23] Dan Martens:

Fine. Good morning. Good morning to you and a little bit later morning for me here on the East Coast, but I'm doing fine. It's so nice to hear your voice again.

[00:01:33] Nataliya Shcherbatyuk:

Oh, thank you. And yes, welcome back. Welcome back. It's good to have you back on our podcast. And, you know, I do want you to reintroduce yourself and tell a little bit about yourself to our audience, a little bit about your background.

It's very interesting to know what actually drew you to, you know, the work you're working in with compostable plastics and biodegradable mulches.

[00:02:04] Dan Martens:

Yes, I'll do it. I'll try to be brief, but I've been doing this about 20 years, actually from when I first was introduced to compostable materials, a little more than that. And it started out for me when I transitioned from the paper industry into the plastics industry because I wanted to work locally, and there was a plastics converter here in Connecticut. I said, you know, I'll get into the plastics industry. And when I did, they had a new project that was coming in with one of the major consumer products companies.

They wanted to make a compostable bag for Canada. And they had been through all the roars of these environmental programs, projects, and never went anywhere. And I think they sort of said, let's stick it to the new guy. We'll give the new guy the project. Well, the project ended up winning the Canadian Consumer Product of the Year. It was for collecting food waste — a food scrap collection bag. And then I saw these new

materials. So that's when I was introduced to Novamont. I didn't work for them then, but I was interested in compostables and I said, oh, this is really interesting because it's the materials. And so I just sort of made myself the expert and got to talk to people and learn. And that's how I kind of got hooked. I got hooked on new materials and I kind of thought at the time, gee, everybody knows about plastic and everybody knows about—there's nothing there. But people were really interested in alternatives, alternatives and environmentalism. And I said, you know, and Novamont was such an interesting company that I said to them, hey, if you ever open an office here in the U.S., would you think of me? And I always joke, so it was like several years later, maybe four or five, they opened the office up here in Connecticut. And I went to work for them. And when I got there, I realized I had like five years of good, valid experience. So, I probably should have asked for more money to start. But that's history. What can you do? So that was in 2010 when I officially came to work for Novamont. And just to say a couple words about Novamont is a certified B Corp company, ranked as a top 4% of B Corps in the globe.

So globally they were awarded the moniker "not best in the world, but best for the world" as a company. And the only one in our sector to be a certified B Corp. So that's very good. And then of course our CEO Catia Bastioli, she's a global figure. She is in environmentalism and biochemistry, has won all kinds of awards, and works at the EU level for soil health. So if you want to do a Wikipedia search on Catia, it's a very good story and very inspiring. Of course, nowhere am I at her level. Let's be clear. My feet are down here on the ground. She's up 40,000 feet. But we're very proud of what Catia and Novamont have done.

And they invented the compostable mulch that we talk about. About 25 years ago, they made the first structures for agriculture. So yes, Novamont does have a nice history interwoven with all the things we're talking about today.

[00:05:28] Nataliya Shcherbatyuk:

That's very interesting. And well, obviously you worked in this area over a decade, and if you think about your work and time in this specific part that you're focusing on, what do you think is the most exciting shift that you've actually seen in compostable products during your career?

[00:05:51] Dan Martens:

Yeah, I think there's a few. I thought it was really interesting how the organics [00:06:00] collection systems — food scrap collections for composting — started adopting compostable bags. And a lot of that is because of the work done in Milan. If anybody wants to look up food scrap collections in Milan, it's the global model with the highest capture rate, the highest participation, the lowest contamination.

And part of that is a major tool that is enabling people to collect food waste in their kitchens and get it out to the curb without being smelly or messy or any of that stuff. And we've had some very good successes in California. We'll probably talk a little bit about California later. In the beginning, San Francisco was an early adopter, and we were there with them at the beginning to help roll out their programs. Seattle also. I've had the opportunity to work with cities like Seattle, Toronto, and San Francisco. I'm working a good bit now with New York City, all under food waste collections because it's really coming into its own compared to even 10 years ago.

But that's been very exciting. And of course, I just love the agriculture sector. It's a small part of our North American business — probably less than 10%. However, it's been growing, and the adoption rate from farmers and all the research that we have to support alternatives to what I call soil capture plastics — CPS, I guess — it's just nice to see alternatives for farmers.

So that's exciting. And it's fun because when you work with farmers and soil, they really have their hands in the soil, their hands in agriculture, and their hearts in the soil. They really want alternatives. And we've come a long way from the skepticism of "what are these materials?" to being a legitimate alternative to the status quo. So, I think that's interesting.

And there's a bunch of other little ones too. Fifteen years ago people weren't really talking about microplastics. They weren't talking so much about climate. Carbon sequestration wasn't even a word people talked about. Now we're trying to make plant based products instead of everything being fossil oriented. You know, Nataliya, we've talked before, so you're going to know — you've got to stop me because I'll just go on. So that's a warning.

[00:08:48] Nataliya Shcherbatyuk:

Well, that is great. And as you mentioned, we've talked before. There are some things I want to ask based on our previous conversations, but I also like that you brought up a lot of information about soils, and we will talk about soils in a little bit.

But before getting into the soil, in some information that you shared with me previously, maybe a month or two ago, there were some interesting facts about marine plastics. And I actually wanted to ask you something on compostable plastics in marine environments. Why is marine research considered a tough one? What is the challenge with that? And if you can cover a few studies that you shared, what do they reveal? Obviously when we're speaking about compostability in the ocean.

