Biodegradable Mulch and Three Sisters Gardens

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SPEAKERS

Iowa State University Extension and Outreach, Christa Hartsook, Joe Hannan, Dr. Ajay Nair

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C **Christa Hartsook** 00:15

Hello, and welcome to the Small Farms Podcast, a production of the Small Farms Program at Iowa State University Extension and Outreach. Our podcast covers the opportunities and challenges associated with rural life.

J **Joe Hannan** 00:29

I am Joe Hannan, Commercial Horticulture Field Specialist with Iowa State University Extension and Outreach and welcome to the Small Farms Sustainability Podcast. With me today is Dr. Ajay Nair Extension Vegetable Specialist with the Department of Horticulture at Iowa State. Welcome, Ajay. Great to have you back on the podcast again today.

D **Dr. Ajay Nair** 00:49

Same here, Joe, it's been fun doing these podcasts. And thank you for having me. That's correct.

J **Joe Hannan** 00:53

Yeah, I agree. I love doing I'm with you. I want to jump right into this today and talk basically about some research projects that you're doing this year. It sounds like you've been pretty busy last couple of weeks trying to get projects planted now that things have finally started to dry up and clear up. So what I... kind of what I heard from you here just in our show notes and things prior to recording here today, one of the projects that you're working on is the use of biodegradable mulches and commercial vegetable production, correct? Can you tell me a little bit about what are you doing? What are you looking at? What are you growing in them?

D Dr. Ajay Nair 01:31

So, as you know, Joe, working with the commercial vegetable growers here in the state, a standard form of production is using the conventional black plastic mulch. And it's very common among commercial growers because the plastic mulch helps to suppress weeds, it helps to conserve moisture, it also helps to increase the heat in the root zone. So the plants can grow a little faster. So many benefits. And weed suppression is the biggest one within the row. Plastics, as much as we love them. We have a love and hate relationship with them, if you think of it, you know, in the beginning of the season, we absolutely need them again for those benefits I mentioned. But at the end of the season, when all the harvest is done, and you know, we have this wet fall and cold weather. Now we have to go out there and pull this plastic out, which is not an easy task. It's not work which everybody looks forward to. And then now after you take the plastic off, you need to also dispose that plastic, and so many universities, and now for many years, I guess I would say about five or six years now, more intense research is going on finding alternatives to this plastic. Primarily because of you know, labor saving, because we are looking for biodegradable plastic that can be completely tilled under, you might just go with a disk and till it under. So a lot of labor saving, you don't have to spend those hours to pull that plastic, and also a lot of environmental benefits, because you are not creating that waste with that plastic. So we have been trialing different types of biodegradable materials. Because, I mean, they definitely sound good with the benefits they can provide. But we need to make sure they also stand up to what the conventional black plastic provides, that is weed suppression holding on until the entire growing season. We don't want these plastics to degrade during the growing season. So we need to make sure we do some comparisons side by side to make sure they provide all those benefits. And at the end of the season, we can just go into them under and don't have to spend time pulling them off. So that has been the core of the study.

J Joe Hannan 03:34

Yeah, you've really not lived until you've pulled up plastic in the fall with rotten tomatoes and melons dried up and crusted up on plastic have ya?

D Dr. Ajay Nair 03:43

Yeah, and you remember, you have worked with this system before?

J Joe Hannan 03:47

Oh, yeah.

D Dr. Ajay Nair 03:47

When there is this soil that is packed on the side of this plastic mulch and you're trying to pull back and the plastic rips. And now you have to go back and pull that soil and move it away and then pull the plastic it's very frustrating!

J Joe Hannan 04:00

Oh, super frustrating! There's nothing like just running over biodegradable, plastic and discing it in.

D Dr. Ajay Nair 04:08

Exactly.

J Joe Hannan 04:09

I wanted to mention some of the old biodegradable plastics that we've looked at, you know, I'm a little dated at this point. 10-15 years ago, the tops of them that were exposed to the sunlight would often degrade. But you'd end up with the railroad tracks right where the soil was buried over to hold the plastic down. And so you still have to go back and do some some removal. This is not your first year for this project, correct?

