Marty Chilvers SDS_mixdown 5-24-22

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SPEAKERS

Brandon Kleinke, Ed Zaworski

B Brandon Kleinke 00:08

I see that plants podcast shares the stories of people in plants, pests and pathogens and conflicts among them. Join us as we speak to the folks who are helping the rest of us that healthier, more productive lives through pest management research. We strive to make science accessible. I see dead plants created by the Crop Protection Network and hosted by Ed Zaworski. The Crop Protection Network is a product of Land Grant University.

E Ed Zaworski 00:30

Welcome back to the ice dead plants podcast. As always, I'm your host, Ed Zaworski. And I've got someone pretty special. As always with me today I'm joined by Marty Chilvers from Michigan State University. How you doin, Marty?

00:45

Hey, Ed doing well. Thanks for having me on.

E Ed Zaworski 00:48

Excellent. No, I just just uh, Marty and I are going to talk about a subject that's near and dear to my heart and his soybean Sudden Death Syndrome. It's what I worked on for my master's degree. And Marty has done quite a bit of work on it up at MSU. But just a little bit of background on Marty before we get started, as is tradition for ICD plants. Marty did his Bachelor's in ag science with with honors is this with the RG eight variations? Yes. You have to honors at the University of Tasmania. So we'll get into that because I told Marty before we started recording, I really want to talk about how we got here as I do with everybody. But his is particularly interesting to me. And then he did his PhD at the University of Tasmania as well. And then his postdoc at Washington State University. So but yeah, like I said, Marty, I've super I've, I've hung around with Marty a lot. But you know, I never really have gotten into it with you

about like, he's he's a he's another whatever you want to say an alum of the boundary of the annual Boundary Waters trip with some of us plant pathologist so but I never really got into this with Yeah, I think we were just too focused on fishing. So, but but, you know, tell me about the you know, how you got into ag back in Tasmania. What are you over here? What, how you got to Michigan State? Told me yeah, I'm sorry. Yeah, sure.

02:17

Okay. i Yeah. So the story is, I guess I liked agriculture. You know, and I enjoyed science. And I wasn't too sure if I wanted to be a veterinarian or not. I tried that out a little bit, but just wasn't so good on the blood side of things, right, unfortunately. But I had. So anyway, I ended up doing a Bachelor of agricultural science, because that's one potential avenue through to veterinary science. But I had an Olsen plant pathology teacher. I can't remember where she was from now, but from Europe somewhere, and she sort of rubbed most of the class the wrong way, sort of expecting us to read and all that sort of stuff. But I enjoyed it, right. And I enjoyed the sort of personality and actually, so I did an honest project, like a research project with her on fight off for us. So that was sort of my first foray into plant pathology. And that's sort of what got me hooked and then had the opportunity to do a PhD. And that was on detritus, neck rot of onions. So in Tasmania, we grow a lot of onions for export. And this neck, right disease causes post harvest loss of those onions during shipment. So they get to Japan or wherever they're going. They open the container doors, and they just flow out of the container if they have neck, right, you know, so that's a big, big issue for our onion production in Tasmania. And so that sort of got me to Washington State. I met a professor at a national conference here in the US, and I came to work for her for what was advertised as a nine month postdoc, and here we are, whatever. 16 years later, I'm still in the US. So yeah, anyway, so I came over and worked for Lindsay do toy for a period of time. But as in Tobin, PVS lab and he worked on Aska kinda blight if chickpeas. So I was working on chickpeas, lentils, dry field peas, or the Pacific Northwest. So I did. I was in that area, Washington State University for about four years before coming to Michigan State University for this field crop pathology position. Yeah, so a bit of a long story as to how I got here.

E Ed Zaworski 04:36

It's funny to me, because man, the first thing you say, I was, I was thinking about going into vet med i That's exactly what I was trying to do. When I came to Iowa. And yeah, the nine month appointment. Yeah, I was supposed to be out here interning for, I think like three weeks, and then it turned into I was here for a year and then I'm At Darren Muller, my former adviser and he talked me into plant pathology with the line of plants gets sick too. While we're playing basketball, right?

05:09

That's awesome. It's funny the way things work like that.

E Ed Zaworski 05:13

Yeah. And it's funny because you mentioned you all you didn't deal well with the blood with a

Yeah. And it's funny because you mentioned you all you didn't deal well with the blood with a veteran. Yeah. Yeah. So that's kind of a similar story with me. I think I got over the, the blood and stuff pretty quick. But then it was just what I noticed was I was thinking about doing large animal medicine. And I met a few guys, I met a guy who worked with bison, who his arm didn't work too well, because he got the the elbow backwards by bison by patted on the butt for a shoot. And I met guys with missing fingers and stuff. And I think a lot of work yeah, like to be active and live an active lifestyle. And I was like, Oh, I don't need to get kicked in the knee or something. And then Hurray, plants, they're, you know, they're pretty safe.