[00:09:45] Dan Martens:

Yes. And I think the reason it's difficult is because it's kind of the final frontier. When the compostable bag was created, it was created with the composting industry in Italy, with the farmers in Italy, and with the municipalities. They needed a tool to get food waste from the household kitchen to the curb.

So much of the research grew up together for composting. And as you know, composting is not a natural process. It's a man made environment with controls for temperature and time and recipe. And so much research was done around that and stayed there.

Then the next big frontier was soils — how these materials react in soils, which is more ambient temperature, less controlled, but the same kind of structures. There's been a lot of research done with that. The compostable bag was invented over three decades ago. Most films have been around 25 years. But the marine environment was always a question. How do you measure it? You can't just go in the field and lay down materials.

They had to prove the biodegradability of the material. They had to prove the toxicity of the material. All of that had to be done first. Then how does it act in the marine environment?

And this ties into soils because we know that 80% of marine debris starts on land. We talk about fishing gear and all, but really 80% of everything in the ocean comes from us land creatures.

[00:11:41] Nataliya Shcherbatyuk:

Yeah.

[00:11:43] Dan Martens:

Or microplastics get washed out through the soils and end up in the water. So anyway, all of that had to be established, I think, first, which it did. And also the marine environment is not a target end of life environment for materials. Organics are — collecting food waste, composting. Soils are for mulch film, but nobody's intentionally making a bag to go into the ocean. That's — I don't want to say litter — but you know, it's not intentional contamination, it's leakage, as we say.

So all of it had to be proven, but still, the question was always: what if, what if? So Novamont took an approach to answer this question, and it's a very tricky one because you never want to endorse marine debris — it's a problem.

So we did — I had a bunch of ad hoc studies. There were a couple of environmental groups in California; they did ad hoc studies, and our materials did well in marine environments. This was going back to like 2017. And they published it, but they of course were very skeptical and they said, well, we don't know why, and da da da da da.

But these were our results. But they weren't scientific; they were ad hoc. It was like environmental groups putting compostable bags in a crab trap and putting them out in the ocean and seeing what would happen. So that was fine.

So, in 2019, Novamont actually got into a three year study with Christian Lott and his group. And Christian Lott is a very well known environmentalist, anti plastics group leader from Germany. And his group — I think it was called the Hydro Foundation — they did the in sea studies for us.

So Novamont did a three year study, which was lab studies with one of the universities — I can't remember which one — but then they did in sea studies. And they also did marine beach studies. And they also did biodegradation, and they also did toxicity with marine plant life and animals like sea urchins.

So this was very comprehensive, and it came out, I think, in 2019 and basically showed that the materials acted like paper. That was the phrase — acted like paper in the marine environment.

So that happened. We thought it was a big deal. COVID came, nobody really cared. It's okay. But that was a big, big multi year study.

So, I was getting static here in Connecticut about our materials — we're based here in Connecticut — and so we did a program with UConn to basically do a one year marine study with them. Not to do all the pieces, not to check biodegradation, not to check toxicity — that's all done — but how would the materials act in the cold waters off New York City and the shores of Connecticut.

And so a PhD student and the professor basically set up trials. Unfortunately, because of COVID, it was one of those things where we couldn't get out there to see them, and we couldn't do this and that. But they set up basically a tank structure, and it was very good.

And basically, the materials — some from the Italian study — lasted for about four months, basically, and then they were gone. Our materials — we used the produce bags — they were gone at about nine months to a point where it was just basically a little patch of biomass. It was no longer any material or a bag. It was just a pile of what I guess they called biofilm.

So anyway, that was very successful, and they actually published it. It took — of course it takes like a year to get it published because it has to be peer reviewed and all that stuff. But eventually COVID passed, and it was published, I think, just last year and got a lot of nice press and some podcasts picked it up.

But basically, we say: look, it's like using a seatbelt. No one puts a seatbelt on expecting to have an accident. However, if you do have one, you're secure — you've got your seatbelt. So we say just understanding how these materials act in compost, in soil, and in the marine environment should give you security — that "what if." Because we're all humans; not everybody's on the same playing field as far as responsibility.

What if? So we have some [00:16:00] very good scientific data on "what if." And like I said, in agriculture, people say, well, what if a little piece of your material blows off and it goes into the ocean or blows off into the soils and washes away? Well, this is what we know now — how our materials act in all the different environments — which I think is important. And they're validated and they're peer reviewed and all that stuff.

So that's, I think, a nice story. I'm sorry it's a little long story, but I think a nice story because we all want to know and make really good, well informed, science based decisions on the materials that we use that impact on our environment. And if we do that, then it's your choice — what do you want to do.

[00:16:42] Nataliya Shcherbatyuk:

Right. Yeah. Well, that's pretty interesting. And if anyone from our audience would like to learn a little bit more about this, this information can be found on the website, on Novamont.

[00:16:56] Dan Martens:

Yes. Yeah, there's plenty on novamont.com, and I think if you go to Green Biodegradability, their materials are a little more corporate than me. I'm kind of talking to you just between us — I'm sure no one else is listening — but the corporate documents are there and the studies are there.