D Dr. Ajay Nair 04:33

That's correct. This is actually the second year and the first year the issue you mentioned with the top degrading those were more of the photo degradable plastics, which degrade with sunlight and definitely it's a big challenge because wherever the sun hits, they will degrade. So that is the top of your bed and the sides which are buried under the soil, don't degrade. So that's why with this research, I should have mentioned it earlier, we are not looking at photo degradable, we are just looking at the biodegradable which means you have to till it under or disc it in the soil so that the soil microbes can consume that. And so the products which we are testing in this trial, there is a company that is Dubai agriculture, they're selling this product called Bio 360. That's one product, we have two formulations of that product, Bio 360 Black, which is the black, regular black color on the top. And then we have a Bio 360, white on black, which is white on the top and black at the bottom. So those two and then another company called Organix with an X at the end, they have similar products, one with black, and one with white. So those are the four and then the fifth one we are trialing here is the paper mulch, and that is gaining traction with some growers in the state. So we thought, okay, let's put in a paper in there too. So that those are the five and the six treatment would be a conventional white on black plastic.

J Joe Hannan 05:50

Okay, so I'm going to back up and talk a little bit or ask a few questions about each of each of those, if you don't mind to the Bio 360. Is that a corn, soybean based product and mixed with ethylene? Or do you know more of what actually makes up that particular product?

D Dr. Ajay Nair 06:08

Sure. So this product Bio 360 is being sold by the Dibai agriculture is made of a product called Matter Bi, which is a corn starch based product. So it's a corn based product, the batch pigment

Matter Bi, which is a corn starch based product. So it's a corn based product, the batch pigment on the mixture is used for coloring that matter by having that black or white and what the company suggests is they are non toxic, you can till it under and it should degrade in one year. So that's for the Bio 360. The organics product, they don't clearly say what is in there, but it's biodegrade degradable, it compostable, it's made with actually a BASF product or compound called Eco Bio and I'm sure there are some plant based ingredients in their cellulose, corn based ingredients. That has been the backbone for most of these biodegradable mulches. Now, there has been concern about you know, what is biodegradable? I mean, should it degrade in one year? Should it degrade in two years? So that's another step, another area of research that is slowly coming up, whether discing in the fall, and coming back in the spring, should you still find the small pieces flying out there? Or should it be completely incorporated, it is influenced by how you till and how you disc it in. But again, primarily, these are all plant based products that are used to make these biodegradable products.

J Joe Hannan 07:26

So yeah, I knew some of the early generations of these particular products. How are they as far as being able to apply them to the field? Are you able to... do they have some fairly, some decent stretching things as you're laying them with the mulch layer? Or do you need to be a little more gentle with the equipment? Do you need to have a little bit finer seed bed with the equipment when putting these products down? Or?

D Dr. Ajay Nair 07:48

Yeah, that's an excellent question. Because even just laying the regular black plastic mulch, I know that our growers and sometimes myself, you know, if you don't have the setting correct, it doesn't work, because you want a firm seed bed. You want to finally tilled soil, and when you run your plastic mulch layer, you should create a nice firm, packed seed bed in which the plastic and the soil touch each other. You don't want air pockets in there either, you know, you don't want that to flutter. So just, you know, the biodegradable part, just to lay correctly with the black plastic is important. And this question about whether you can use these regular plastic mulch layers for biodegradable mulches is absolutely critical, because if it doesn't, then there is no value because no one is going to lay them by hand, they have to work with the regular tractor and the plastic mulch layer. So in our experience, if we keep the tension correct, and most of the time the setting for the regular black plastic mulch works for these also, but you need to be careful you don't stretch them too much because then they start tearing when you start laying. And we have fine tune the setting very similar to the regular black plastic mulch. They lay really well. You talked about tilled, or the tilling of the soil. Yes, you have to make sure that the plot is well tilled. You don't want stubbles there like corn pieces and stone pieces because then they start poking the plastic can start degrading that way. So yes, fine tilled, proper setting. And you can you can easily lay this with this with a regular black plastic mulch layer. So with the Bio 360, both of them, the Organix, both of them very easy. With the paper, you have to fine tune that a little bit more because the paper doesn't have that stretchability which these plastic have. You need that stretching when you lay the plastic so with the paper you have to reduce the tension back there and in the paper you will find two different types of paper you will find a heavy, actually three different types, a heavy gauge paper, a light gauge paper, and you will find a paper that is crepe, which means it's not like a regular sheet of paper, it has divots in it. It's like crepe paper. So between these three, the crepe paper is the best one to lay because it provides that a little bit of way and tension you