06:06

I tend to fight back, which is good. Yeah.

E Ed Zaworski 06:11

So Well, anyway, thanks. Thanks, Marty. Yeah, I enjoy that really, hopefully, the listeners do as well. But yeah, with that, like, we're gonna get into, we're gonna talk about soybean Sudden Death Syndrome, or will abbreviate it a lot as SDS because soybean Sudden Death Syndrome is a mouthful, right? But we're gonna get into a little bit background there. We're going to talk about another pathogen that can kind of have a synergistic relationship with SDS, which is another abbreviated term of Sen, which stands for soybean cyst nematode. And then we're going to talk about Marty's research of what he said about five years ago. Yeah, Ting, soybean yield and sudden death syndrome developing using development using at planting risk factors. So it's kind of a paper discussing potential modeling of SDS and trying to predict risk and yeah, more or less, right. Yeah. So. So yeah. Well, we'll jump right into some background then. And,

07:21

sure. Absolutely. I guess I'll give you the quick rundown. So or how I got started in the SDS. So yeah, yeah. So yeah, getting here, basically, in 2009, at Michigan State. And I think we had a couple of bad SDS years around that time. So looking for, you know, what are the most pressing problems that in white mold, I guess, really in soybeans is a couple of our major issues. So we've been working on Yeah, that in seedling diseases to a lot of our work, but anyway, so SDS was certainly one of them. And so we've had a couple of PhD, I guess we're on our third sort of graduate student now working within that STS type system. And we've had postdocs working on this as well. Yeah, so the first student that worked on this, he developed like a real time PCR assay. So what that means is that it's a DNA detection assay, basically, that's specific to the fungus that causes soybean Sudden Death Syndrome. So we were able to use that assay, and actually a lot of diagnostic labs like the one that you work in to use that assay, right?

E Ed Zaworski 08:33

Yes, it's a fundamental. Yeah. Some fundamental research here. Just yeah. And so identify this stuff in soil, right. And in plant tissue, right? Yeah. Yeah. So yeah, I

08:44

know, our lab and a few others have used it to diagnose like fruit, fruit samples that come in, like, does this have SDS or not? And so they take that route, extract the DNA, and then use these this qPCR technique to figure out if we have any STS fungal DNA in that tissue, and then they go, Aha, like, Yes, this is probably what's causing the disease in this plant.

E Ed Zaworski 09:08

Right. And before we, before we get too much into the weeds of the research, do you want to talk about that really quick, just a brief overview of SDS because assures us I always I probably neglect to do this. I probably have neglected to do this in previous Emelia. Yes, well, but SDS, soybean Sudden Death Syndrome, that's the name of the disease, right? But the pathogen which causes the disease is fusarium vermicular. For me here in the US, I think, maybe a couple other species in South America, but maybe that's too much into the weeds, but Yeah, can you give us a brief overview of what is going on with SDS? Why is it called SDS? Sure, first choice.

09:50

Yeah, I mean, I think the the name Sudden Death Syndrome is really fitting for the disease. And it's it is kind of an interesting disease the way it infects the plant and causes symptoms. So yeah, it's caused by that that fungal pathogen fusarium vernacular for me, and it's, you know residing in the soil. And it infects plants pretty early as far as we can tell from a lot of research that's been done. So early planting tends to promote infection, right, where we've got slow germination of the roots, tends to promote that infection to the root system. And then the fungus itself stays in the root system, it doesn't move anywhere else. But it produces toxins that get translocated up into the foliage. And that's where we see this, you know, sudden death, symptoms start to appear, especially, you know, around, you know, late reproductive stages as, especially as the beans are starting to fill. That's when things can really, you know, be very, very sudden, and we've we've, we've done trials where we've invested a lot of time inoculating, irrigating doing all these things to try and get disease, right to test varieties, or seed treatments. And I'm freaking out thinking, Oh, my goodness, we've wasted so much effort getting this thing together, and it just is not coming out. And then all of a sudden, things change in a week. And now we've got, you know, plants that are had the leaves falling off, and pods are boarding and all this sort of thing. So yeah, the name is very fitting Sudden Death Syndrome. It's a very dynamic disease. Yeah, it is, it is, it really is. And again, you know, the fungus is only in the root. So it's the toxins that get moved up, pulled up into that foliage that that cause that symptomology. And the symptoms are, you know, into vinyl chlorosis, which is yellowing and necrosis, which is death. So typically, the veins on the leaf will stay kind of greenish color. But between the veins, it'll, it'll turn yellow and die, and those leaves will fall off. And the petioles will remain attached. Right. So that's a good sort of diagnostic feature if a farmer is out walking a field and trying to figure out if this SDS or not, the PDF files will remain attached. But the leaflet on the end will fall off. Yeah, and then it's going to reproduce that fungus is going to reproduce on that root system, you may potentially see that if you pull a root system up and see that blue

E Ed Zaworski 12:22

mass, yeah, that's

12:23

the technical term is sparra Nokia. But yeah, it's a small mass, right? You can get confused. There can be other fungi down there doing that too. But yeah, that's that's one nother diagnostic. And again, that's why we develop this DNA based assay, right, like, to help us identify what the hell is out there. Because if you don't know what it is, you're not gonna be able to treat it correctly. So diagnostics, as you fully know, is important for fixing problems.