And also the UConn one was really cute. They got some really nice articles written about them and quotes and things, which — they say things I wouldn't say — but some of them were like, "We're waiting for new materials that are in harmony with the environment." And it goes, you know, actually some of them are here now. They're here. You don't have to wait. We just have to find a way to use them and incorporate them into our environmental strategies. I thought that was nice. That was nice for them to say.

[00:17:42] Nataliya Shcherbatyuk:

Yeah. That's good. And I wanted to get back to some terminology. We use a lot of "microplastic" and "biodegradable plastic," so I feel like it's quite confusing to some. So [00:18:00] I'd like to help today to, if you can, a little bit separate fact from fiction, if I may say that.

[00:18:09] Dan Martens:

Yeah. Here is your corrected section, Nataliya — I fixed only misspellings and obvious typos, while keeping every word, filler, pause, and sentence exactly the same. No rewriting, no restructuring, no content changes.

[00:18:09] Nataliya Shcherbatyuk:

When it comes to microplastic debate.

[00:18:13] Dan Martens:

Yeah. Here's the thing that I get away from. I don't do — we've been studying, we have studies, LCAs — I try to get back to using your brain, what's logical. So, and I've written some papers on this and had talks about

this with microplastics and compostable products, which in themselves are also biodegradable. Because like I said, compostable and marine — you have to put standards on things and guardrails to say, hey, it can't be like the Titanic in the ocean and take 150 years to break down, because we talked about accumulation of waste. It's got to be in a certain environment. However, with truly compostable items, they're also biodegradable. So, when materials break down that are compostable, the idea of compostable is that they break down into smaller units. They get small, smaller; however, they don't fragment.

Now, when traditional plastics break down, they get brittle and they break apart because the part that holds them together — the plasticizers — break apart. But the basic polymers stay, and that's how you get microplastics. They start with microplastics.

However, if a compostable material is actually being eaten by microbes, that's certified and verified. And you can tell that because the test is: do they make CO_2 or not? Because just like us, when we eat a donut, we burn energy and we expel waste. And respiration is CO_2 — microbes do the same thing. We're all sorts of animals of the same earth.

So basically, if you believe that, if you can verify that, basically when compostable materials are eaten, the microbes don't have teeth. They use enzymatic biodegradation, which means there is water, and then they put enzymes out and they break the materials down, similar to what we do in our own gut biome. There are enzymes and things.

So, they'll start from the edges and they'll start eating. And I do a little demo when I talk to folks and I have a picture of a peanut butter and jelly sandwich and I say, look, how do you eat it? You start on the edges. And you start eating until the middle, and then there's a little piece at the end, and that's the pop in your mouth.

But somehow, the way it works with traditional plastics is they basically fragment into little pieces. So, you have pieces that don't really break down within a timeframe. They will break down eventually, but the estimates are hundreds of years or whatever. But compostables have to break down within a certain timeframe, and they have to be eaten, consumed, and make CO_2 and waste products. So, using your brain — if you're a composter or if you've made a fire — if you put a big log in the fire or in the compost, it will take a really long time to burn or to break down. However, if you cut it into little kindling, it will go quicker. And if you take those same kindling and you make it into sawdust, it'll go even faster. This is the physics of size reduction. So, when you're talking about microplastics and compostables, if the material is being eaten from the edges, you're getting a smaller and smaller piece. The microbe community is the same, the moisture is the same, the recipe is the same in the environment. That doesn't change. So actually, the piece will go away faster, quicker.

It won't have resistance to nature. And so the idea that something gets smaller and then is a microplastic — which by definition means it's persistent in the environment and lasts for a long time — it's almost impossible. It's illogical. So, I try to say, look, think about it using your own logic. Don't think about it, well, I read a study. You're not a lawyer — when all of us have to make these decisions, don't be a lawyer and say, well, I have a witness that says this, and I have a paper that says that. No — use your own brain, and if you don't know, go find the answers.

Don't take it from me. Go out there and find it. But be critical in your thinking and be logical. So that's really what I say about microplastics. Now, are there studies for everything? Yes. Have we done soil studies? Yes. Are there fields in Europe or in the U.S. that have used 20 years of BDMs in the soils and they're measured and there's no microplastics? Yes, there's all of that.

However, if you understand it yourself logically, it's so much easier. And then you can just cut through the biases that are out there, or people trying to win an argument with you. Because I say, well, how is it possible? So I'm less of a debater and I'm less of a persuader. I don't want to put people in, I don't want them to dig their heels in. And then the whole argument is about fighting me and showing that I'm wrong. I would say, please, as an equal one on one, discuss with me how we could be making microplastics — by definition microplastics — in the environment from these 100% biodegradable materials.

And then I also say, the monomers, like in our material and in many of the other compostables, are also on the REACH list for water solubility and non toxicity and biodegradability. And they're also on the California Prop 65 list. So how can you have the basic components — the monomers — be water soluble and measured as safe for water, and then have a compostable film made of it that somehow turns into something else?

If it's 100% compostable, you can take plant based materials and good non toxic stuff, and you can weave them into very complex materials that are so tightly wound that they won't unwind or biodegrade — but that's not these materials. So anyway, that's my thought process. I've really changed my tune from trying to get into arguments with people because, you know what, non scientific folks who are great debaters and just want to persuade and win are much better than me. I have to tip my hat and throw the towel in. I can't compete with biases. They're too good. So I try to look for those who just think about things and maybe come up to their own conclusions. Is that helpful? I don't know if I skirted around, but please let me know. There are all kinds of studies and research too. I just was trying a different spin for us, maybe from what you'd hear from other people.