know when you're laying it. The heavy paper, in my experience at least, it tears very easily, because it doesn't provide that elasticity. And you know, the bed how it is, you know, flat at the bottom and curves at the side. And if something happened on one side, it starts ripping very easily. With the lightweight paper, if you have the correct setting, you can lay it very similar to the black plastic much.

J Joe Hannan 10:19

Gotcha. Yeah, I haven't used the paper mulch systems yet. I've used a lot of different plastics, but not the papers, I haven't had a chance to really play around with those.

D Dr. Ajay Nair 10:27

I feel like not a downside, but the challenge with the paper is that they're more expensive. If you compare the costs, because that's also another thing, you know, which growers would like to know, what is the cost and how much it is. So regular plastic mulch, you know, just to have a standard dimension of four feet wide and 4,000 feet long roll will cost maybe $130-140 with shipping and all that. Whereas the plastic, the biodegradable will be maybe two times more. So you're looking at $250, $230, and the paper will be maybe three times more expensive than the regular black plastic mulch.

J Joe Hannan 11:03

I will say by the time you will figure out your time and effort and labor at the end of the season to pull up plastic. If you can just run over, pull up your drip tape and run over with the.. yes, you can probably make up a lot of that costs because even $250 for four by 5000 foot rolls not too bad.

D Dr. Ajay Nair 11:21

That's true. Yeah, one has to definitely do the math of how many hours we're spending out there in the fall to pull that black plastic and then do the comparison and you are very correct. You know, these these, these biodegradable plastics will pay off and given the results, which we have seen, and I know you wanted to discuss that as well. We are very happy with how these products are performing.

J Joe Hannan 11:41

Yeah, so I guess that's a good segue into what are some of the results what are you seeing with these products? This would be your second year correct?

D Dr. Ajay Nair 11:50

That's correct. Yeah.

J Joe Hannan 11:51

So, tell me a little bit about what your preliminary thoughts are. We're gonna hold this to you here this fall, though.

D Dr. Ajay Nair 11:57

So based on the results from last year, we found similar yields, statistically similar yields between all the plastics. Like Bio 360, both black and black on white, Organix, black and black on white, a conventional all five of them had statistically similar yields for pepper. We grew two types of pepper- Jupiter and Intruder. Intruder for green and Jupiter for the color. So similar yields and the paper was the one which was statistically lower in terms of yield, so the yield wise paper did not perform as well as the other five treatments we had. In terms of marketable weight. This is in terms of the number of fruits you harvested, in terms of marketable weight paper was still a little low as compared to all others. The highest one was the organics white on black, that was the one that gave us the maximum yield. The difference between black and black on white as you know, white will reflect a little bit more light and will also cool the soil a bit as compared to regular black plastic mulch. And oftentimes in Iowa, you know, July and August can be extremely hot and it is for that reason we decided to compare with both black and white on black because white can cool the soil a little bit, and maybe that is what is playing here. Is that the white on black treatments were doing a little better than the black alone.

J Joe Hannan 13:15

Yeah, if I remember right, right around July 15th-20th and there are a couple other days there we had some 95-100 degree days and if you're coming into production at about that time, I can see where that would be a little more yield producing

D Dr. Ajay Nair 13:32

Yeah, and another thing we have seen with the paper and that would the reason that's acting against it is the soil dries a little quicker under the paper as compared to the plastic mulches. So we see these plastics are holding moisture better as compared to the paper treatment

J Joe Hannan 13:49

So it could be a good thing on a wet year though so this could be...