E Ed Zaworski 12:49

Yeah, there's a, there's a few look alikes that also create this inter renal chlorosis or yellowing on the leaves. And it can be, I mean, if you're the untrained eye to and and even to the trained eye, it can be difficult to say, which one of these pathogens that might be because, again, they're in the roots, making toxins like off into the leaves. So there's kind of a disconnect there in identification, and that's why Yeah, like, what you're saying, and what you're talking about that qPCR study is critically important to diagnostics and yeah, and beyond.

13:25

Yeah. Did you want to talk about the look alikes, or, ah, we don't have to, if we can keep moving, whatever you want to do.

E Ed Zaworski 13:34

Let's let's keep moving for now. Because yeah, I mean, we could, but then we're gonna have a two hour podcast perfectly fine. So this is something I forget to mention. I'll try to pepper this in, in future podcasts. But folks, if you have any questions about anything, or if or if you want clarification, or if you want to just give us a comment, like, we want more, we want to hear about the lookalikes for two hours. You can send emails to crap protection network@gmail.com. And I'll put that in the show notes from here going forward. But it's something that, you know, as I'm trying to improve these podcasts, it's something that I need to mention more often. So you can get jump in. But now let's stick to SDS. That's fine this, but just suffice to say there are local like So yeah, this qPCR and identifying the exact DNA and the roots, helps to make sure you got the right. Problem here when you're absolutely so so how, how Marty how do people I'm sure that SDS is a very perplexing disease to to growers, especially because of its just the nature of it just showing up later in the season. And they don't really have much for indicators early on, but how do they manage it? What do people do thus far?

14:51

Yeah, management really? I mean, yeah, like every disease I keep preaching this right resistant variety is very, very important. And prior to that, you know, knowing what you actually have. And we we've banged on this already about diagnostics, right? Like, you've got to know that it

is actually SDS and then keep field records, right being aware of which fields have a high level of SDS and that need to be managed appropriately. So yeah, variety of resistance is absolutely critical, that's going to be step number one. So talking with your seed dealer about that making sure we use soybean varieties with good levels of resistance, and then a seed treatment, something like a LIFO or Saulteaux. A couple of seed treatment options out that we've seen have pretty good management efficacy for SDS no silver bullet, but certainly help suppress the amount of SDS and then we also want to test and manage for soybean cyst nematode, which we should be doing anyway, because nematodes can also be quite damaging. And then actually some work that came out of Iowa State, some of your colleagues, they saw that, you know, sort of extended crop rotations seemed to help. Great. So three to four year rotations, where you've got different crops, not just corn, soy, because it's just so a bit, you know, if it's just cool, and you can go and have five years of corn and come back to soy, they still have the same devastating levels of SDS, apparently. And we've done some work to looking at survival of that STS fungus in corn, it doesn't cause disease in corn, but it seems like it can just sort of hang out and just survive in the soil. So those extended crop rotations, where you've got something different in the system in the rotation seemed to help. And I think there's a lot of interest now around. Okay, so if we can't get away from corn, soy rotations, you know, can we do something with a cover crop? Will that help? And my guess is to what's going on as you just basically in increasing diversity of the crops, obviously, in that helps with microbial diversity. And that might be helping to suppress the amount of STS fungus, it's in the soil. So yeah, that's that's pretty much it in a summary.

E Ed Zaworski 17:03

Gotcha. Well, I didn't, I always hate to derail people, but you are, you are building your so you're talking about your original research was on the qPCR. And now, now, I wanted to get into the background of SDS, just so that people could, you know, follow along there know what it is first, but so keep building there. So you started with the qPCR study. And yeah, and