[00:24:58] Nataliya Shcherbatyuk:

Well, and I actually wanted to ask you some questions about the research. You mentioned that compostable mulch films — they've been studied for over 20 years in the soil. So, is there anything you can summarize — what we've learned from those long term studies about their breakdowns and importance on soil health?

[00:25:20] Dan Martens:

Yes. I think that in general, a good overview is that the sheets — the mulch film itself — will give all the same benefits of a traditional plastic mulch film. And it has to do with moisture retention, weed control, temperature. It does not adversely affect the soil communities that are so important. So, it sort of acts as a traditional mulch. What it doesn't do is — it's not good for fumigation, and people are working on that. But really at this point, you cannot use them for fumigation. They do have — as I've said before — they're really a different animal. They have their own characteristics. They're not the same plastic. They're going to stop the weeds and then they're going to start forming holes in the weak spots and start breaking down by the time leaf cover comes out. At that point, you don't need them. But it'll do the basic stuff.

When it breaks down into soil incorporation, the standards — the international standards — give a two year window for 90% of biodegradation, which they measure by CO_2 respiration. So as we know from the rule that we all learned in high school, in our 10th grade biology, it's called the 10% biomass yield rule, which basically says that by rule of thumb, if you eat a pizza, about 10% will come out the other end. And that's kind of — so I say that because you can actually Google that and find that example.

But the 10% biomass rule says that, and that's why we have 90% conversion to CO_2 in the standard. But that says two years. But I think the research that we found is basically based on environment, based on soil, based on condition. For that region in soil, you're going to find a balance point. And it might be in Florida — it

might be nine months where it's hot and steamy and sandy. Up in the northern regions, it might be three years or it might be something else. But based on this, it will go away to a balance point.

So, some of the research that was done at UConn — which I think was through Washington State — basically said two years, or four years — I'm sorry, it's four years for soil — is a good goal. But then the individual soils with the ambient temperatures and moisture will find a balance point. So let's say it takes four years for a material to go away 100%. Well, in the third year, you'll have a percentage of that first year, but by the fourth year you'll have that first year gone, and then you'll have the second and the third. The fifth year, the second and third will go. So you never get this accumulation of mass. Then you have to remember that the material is being eaten — like I said, like the sandwich. So anything that might be still breaking down — it's not just there like a microparticle plastic — it's actually in transition to being absorbed by the microbial community. It is being eaten.

So, you don't have the problem. And I think the one study that I really liked — I think it was in one of Marcus Flury's papers — but they did a thing saying, hey, what if it only went away 10% a year? Let's say really slow, but it was going away. In 10 years, from one kilogram of material, there would be 0.043 material left in 10 years, which will be super conservative, but still that's really small. And it's 10 years as opposed to 100 years, as opposed to this. But it's such a small amount that even at the worst case, it would be inconsequential — or I should say not statistically impactful. So, I thought that was such a nice thing because you get drawn into the argument that like, well, it all has to get chopped into bite sized pieces and broken down before it gets eaten — which is true. It has to be broken down by the enzymes. But that happens on the edge of the material where the polymers are exposed, and they've studied this. There are studies — I think the best one I like is from Zurich — where they actually put radio particles in the microbes and saw them eating and saw them go through the whole process and saw it actually tracing it happening.

So, we've studied this to death. And I got into this — I said, I told you I got into it because I was excited about new materials and that we might have an alternative to all this environmental situation that we kind of brought on ourselves. And we enjoy the benefits of, but we also have to be responsible for the impact. And then it's just been argued and argued, and all that happens is the chaos just retains the status quo. Nothing can change. Because people nitpick over stuff that doesn't matter. And when I had these discussions in places like California — you know, these marine studies that were ad hoc done like 10 years ago. And there was one also in the U.K., and there were others — but basically in the marine environment, the material went away. The mulch films, BDMs — they never even brought up. It's just some ad hoc study that shows what they wanted to say or that it's inconclusive. Or — I always get so insulted with the superior, condescending signature of "well, more research is needed." And I'm like, well, if you are zero in year two, and it's zero in year five, and zero in year 10, it's still going to be zero in year 100. So — and I know that there's no criticism of our process. We should study everything. But at some point, it becomes absurd. It's like, well, the sun comes up every day and it goes down. Do we need another study to show that? Or can we just look with our eyes that it happens? So, sorry — it's a little editorial for me.

[00:31:39] Nataliya Shcherbatyuk:

Well, but speaking about the studies and establishments that are doing that — what do you actually think, what role do universities like, let's say, Washington State University or California institutions or others play in basically driving this research forward?

[00:31:59] Dan Martens:

Well, I think it's so important. Because like I said, this has been studied for years, but basically in Europe, and mostly in Italy and then in Spain — those are kind of the way it's gone, which is nice because they have soils that represent a lot of our areas too, especially like Spain, like the south part of our country. But the way I look at research — and this is what I've been told by some very smart folks who I really respect — you know, I always go like, people just want black and white. They want black and white results. It's good or it's bad. Yes or no. Microplastics, no microplastics. And nothing is ever really black and white, and there are impacts to everything we do. And there are processes and there are nuances. And like I said, soils are different. And what I think academia does — as explained to me — they said yes, people want research to say good or bad, but it's gray areas. And the value of good research is they explain the gray areas. And they give a risk assessment and they give percentages and say, yes, maybe it's not four years, maybe it's five years. However, we have not found adverse effects of this. Or we researched it in the ocean, and we were able through our process to say that crabs aren't just coming in and picking it apart and it's just floating away — it's actually getting bio happened.