D Dr. Ajay Nair 13:53

Yeah, a good thing on a wet year, and the downside of that on a wet year, if there's too much moisture the paper starts ripping on the edges. So when we tried one year, when we were trying to install, and maybe because we did not install it correctly, the paper just ripped on the

side after a heavy rain and then just came off with a wind the paper just came off. So yeah, there are benefits and challenges you know with with moisture and how the paper reacts

J Joe Hannan 14:20

I have just one follow up question before we move on here, Ajay. But the paper then, if the paper mulch in last year's trial, if it was drying out a little bit faster was it still not getting any more water than the other, I mean, so was water application uniform across the project? You didn't adjust for that additional water use or loss?

D Dr. Ajay Nair 14:41

Yeah good question. Yes, the water, we kept the water constant across all treatments. So the paper got the exact same amount of water. Although, if you look at it, the paper might have got a little bit more moisture because the paper soaks the water in overall whereas the plastic doesn't. So it makes it run away, so paper might have overall got a little bit more water than the others. But when you're irrigating we were providing the exact amount of fertilizer, same amount of fertilizer, across all treatments. Another quick interesting fact, which I would like to mention, is we measured the blossom end rot and you know blossom end rot, there are two factors, calcium and also water. Know how the water moves in the plant. We did see that the white on black, both Organix, the conventional which was also white on black, and the Bio 360, they had statistically lower blossom end rot as compared to the black ones.

J Joe Hannan 15:33

Interesting.

D Dr. Ajay Nair 15:34

Yeah, so, we will see how this year, you know, how it plays out. But it had less blossom and rot as compared to the black one. So I don't know something to do with the soil temperature and the way the moisture moves for the white ones definitely stood apart. There was a big clear line that the white plastic had lower blossom end rot as compared to the black and the paper.

J Joe Hannan 15:55

That's very interesting. I know, cuz even, you know, if you're getting just one or two degrees reduction in temperature around the plant, that's a fair bit of water use that you're not using anything. But, interesting to see how that will play out here this year. I assume you'll measure blossom end rot again this year.

D Dr. Ajay Nair 16:11

Yes. We will.

J Joe Hannan 16:13

Well, any final comments on the biodegradable mulches?

D Dr. Ajay Nair 16:16

I think we recovered most of the highlights.

J Joe Hannan 16:19

Okay. So, another project that you have going on this year is a three sisters project, looking at the effects of soil health and properties and growing corn, squash, and beans together, correct?

D Dr. Ajay Nair 16:33

That's correct.

J Joe Hannan 16:34

So tell me what you're doing then with that project?

D Dr. Ajay Nair 16:37

Yeah, so this is how the production used to happen here, when the Native Americans were here. The three sister, which means they plant the beans, and the squash, and the corn together, that was the traditional way. So this is a USDA project, Dr. Christina Gish Hill from the World Language and Culture Department, she's the PI, and myself and a few others are serving as the co-PI. And we are really interested in three major objectives, you know, with this with this project. We want to evaluate, or kind of assess the cultural, nutritional, and agricultural importance of the three sister crops among different Native American communities. And we are working with five of them right now, one in Wisconsin, another in Minnesota, in Iowa, and also in Nebraska. So we have some collaborators, Native American groups we are collaborating with. We are also interested to engage the native gardeners, again this is not on a commercial scale, but more to engage these Native American communities and helping them go back to answer some of the questions why are these systems working? Why were they better to begin with? And the third is to evaluate the effect of the Three Sister System on the soil properties, especially physical properties, chemical properties, biological properties. So it's just like reinventing that system and reuniting the three systems together and understanding them a little better.

J Joe Hannan 17:58

So this is more targeted for that home gardening, subsistence gardening type system. So probably a lot of this is being hand done, so it's fairly easy to do, to plant, or interplant these three crops.

D Dr. Ajay Nair 18:09

That's correct. More for, again, working more closely with the Native American communities in these four states. But we are also setting our research trial at the Horticulture Research Station, because in the these Native Communities, we might not be able to get the soil samples and do it the right, the way we want to do it. But we do have a research plot, in which we are creating mounds, and we have four treatments across a block, we have four blocks for replications. So within a block, we have a monoculture where we have 16 mounds of just corn, then we have another treatment in which we have mounts for beans, and other treatment mounts for squash. And then the fourth one will be three sister, which means on one mound we'll have all these three together. And so yeah, it's fascinating and interesting to me, I've never done a project like this before.