17:28

I tell you what, another really important so you know, so did my degree, my PhD in epidemiology, right. And so having an understanding of what's going on out in the field with our pathogens, is really important, right, understand your disease cycles, so we can do a better job at managing them. And so one way that we use that DNA test that qPCR assay, was to actually track the amount of STS fungus in the roots of soybean plants. Okay, and so we took actually four different varieties of soybean to that have that develop foliar symptoms of SDS and are very susceptible to SDS gotcha interior that have like resistance to the folio symptomology. So you plant them in the field, you don't see any SDS development, and you get pretty good yield off them, right. So what we do is actually track that through the routes over time, and we learned a couple of things. We learned that as soon as we were able to basically pull plants from that field, those plants were infected, which we sort of knew for some other research as well. So confirmed that during the course of the season, the amount of fusarium in that route continued to increase, even after harvest, the amount of DNA sort of increased. But what was really interesting was that both what we call resistant and susceptible or tolerant and not tolerant, depending on how you like to talk about these things. There was no difference really in the amount of DNA in the root system. Right. So that's a little bit counterintuitive. You think that you plant a resistant variety that Okay, great, that should not be accumulating that STS

fungus in the root system, but it still does accumulate in the root system. And so that also is an important thing for management. Because, yeah, okay, let's plant a resistant variety in the field. We don't see any SDS problem solved. Not really. It's still there, right? It's still increasing in the root system. It just didn't cause you significant, you know, obvious disease issues and significant yield damage. And there may still be a yield penalty to having infected roots.

E Ed Zaworski 19:51

Right? Yeah, but it's, it's it's less understood, right? I I'm, yeah, I studied this long time ago. I'm not I'm not up to date. On the most current research, but last time I checked the amount of root infection, it was more difficult to find a correlation with how it affected plant yield from the root infection than it was with the full year. Sudden Death Syndrome. Yes, yeah. Toxins going up into the leaves. Right?

20:21

Absolutely. And I guess we should talk about that element too. So, yeah, so yeah, I mean, the problem with like, trying to figure like, look at roots is like, you and I can pull up a plant look, look at the roots. But we can't tell if it's SDS causing root rot or something else. Right. Right. So it's also a lot of work to dig up a plant, right? Especially if you got to dig up 1000s for breeding, you know, at the company level or the public breeders. So we don't tend to dig up a whole bunch of roots and breed for root. Right? architecture or symptom ology, right? When we do the breeding, we're going to walk the fields quickly and do a quick score of okay, I see, you know, moderate levels of SDS in this field. This variety, you know, is moderately resistant on and this variety sucks over here, because it's completely defoliated, right. So we're not going to, we're not going to continue that line forward, we're going to drop that one. But we're going to use those varieties that have resistance to the failure, disease component. We did build on that a bit here at at Michigan State. So we worked with our breeder here, D. Chen, Wang and his breeding program. And we did use this DNA test on a whole bunch of routes 1000s 100, at least hundreds of routes. And we were actually able to detect disease, basically differences in the amount of SDS, fungal DNA in roots of different plants. You know, different plant parentage, I guess, or different plant varieties, if you will. So it's it's there, there's, there's a signal that we can detect that Aha, you know, we could potentially start trying to breed based on how much STS fungus is infecting the roots. Gotcha. But it's so expensive and hard to do. It just, it takes a lot to dig a whole bunch of plants up, wash them all, do DNA extraction, do the real time PCR, you know, right there, you're talking about 1020 bucks worth of materials just to do one plant. Right, right, out everything in there. So it's expensive and time consuming. So we just don't tend to do it, unfortunately. And maybe we will in the future is, you know, technologies to continue to evolve. And we think about other ways to try and, you know, do this sampling quicker. Sure, yeah. But you know, that the screening of varieties based on foliar symptoms alone has certainly been incredibly helpful and allowed us to develop varieties, soybean varieties with pretty good resistance to SDS. So we've, we've solved a lot of the problems with the tools we have, but I think there are other potential gains in the system.

E Ed Zaworski 23:04

Excellent. Yeah. It's funny, I never really thought about it from the standpoint of just sheer amount of work. And yeah, that's a good point. Because I like I said, I hadn't thought about it.

And yeah, to do to go through and visually score fullier symptoms is, it's not that it's no work. But it's reasonable work compared to, like you say, to get enough data points to, you know, get all those roots, get the whole root system, which is another thing, you know, me working in the diet diagnostic clinic, times people send us routes, I'm putting air quotes here. That just meant that they walked over to a plant and yanked as hard as they could and got what they got brought into us. And so but and that's not that much work, but you're also not getting that much information from it, right? Anything that's rotted is probably left in the ground. And that's another

23:56

point. And that's something that we didn't have time to look at we, when when we did this, it was somewhat crude, right? I'll admit, there's still flaws, there's nothing, no system is completely perfect. But yeah, we would take an entire root system of a plant, and then dry and grind that entire thing. We didn't start partitioning the roots right into lateral roots and tap roots, because that would be really interesting too. And then you're right, there's still information missing because you're not going to detect it if the roots already rotted away. True. Yeah. So there's other you know, there's other things that you need to be mindful of if you're really trying to dig into this if it gets complex.

E Ed Zaworski 24:37

Indeed it does.