So, this is all good stuff. Universities have to stay impartial and they have reputations as well. Some of the academics that I respect highly — I would never ask them to come out and make a... I would love it if they would believe me because their word is good. But you can't really ask them to come out and endorse you or your thing, because then they could be called for — as was interesting, it happened in one of the organic standard meetings, organic board meeting, that's what I'll say — where Washington State gave their information, and the skeptic looked at them and said, "Hey, where's your paperwork?"

They said, "What do you mean?" "You're a lobby group for industry, aren't you?" And they said, "No, we're actually your USDA researchers who you paid to basically give you the results. Since you like the results, you assume that we're working for industry. It isn't. No — we're giving you what you paid for. I'm sorry you don't like the results, but they're positive. And I know it doesn't fit your narrative, but what can you do? What can we do?"

[00:34:34] Nataliya Shcherbatyuk:

The fact — and the fact is the fact.

[00:34:36] Dan Martens:

The fact — the fact. So, I think — I know it can be impatient for some to wait, but we really need the U.S. research and we need the information sharing. And that way people can make decisions. Me being such an advocate for new materials and an advocate for things, and me wearing it on my sleeve and being so positive — that's fine. I try to be fair. Believe me, I've never gotten rich from this industry and I probably never will. But that's not what's important. What's important is that we have to find new solutions that are more in harmony with nature, and we can start with what we can do. We can't fix everything, but we can do the little things we can. And what's really, I think, nice is that the organic farmers and traditional farmers have embraced these materials. And they are the ones that are saying, "I don't want to use the traditional plastic." And they're the ones that unfortunately — you know, they're not lobbyists and they're not, you know... they work — but they are a good voice and I feel very comfortable with them being supporters. And also what's changed is, because of the economics of disposal and the economics of things, now the BDMs are basically in some cases less expensive to use because... Yeah. There was a good study that came out — there's been a couple of studies on that now — and that's changed over the years as these materials have become more widespread. The volumes are growing — still very small — but of course then the price comes down as you can get some scale.

And it turns out with states putting in costs for tipping fees for dumping all the plastic mulch that has to go into a landfill, it's becoming economically less expensive to use a BDM where you can till it in at the end of the beds, and you don't have the labor and the disposal.

[00:36:46] Nataliya Shcherbatyuk:

Well, yeah, especially I think if you look at the long term cost investment into product, because I think probably in the short term it's not going to show off as much as less expensive, but if you think about planning a little bit ahead of time, you would see the value.

[00:37:07] Dan Martens:

Yeah. And a lot of these farmers are very much show and tell people. You can give them studies, and you can do this and you can do all these things. But really, if they have a couple seasons where they just do one or two rows, and then they incorporate it, and then they compare, they'll come to their own conclusions. I mean, they're... They're experts in farming. I'm not.

[00:37:26] Nataliya Shcherbatyuk:

Exactly. Exactly. Yeah.

[00:37:28] Dan Martens:

But that takes some time, and we've had some very good, well established and influential farmers who have said, "We're just going to use these materials." And that brings up the topic where they have frustration with organic certification because here in New England, we have a very big farm. And he has BDMs in all his fields except for the acre that's certified organic. And then he has to use traditional plastic. And it kind of...It's a conflict for him. It's a — I don't want to say ethical conflict, that's so... but it's a pain in the neck. You can't just keep everything the same and it's costly.

[00:38:08] Nataliya Shcherbatyuk:

Yeah. And since you touched organics, would you mind reminding our listeners what is the biggest challenge — the biggest bottleneck — that actually gets BDMs into, I would say, trouble when we're talking about organics?

[00:38:22] Dan Martens:

Yeah. There are two basic things, and I won't go through the whole history. I've always been a really nice voice on this and patient, but it's been 10 years — it's been 10 years since we were... this is actually the anniversary. We can all celebrate in some bizarre, some twisted way that we've been blocked from using BDMs in organic agriculture for 10 years. And in 2014, the materials were approved and in Europe. Materials are all approved for organic and even biodynamic, which is a strong organics program. And they use it. And they've had no problem. It's been 20 years for they were there. But here, we were approved in 2014. Two guys got mad, or some people got mad. They said, oh, we can't do this. We can't certify something that looks like plastic. And to be truthful, there weren't the standards then. There weren't the tests then. There were European ones, but there wasn't U.S. work done.

So, I could see why they might want to put a halt on it and they might want to say, okay, let's wait for some research. We approve it. But what happened is the executive director at the time — and you can look this memo up, I'm citing it now on the 10th year anniversary, I'm calling it the Black Memo — basically it was put in place to block our materials. And what it said was you had to be 100% plant based, bio based, and you could not use any GMO processes.