J Joe Hannan 19:00

Yeah, it's it's kind of unique.

D Dr. Ajay Nair 19:01

And trying to understand how the the three system... and the other thing I would like to highlight is that the seeds we are planting, these communities are growing. So we've gotten seeds from them. And we are going to grow these seeds, these crops, and hand over the seeds back to these communities. So there's a lot about bridging, you know, understanding these communities, their nutritional values, and just connecting with the folks and leaders in these communities, you know, these Native American folks who are still practicing this and trying to bridge that gap in between the university research and working with these Native American folks.

J Joe Hannan 19:40

Sounds like a lot of fun. Yeah, a lot of fun getting to learn new communities, new cultures, and new people that are right in our backyard.

D Dr. Ajay Nair 19:49

Exactly.

J Joe Hannan 19:51

And I'm assuming this is the multi year project. This is the first year for it, I assume?

D Dr. Ajay Nair 19:55

That's correct. We will be having two years of this research and it will be at the Horticulture Research Station. And then we are doing a lot of outreach. We were planning to go actually this spring, but because of this pandemic, we were not able to, but in the fall, we will be visiting some of these communities meeting with their leaders, understanding their culture and what they need. And we have to be very careful and cognizant about, you know, entering their fields, you know, they pray to these crops and they have different rituals. So, a lot of learning for me, you know, as you know, and when we go out to visit growers, and you and me will talk to the grower, we'll go inside, and we'll pull the plant, and we look at the roots. (Laughing) But in this one we have to be very careful of, you know, we don't offend them in any way.

J Joe Hannan 20:38

Right! We just don't know that culture very well. But yeah, you know, you go to a site visit, you go and yank a plant down, like, "oh, by the way, can I pull a plant?"

D Dr. Ajay Nair 20:50

(Laughing)

J Joe Hannan 20:50

Can't do that here, can ya?

D Dr. Ajay Nair 20:51

So, some of the soil health measurements, you know, you had asked, what are we collecting, we're looking at the physical properties, we're looking at the chemical properties, nutrients, also biology here. So Marshall McDaniel, he's also co PI in the Agronomy Department. So Marshall is the lead there, his lab is helping do that. His lab is also sending some testing kits, small kits which can go to these Native American growers and communities where they can do a soil analysis themselves, like some basic things like pH and EC, so his lab was spearheading that, you know, the test kit approach. And we will also be doing some workshops when we go to these communities, educating them and letting them know, informing them more about the differences in soil when you have three sisters, pest management aspects, and anything that has to do so that they can be self reliant and grow these crops in their backyards.

J Joe Hannan 21:46

Sounds like a great project. I look forward to hearing more about this one and multiproduct here, maybe this fall and finding what your results are. At the very least, I'll see you at conferences.

D Dr. Ajay Nair 21:59

Absolutely, we'll touch base.

J Joe Hannan 22:01

Ajay, unless you've got anything else here.

D Dr. Ajay Nair 22:03

Thank you for doing this podcast. Again, I feel like a lot of research that happens in the university happens within extension and all, and we only could share so much, and these podcasts are giving opportunities to even talk about issues during the growing season and what we do, like we talked about planting, and seed bed, and raised bed, and thanks for creating all this. This is very helpful.

J Joe Hannan 22:26

Yeah, well, I can only create it because of you and Patrick and other folks come on and talk, then of course Olivia Hanlon at the ISU Small Farms Sustainability Program. She actually does the hard part, she does all the editing. I'd like to thank her for for doing that. I would like to say the podcast is not just for Ajay, and I, and folks at ISU to come on and talk, if you're doing an on farm project or pass something of interest that you want to talk about on your farm your community. I'm always looking for guest hosts I try to put out a podcast weekly, just shoot me a note at jmhannon@iastate.edu and we'll get you scheduled to come on and talk about your projects. Thank you, Ajay. Thanks, everybody for tuning in and listening today and we'll talk to you next week.

I Iowa State University Extension and Outreach 23:30

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