B Brandon Kleinke 24:45

Check out crop protection network dot o RG for the latest extension resources on field crop pest management, identify pest issues trained using scouting tools and discover strategies for keeping crops healthy.

E Ed Zaworski 25:01

So okay, so then is the next step to where we are now with this this paper we're talking about? Yeah,

25:09

yeah. Yeah, for sure. I think so. So yeah, that's pretty much yeah. So yeah. And the line of like, the things we've been doing. Yeah. That yeah, the next step that we thought was, you know, wouldn't it be cool to try and predict how much STS risk we have in a specific field. And basically, what we did is conducted an experiment that was like a proof of concept study. To demonstrate that, yeah, we can actually detect SDS in a field. So the way we did that was to basically grid out a portion of a field, and then take grid, soil and plant samples from that grid, and then track over time, how much disease developed in those plants over time, and then harvest those those areas to see how it correlated to yield. Gotcha. Okay, so at the start of the

season, right at planting, we took those soil samples. Yep. And we quantified with this DNA tool, this qPCR tool, how much fuse area and vertical are for me, that SGS fungus was in that soil sample. And we also looked at using standard lab techniques that you guys use as well. The soybean cyst nematode egg counts. Yep. Yeah. And then we basically looked at the correlation across a couple of years in a field area, like can we predict where the fall we are STS is going to develop based on the amount of STS fungus and, you know, does soybean cyst nematode play into this at all? And it turned out we could so we did two years of this study. And we could if we took that soil sample, at the start of the season, we could detect where the hotspots in the field were gonna be, which was really cool. I was really geeked I'm like, oh, yeah, this is awesome that we can actually detect, we could take a soil sample and tell you how hot it is basically, for SDS, how likely it is to develop symptoms. And interestingly, the amount of soybean cyst nematode eggs or nematode pressure actually contributed to that amount of SDS develops as well.

E Ed Zaworski 27:23

I think that's a this is a good segue to maybe talk about SDN, a little bit. soybean cyst nematode. So generally speaking, and what I've, what I read in your publication a number of times was, it's described as having a synergistic relationship with SDS, right? And I had to, I had to look it up, because you know, these words, these definitions, like anything else, if you don't use them a lot, you you lose them. So I'll read you. What I found, I think it was the Webster dictionary for synergistic relationship was relating to the interaction or cooperation of two or more organism organizations, sorry, substances, or other agents to produce a combined effect greater than the sum of their separate effects. That's a mouthful, but basically, I'll do my interpretation of it is that yeah, when you have both SDS and Sen present, you can have worst yield loss than either one of them separately. And it's, there's a lot, there's a lot there, and we can get into it as much as you want Marty, but generally speaking, how might Sen. affect the development of SDI? So now, that like I said, shoulder stuff here, so go into however much however much detail you want, but

28:47

sure, you know, I mean, honestly, we don't really know the full extent of the role of soybean cyst nematode with SDS. And so one of the PhD students in the lab tried to look at that and he actually use C. elegans which is a bacteria eating nematode just as a model because it's easy to grow and whatnot and yeah, it's, it's because you can't really culture soybean cyst nematode, you've got to grow it on the plant, right? You can't just grow it in the lab. This other nematode, we could grow it in the lab. And so that's why he played around with that. He saw that the STS fungus was capable of colonizing the nematode and basically using it as a food source. Oh, yeah. Which is kind of cool. Again, it's not Sen right. It's another nematode bacterial eating so we've got to be very, very careful about how we extrapolate from that. But there's there's been other work done and we still don't know whether the STS fungus is using the soybean cyst nematode wounds as maybe entry points or if it's actually transmitted on soybean cyst nematode, which is another question we were trying to answer. We have you know, people have reported isolating fusarium regular for me from soybean cyst nematode cysts, right? So yeah, I mean, maybe maybe it's hard to say and they may have just also I think what is perhaps more likely is that soybean cyst nematode, when it's infecting or feeding on

the soybean plant, it's probably just having other effects on the plant and making it just making it more susceptible to fungal infection and RAM ramification through that root system when it's actually already infected. I think that's what's probably happening. No, that's

E Ed Zaworski 30:31

a good point. I tell that to clients in the clinic all the time with regards to whatever diseases I find on whatever plants they submit. It's not always as simple as, hey, there's a disease if you solve this problem, if you spray a fungicide or an insecticide or in a mat aside, you'll be fine. Because, yeah, stressors, environmental stressors, or in this case, the nematode might be stressing the plant could be a contributing factor to make it more susceptible to something else. And I mean, I think you can even see that in people, you know, they if you get stressed if you're stressed at work, you're probably way more likely to get a cold or the flu, right?

31:10

Absolutely. Yeah.