Now, that's not feedstocks, that's not the plants — that's processes. So what they put is it's impossible for us to make these materials 100% plant based. And believe me, this is a goal of Novamont, to have completely plant based chemistry, and we've done a lot. But even with that, we can't do 100% because some of the chemicals we can't make yet without petroleum based sources. But they're 100% biodegradable and they're 100% non toxic. So that was put into place. It was basically something that couldn't be done, and it was put in place. And then it was the thing about the GMO processes — even though there's no GMOs in the material and we can't get the plant based — you can't keep doing the same thing you've done forever and expect a different result. So, we basically need innovation. We need new chemistry, we need agricultural product feedstocks, we need all this stuff that will move us to the next level, but we're blocked. We tried to fight it at the beginning. We had momentum. We had a petition with 500 signatures on it. And they said, well, it's not all farmers. I said, okay. So they discounted the petition. We had a study from OWS at the time that said there's no way that these materials can be made with 100% plant based. They just can't be. And that was discounted and forgotten.

People have brought it up from time and again. They said, well, they would lower the requirement, but this bio based requirement — there's no reason for it. There was no reason for it, but it was put in as a block. There's nothing with that requirement that has anything to do with the soil, with the breakdown, with biodegradation, or anything. And meanwhile, Europe and other parts of the world are just moving forward. And all that's done in the controversy is status quo, status quo. So, in 10 years, the only thing that's changed is nothing — farmers only have one traditional plastic mulch film that they can use.

So, on the 10th anniversary, I got back to writing the letter and this and that and all the other things. And unfortunately — I hope I don't get too many people mad at me — but I've been a little vocal about it. So I went to the USDA, and I heard a big thing about how they wanted to use agriculture. They had a big meeting, two days, and brought everybody in, had a big meeting about how we want to use agricultural products to replace some of these fossil based products and all this stuff. And I listened. And I listened. And then I finally had to say, look guys, you're the USDA. You have this bio lab in California that does all this bio research with plant based agriculture, and you're spending money on that to find alternatives to fossil materials — which I won't say the name of — but really it's a nice laboratory and it's USDA and it's in California and they do really good work there. A lot of it's based around PLAs and PHAs but trying to come up with products from agricultural materials. And then you have USDA studies, of which we've spent $15 million so far for the SCRI projects for BDMs — on two five year studies. And I've been on the board of both of them, and the results have been very... but that's taxpayer money that we've spent through the USDA to basically validate that these materials are safe and non toxic. And then you have the organics group, which is also under the same USDA umbrella — it's the same — who deny the use of these materials and then basically just buried it and have gaslit it to the point where they go, "Oh, what do you mean? You have a pathway to certification. All you have to do is meet these requirements that are impossible to meet." So, me, starting out — like I said, 20 years ago — wanting to make a difference in the environment and in the way plastic materials impact nature or are in harmony or disharmony with nature... I sit there and I'm getting a little feisty in my old age and say, look, enough. How can you have two thirds of this USDA branch approving and supporting and doing, and then have one blocking its use?

So anyway, I don't know the answer. I will try. I will try to bring this up and talk about it. But there's no logical reason why farmers shouldn't have the choice to use these materials. And like I said, I'm not a bully. I'm not saying you have to cancel all the rest and you have to not use and ban them. I'm just saying for those farmers who want a choice — let them have the choice. And if it's too expensive and nothing goes anywhere and it's just a big… that's fine. But let people have an alternative. Academia has done so much — now it's just repeating the same stuff over and over again because the results don't change.

[00:45:16] Nataliya Shcherbatyuk:

And, you know, I actually wanted to ask you a question about standards, because you mentioned the standards, but I'm pretty sure that not everybody understands and knows the standards. And for example, standards like ASTM D6400 or ISO 17088 — they often confuse people. So, what do these certifications actually mean for farmers and consumers?

[00:45:45] Dan Martens:

Okay, so the certifications are very important. And this is what I say — don't listen to anything people say if they have a certificate. They actually have a certification like you're talking about. So, the root of all this is ISO 7088, and that's the international standard. It wasn't put together by industry; it wasn't put together by a university — it was put together over a lot of years talking about basically what is biodegradation. It measures four points. It measures CO_2 being created in material — and you can look it up — but basically it says 90% in, I think, 180 days for composting. And then it talks about disintegration. So the materials can't just be a big sheet and then on, I think, within 90 days, it's got to meet a certain specification, which I'm not going to say because I'll say the wrong thing. But you can look it up. So it can't just be a big sheet of plastic and then on the 89th day it just melts into a little bit — so you can't have contamination. Then it measures for toxicity. And for toxicity, it's toxic for soil and toxicity for plants. So that's measured. And what's the fourth one? Well, you can look it up. But then once you get that, then that gets into country certification.

So, in the EU they have their certification — their EU certification. In the U.S. we have what's ASTM — American standards — ASTM D6400. But it's basically those four components, those major components of toxicity, disintegration, biodegradation. And that covers its impact in the environment — and it puts timing on it and it puts temperatures. It's a standard, but it's based off that international standard. So, after that, for compostable products, then there's certifications for the products. So, BPI is the U.S. go to certification body. So, what they do — and this is where it gets confusing — because they don't do the testing. They have to go to certified laboratories that do all the testing — excuse me, I have to drink some water — and then they certify the results.