E Ed Zaworski 31:13

So yeah, um, no, I think I think that's pretty good. And because we don't, you know, we don't want to get too into the weeds with soybean. Oh,

31:20

that's totally fine. Do you want to talk about the next steps for that that study then? Yeah, what was trying to do? Okay, so, so the intent now is really to test this across a whole bunch of locations. So. So basically, we've got this proof of principle study that we published, right. And we went through peer review, which is a good process to go through to make sure, you know, keep us in check sort of thing. Yeah, we proved it that sense, split. But what we're trying to do now is, can we actually take your soil samples from different growers and make predictions? And so that's, that's basically what we're in the process of doing right now. So we've got a another student that's working on that. And we're essentially collecting a whole bunch of soil samples. We're running through the DNA extraction process, and then we're going to quantify how much SDS fungus is in those soil samples. And then you see treatment data to get a sense of, you know, and whatever disease data we have, as well, to get a sense of how well we can actually predict that risk. And again, like he just said, it's, it's not just spray something, can you've got your answer? Salt, problem solved. Right. Right. There's other other complicating factors. And during the season, if we have very heavy rainfalls, right after planting, and again, around August, that tends to drive SDS, right? So it's also that environment, if you don't get conducive environment, you may not get, you know, very, very heavy disease setup. If you do have a very conducive environment, then yeah, you may see, you know, severe SDS develop. It's, it's, it's a combination of factors. But, but basically, I guess the other thing we're building on to is very, very much analogous to the soybean cyst nematode tests, right, so, so growers bring in soil samples to, you know, your diagnostic lab or to the Michigan state lab. And then we, you know, we go through the process of quantifying how many soybean cyst nematode

eggs there are. The advantage with nematodes is that they're big enough that we can basically save them and use heavy water, like with sugar water, right to float them off, and then capture them. So that we can look underneath a microscope and someone can do account like, you know, we do account Oh, you have so many eggs per 100 CCS oil, or whatever the metric is. We're essentially wanting to do the same thing with this test. Right? But because the fungus produces spores that are so small, we can't use microscopy. And they're indistinct. They look like other fungal pathogens or other fungi, other good fungi, too. So we're using this DNA tool to go aha, you know, we detect it and we detect this much we believe your risk level is this, this particular level, you should take this particular course of action. Or, you know, SDS should be hired new management list or we don't detect it, we think you're you don't need to worry too much about it. That's the intention.

E Ed Zaworski 34:22

That yeah, that's, that's awesome. And that's, that was one of my questions that I was going to ask you is, I mean, somewhere down the line, is that the intended result and just I want to elaborate a little bit more, I mean, you talked about that's, that's what we can do currently for nematodes. So I just want to paint like a visual, right. So essentially, what growers have available to them now in most soybean oil like corn and soybean growing states, right, our folks can go on their field, they can take a probe that you put into the soil at different intervals in a kind of a zigzag pattern across their field and you can get an overall All idea of populations of certain nematodes. So essentially, we'd be looking at doing the same thing with freezer in Virginia for me or SDS, would it? Do you envision it as being? So this this, this is me geeking out a little bit, but maybe again, people will find it interesting. Do you envision it, you'd mentioned that you could almost think you that you could see, when you did the spatial analysis, you can see hotspots of SDS. And I know, at least right now, since there's limited products on the market that really are good on SDS, do you envision people using that like spatial data to or do you envision I'm saying more like, your, this field has a population of of users and for uniformity, so you should be aware, and you should be ready to manage? Because SDS is, is a tricky one for me always, because there's a lot of diseases that you see them show up, and you can take action at that point. But SDS, you can have levels there. And some years, it might not even be the right conditions to get it. So you're always taking kind of a gamble. But the idea of this seems to take a little bit of the gamble out if the if you know, hey, what what are my baselines but yeah, do you? Sorry, that was a question. Do you do you do you envision it being more spatial where it's you're looking for hotspots or more of a field level thing?

36:22

I think it'll be more of a field level thing? Because I think at the moment, too, well, let me rephrase that. I guess. So what I mean, what are we currently doing for soil fertility and nematodes? It tends to be a little bit more. I mean, I guess fertility is can certainly be graded out and whatnot, more fine scale, and that tends to be the case. I say with nematodes. It's more of a field by field situation right? In there will be a cost to testing and whatnot. So I think your field by field at the moment. Oh, yeah.

E Ed Zaworski 36:55

Yeah. Think about that. If you did 500. Right, or test our locations in a field I'd get Yeah.