So, they're a certifier, just like OMRI is a certifier for the organics program. And then what BPI does is they add two overlays. So not only is it the ASTM standard, which is the ISO standard, they also add a standard for no PFAS, which came out of concern about PFAS being in products. So, you have to certify with them that that's not in it. And then they only certify products that are food related — They have to do with agriculture, either composting or to a lesser extent soils, because soil is composting. But yeah, they actually are very strict and very stringent. And a lot of this rhetoric about BPI being an industry group is just — it's really not true. It's a certifying group. But they basically cover all these things. So when people say to me, "Well, how do we know that these materials aren't toxic? And there's things hiding in the recipe and there's trickery and dark magic happening — and it's like, no. It's because everything has — you have to give your recipe list. It's got to meet the non toxic REACH list, or actually water non toxicity. And it all is certified before it even gets to the lab, before

it gets into your test on biodegradation, before you measure the pile. So then you can have an overlay test like CMA does. And what they do is they do in pile certifications, but they're not certifying for the toxicity, for the CO_2 — all that is done from the lab test. And then you have your in field testing, which is another layer. So, it's layer upon layer. And then if you want to go deeper, there's the soil biodegradability test, which right now is TUV in Austria. They certify, but it's to a standard that was created primarily — not primarily for agricultural BDMs, for mulch films. So they talk about what happens in the soil. So what they do is they stretch the time out from like 180 days to two years to 90%. And then they have their parameters, but it's based still on the ISO 17088 as the granddaddy of what is basically biodegradable — not even compostable, not soil, not marine — it's what is actually biodegradable at its basic components. And then after that, you have home compostability, which basically says that in ambient environments the material will go away. They give more time — basically within a year it should go away with whatever's in your home composting pile.

Now I have to — can I switch for a second? Because I know we probably only have a bit, but this is very important. This is a subtlety and a nuance that really gets misinterpreted and gets used against people trying to do something different. These certifications are certifying how materials will act within certain parameters, okay? How they'll react in compost, how they'll react in soil, how they'll react to it. we don't really have a full marine one yet, it's being done — but how they will react in different environments. They are not — or in a home composting environment — they are not instructions for disposal. They're not. And it gets misinterpreted. And I see — I was in Washington, D.C. with our industry group, and one of the folks was using the same chart that gets used over and over again, and they're saying, well, this material is good only for municipal composting, but not in home composting. And I said, guys, we have to stop. We have to be better as an industry in communicating. Because what gets used is they say, oh, well, this one's home is compostable. There're no home composters in our town, so we can't use it. And its instructions on how to dispose. Oh, this is soil degradable. However, there's no farmers here, so this material — there's no validity to it being used in any way, shape, or form. So, when you say stuff like, oh, this is soil degradable — that's not saying it's only that. Because the basic polyester is from organic compounds and enzymes are esters, which eat esters. And one of the best polyesters that I love to talk about is butter — lipids in butter. So that's all. And also gelatin is very much like a mulch film, just at a different level. But we have to be — when we talk about all these certifications — it's not like, well, they're only... and the poster child for this would be PLA. PLA is a material — it's lactic acid that's in our muscles. It's something that we produce. It's natural. It's in sutures when they do your surgery — they leave the sutures in. Lactic acid — it's not toxic. However, because of the type of polyester that it is — it's a straight structure and it has a high glass state and it's rigid — so it takes a while. But just because it doesn't meet a soil requirement doesn't mean that it won't go away in soil. It just won't meet those parameters. But it's still biodegradable. So when we're trying to say, how do we want to change these materials that were designed to be in defiance of nature — for good reason, because we don't want our car bumper to fall off when the sun hits it — so we create it to defy nature... we can also create these materials that are in harmony with nature. But they have to be in harmony with nature, not just, oh, it's only good for here, only good for that because it's certified. It's certified for that and the parameters, but it's still biodegradable material. And maybe I spent too much time on this — this is a little bit of a mind bender because we just want to say, well, is it good or bad? Is it this or is it that?

[00:54:16] Nataliya Shcherbatyuk:

Right. Yeah. It doesn't work like that.

[00:54:18] Dan Martens:

Yeah. But it's not deep chemistry, it's just logic. So if we use our own brains logically, think about it, I think we can maybe come to our own conclusions, which is really what — if I say anything else here — that's what we should… that's what I hope people do, is they're interested enough to find out and draw their own conclusions. So.

[00:54:39] Nataliya Shcherbatyuk:

And then if you're looking ahead, what do you think are the most promising innovations you see in compostable plastic or actually in the mulch alternatives?

[00:54:53] Dan Martens:

Well, what I see — and I'm gonna, since we're talking, hopefully folks here are thinking about mulch films — I really think that we have to come up with multilayer materials. Like right now, the monolayer — it's the cheapest and it's this — however, it's sort of like the Model T. But I really think that there will be biodegradable, compostable films that are created that are multi level — they're called co extrusions — but there's actually a project that I've been asked to be on with one of the tech universities, which should be really good. But basically, how do we engineer these materials to still be 100% soil biodegradable, but maybe be good for fumigation, or maybe not break down as quickly in a hot, steamy environment? And from the agricultural side, I always laugh because people talk about microplastics and talk about persistence and all this. I've never had someone call me and say the material lasted too long. They're always complaining that it broke down too soon. So I'm not sure that's really an issue with the farmers. If they had their way, they would love for it to last up until the last day and then they could spray something on it and it would disappear. But that's not the way. So, I think that is really important. I would love to see that some of these bio compo— getting away from calling them compostable — biodegradable — like in some of the stuff that hits the road, like your shoes. When people talk about microplastics, what they never bring up is car tires and sneakers. The little bits from the billions of people that wear them make persistent microplastics. And if they were made of a material that didn't have a lifespan of forever, we can't stop them from getting into the environment. I think that would be something. And it's so passive that people don't even realize it. So if we could fix that with something that would be biodegradable — and I'm not gonna say compostable because I don't want to be attacked for saying throw your gym shoes into the green bin — but just some of these materials that are more in harmony with nature. Because why is it — when I'm not in the industry anymore, I'll write this up — but why can't some of the greatest minds out there in the polymer world come up with materials that only last for 10 or 15 years? Like when it's something that we don't use forever. It's not going to… the inside of the pyramids. But it's something that we want to carry around. And then if it gets away, why can't we have a petroleum product, a plant based product, that works for less time and then breaks down? And then if you recycled it and you add new material to it, it got its life back and you could use it again. Or like we can do with compostables — for some of these hard goods. I hate to use the word chemical recycling, because that's been so beat up. But for compostables — where traditional plastics, they always say, well, there's thousands of chemicals in them, and hundreds. Well, in compostables there's like 10, or less. PLA is pretty much just PLA. And I'm sure they'll make it more complex for different things, but you can unwind those really easily. And bio based products are really easy to unwind versus some of the other really complex plastics. I don't want to name different names, but they're just easier.

So why can't that be a solution for getting these monomers back? And the monomers are really expensive. I mean, building bio based products is not mass scale. I mean, we couldn't grow enough corn to

replace all of the oil, but you could do it in certain things. And if you can get those chemicals back, reuse them in different processes to make more... I mean, we just don't have scale, but it's really easy. So, I would love to see these new technologies take what we've learned right now. I'm not saying we've maxed out what we can do today, but we've done pretty well with what we can do today. But we should keep that same theme and that same goal and the same excitement that we have for creating these products, which we just don't want to give up. We're a society of consumerism and convenience. So we can meet people halfway and we can try to make products that are less impactful on our environment. And then — wouldn't that be great? Wouldn't it be sweet if we didn't have to go find a shopping bag that I bought for my Boston rock group from Corvettes in the seventies still floating around the ocean? Don't do the — yeah, don't do the math on the age. That's okay.

[00:59:44] Nataliya Shcherbatyuk:

Yeah. Well, that's definitely tons of food for thought you bring up today, Dan. That's quite interesting.

[00:59:52] Dan Martens:

Interesting, and thank you so much. And for folks out there, if you want to noodle stuff around, I'm happy to do that. I hopefully think for yourself a little bit. I always say we can't change everything — if we won't change anything. So, any little thing is helpful.

[01:00:08] Nataliya Shcherbatyuk:

And then if you could leave our listeners today with only one key message about compostable mulches and plastics, what would it be?

[01:00:20] Dan Martens:

I'm getting more and more into — we need new materials. We can't ban our way into the future. We have to... I have a very hopeful outlook on science. We have the smartest people in the world here. We created a civilization that was based on petroleum products. I didn't say we created a con— we created our civilization based on that. We could have created civilization based on steam power and made ceramics that heat up water with the sun. But we didn't choose this pathway, and it's been very good for us. We've had... we could go back to an agrarian society where we all live within 20 miles of a farm, and we have horses and we could choose to go back to that. However, if we don't choose to do that, then we need to change how we do things and we need to change the materials that we use that impact our environment. So, I would hope that everybody would start thinking about and be open to and supportive of that one small step that we do.

I always say if there's one person in 10 who throws litter out their window of their car, but if there were nine out of those 10 that every time they saw a coffee cup on the side, they picked it up and put it in the trash can, we wouldn't have to worry about that one guy. So I guess it's an awareness. And I guess it's almost like an ask — but I'm almost pleading — to please keep these things in your forefront and care about our planet, care about our environment, and then really say, hey, what else can we do? Don't just get — which tends to happen — get cranky and cynical and say, ah, nothing will ever change. Let's force it, make a change. And stuff like these mulch films — get them certified, get them done, give the choice. Science supports it. And now it's just a lot of people who are stubborn and dug their heels in. And in this environment, it seems like nobody can be wrong. Nobody can say "I'm wrong." Everybody has to fight to the death, and we have to stop. And you're

going to have no change if we do that. So that's a long winded... I'm sure someone smarter than me can digest that into something simple. But I can't, unfortunately. Wish I could. But thank you so much. Thank you so much.

[01:02:45] Nataliya Shcherbatyuk:

Yeah, that was definitely a good message, Dan. Well, thank you so much for your time and for tons of knowledgeable information. And I'm pretty sure I'll be asking you soon if there are any updates that you can provide to our listeners again on the podcast.

[01:03:02] Dan Martens:

I would love to tell you yes. So I'm gonna keep plugging away and thank you so much. And thanks everyone for your interest and listening to these topics. I really appreciate it. Thank you so much.

[01:03:13] Nataliya Shcherbatyuk:

Thanks, Dan. 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 website: *www.smallfruits.wsu.edu* (*smallfruits.wsu.edu* in Bing) and choose *"Mulch Technology."* 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 in this podcast are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

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