37:05

Probably for reagents. And every Well, I mean, different, again, depending on how you do it, and how you scale it. Right? So sure, it comes back to techniques. And I know, there's companies out there now that are using other techniques. And something else that you know, we are using is amplicon sequencing, or, or maybe true meta genomics, we're doing shotgun sequencing. So we're using those in some more ecology type studies where we're trying to track the influence of Tiller versus no till on systems or, you know, the effect of fungicide applications. We've got a couple of papers out recently on that sort of work. So, uh, yeah, I can tell we're getting, there's more and more ability in terms of sequencing ability, right, that the cost of sequencing has gone down dramatically. It's like, you know, computing power, right, like it increases, right. Exponential exponentially, we're seeing the same thing with sequencing ability. And so I think in the future, we probably won't use this specific qPCR assay, we will probably be just sequencing everything that's in the soil. And there's companies already promoting that, which is really interesting. I don't know really where their cost point is, at this point in time and how useful that data is yet. There's definitely a lot of startup interest in whatnot. And that's great, and it's exciting, but I definitely caution people to okay, like, Okay, how are you really going to use this information? And how much is it worth paying? But yeah, I can I can see that definitely is going to happen. Absolutely. With time as sequencing costs continue to decrease that we'll be able to pick out not just, you know, fuse, Areum burglar for me, but the Phytophthora pressure, the soybean cyst nematode, the other soybeans, I'm blanking on other names now, but you know, oh, that nematodes that are really important now Oh, man, lesion lesion nematode, we see quite a bit of that sometimes. Right? And there's a whole bunch of corn too. Oh, yeah. Dagger,

E Ed Zaworski 39:09

steer. You're speaking my language right now. I've spent so much time already looking into microscope identifying nematodes for these types of samples that suddenly do it with qPCR. Yeah, I mean, I don't know if they'll get my job security.

39:27

Well, we're still gonna need people in the system right to help interpret that thought or and this people, the people elements never going away. Right. It may change a little bit. Yeah, but

E Ed Zaworski 39:39

no, that's so. Okay. Hang on. Let's go back here. We just we just did like a huge So, to summarize, you know, you develop some qPCR to identify SDS and then you started to quantify it in the roots a little bit and then most this this But publication that we're talking about, you're using it to identify it at a field level to see if it's there. What kind of populations you have, you know, kind of maybe give you a make it a little bit less of a gamble is the hope. Right? Yeah. And agency apply product when needed? What's uh, do you have any? What's the what's in the

future for your lab? Like, what are you? What are you going to? What are you going for next? Yeah, I mean, you mentioned you're reaching out to other locations, you're trying to kind of make your make make the model more robust, essentially? Yeah,

40:30

absolutely. So that's, that's what I hopefully will pull together over the next year or so, as the current student sort of works through samples, and yeah, I mean, we've, you know, we collaborate so well across all these different land grant universities, it's fantastic. So we've got a whole bunch of soil samples from across the the soybean growing area. And we're basically going to be processing those and just trying to determine like, you know, how well does this tool work on a whole bunch of different soil types and different SDS pressure? You know, does does the tool really work or not? It's kind of the validation phase, right? So we've done the proof of principle, yes, we can do it on a single field. But can we do it across many different soil types and fields. So that's what we're hoping to accomplish and get a study like that wrapped up to demonstrate that we can actually use it in a meaningful way.

E Ed Zaworski 41:25

Gotcha. One of the most frustrating courses I took in plant pathology in grad school was a course I think it was called ecological based pest management. And we worked with a modeling system. I can't remember the name of it. But yeah, if there's my one takeaway from using this program and trying to model stuff was it, it's really hard to dial in a model. Right. And, and that's, that's what's cool about what you know, kind of your next steps is like, you get a model. It's, it's, it's good, right? But there's always room for improvement on these models, where you're talking about some of the predictive disease forecasting models that are out there for, you know, this forecaster, and the third is monitor apps that are development for predicting disease. Yeah. So it's exciting to hear, you know, the further steps to kind of refine the model and see Yeah, like you said, if it's applicable to, you know, maybe the Midwest, maybe the nation, maybe the world. Yeah, yeah, that's right. That's the whole life, I guess. Cool. Yeah. Well, I I'd say, Do you have anything else to add on on?

42:37

I can complicate this story for you? Sure. So you mentioned at the start to that there's other species that can potentially cause SDS. Yeah. Right. And so we have found one of these other species in the US in Michigan. And I'm sure we can probably find it in other states, too, if we go looking. So we're actually out doing this population genetics survey for a fuse Aryan vertical or for me to figure out like, yeah, where did it really come from? Where's the center of origin? It's helpful, right? Because if you understand that, then you know, which isolates to potentially use when you're screening breeding material for resistance to disease, it's an important sort of fundamental

E Ed Zaworski 43:21

because there's different there's different isolates for this pathogen, right? You've got Geron for Gila for me, the species but not every, and an isolate is just a, just for lack of better words

genetic variation within the species. Yeah, it can be that can cause worse or

43:38

Yep, it can be highly aggressive, or it might not produce much disease, or it might produce a slightly different symptom, perhaps, right? There's diversity. So that's something else we looked at. But when we're out collecting, we actually, the student was really disappointed. We collected we pulled a bunch, you know, from each field, we were pulling like 49 soybean plants, and then going ahead and doing isolations, which might not sound like a lot, but it's, by the time you do the isolate, you know, it's hard, right? isolations that takes many weeks. Anyway, he was really disappointed. He didn't get regular for me from this field that had SDS. Yeah. And I'm like, actually, this is even more interesting, right? What the hell is going on with this field? And we found this other species, it's called fuse Areum braziliense. So named after Brazil, right, right down first in Brazil Brazilians. And so yes, it does cause SDS, but what we think is actually going on that particular field was rotated with soy, sorry, was rotated with dry beans. Okay. It was a soybean potato driving type rotation. When we went and actually looked at a lot more dry bean fields, because we grow a lot of drive into here in Michigan. We actually found a lot of this particular pathogen, fuse area and resilience. So our hypothesis at this point in time is that yes, please Eric braziliense Can cause SDS on soybean plants, but we think maybe it prefers drivings. Okay, and causes root rot on the dry beans. And actually featuring regular for me the SDS, soybean pathogen can cause root rot on dry beans. So they can infect both crops. But anyway, just to sort of complicate the story further, there may be other species potentially, that cause SDS and so we may have to rethink the diagnostic assay at some point, you know, it's, I wish it was clean cut and simple, but generally never is right.

E Ed Zaworski 45:34

Yeah. Yeah, it's in the we've talked about soybean cyst nematode, a little bit here, right? And there's a similar thing in that world. There's a there's a corn cyst nematode, and we dread the day that anybody found the presence of a corn nematode because then you would no longer be able to just look because like, like Marty said, you can with nematodes, they're large enough to where you can use fine mesh screens, and you can filter them out and look at them under a microscope. But if you got to that point, where there were two very similar cyst nematodes,

46:09

so we have that problem here in Michigan, you do so we have sugar beet cyst nematode.

E Ed Zaworski 46:13

Ah. Sorry, you guys. Yeah, so much of a more of a diverse cropping system out there. Because yeah, I'm not familiar with dry beans at all, and definitely not familiar with sugar beets. I know they have.

46:25

Yeah, that's right. And I mean, soybean cyst nematode can also reproduce on dry beans, you know, but we also have sugar beet cyst nematode, that, obviously, as the name suggests, is an issue and sugar beets, but we have sugar beet and soybean and drove in rotation, right. So it definitely creates an issue. And, and again, that's where we get back to some of the molecular techniques to try and distinguish these in the lab. Like what, okay, we can find this counts of eggs. But what is it for CES?

E Ed Zaworski 46:54

So there's no shortage of work for you.

46:57

I think that's probably the moral of the story of the podcast, right? Like, unfortunately, there's job security, and there's always new diseases to popping up. So yeah, yeah.

E Ed Zaworski 47:09

So okay. I mean, I feel like I've cherry picked you right into a good answer here. But I always like to ask people at the end. What is like a good takeaway for the general public? Why should they care about this? This? You know, they've listened to it, we've broken it down to a basic level here, but why should they care about it? What should they know about it? And? Well, here's what you have to say.

47:32

So I think for the general public, if you like to eat, you know, plants get sick, too. Right. So it's really, really important, right? We're also dealing with some new diseases in corn at the moment, too, that are really creating some headaches. And so you know, that's going to affect your food prices as well, you know, diseases, there's a cost of management, but there's also yield loss from those pathogens. Yeah, so you're studying plant diseases is an important piece of our food security. And unfortunately, you know, whether global trade and movement of products and produce and whatnot, we do tend to accidentally introduce things too. And, you know, if, if we do continue to see changes in weather patterns, yeah, heavy rainfall events, for example, that's going to promote certain diseases. Right. So yeah, it's a continuing issue for food security. And that's, I guess, that's why I really liked my job, too. You know, I enjoy having that practical sort of impact. Yeah, because I like to eat as well.

E Ed Zaworski 48:42

Yeah. And, I mean, like, just listening to that last part. It's, it's super interesting, you'd be listening to like, the, you know, like you said, the, to make things more complicated. It's where my brain went there when I was thinking about this, you know, what should the general public know is like, this is like an arms race. You know, like, there's, there's constantly not only are

pests evolving to the management techniques that we're using, but there's, you know, there's new, especially with climate change, there's new pests that are emerging as important because, you know, not only because of the climate changing but because the crops the way that we manage them our practices, you know, so there's always things come together, we're never going to solve all those problems, which is a little bit of gloom and doom but the great news is we have people like you Marty that are out there out there thinking about it out there trying to figure these things out and you know, I don't I don't I don't think that's always like a forward facing thing and that's that's that's what I aim to do with this podcast is to get people like you out here to be heard and not that you're not heard already but it just in a different whatever gonna say form of media here. But yeah, no, that's, that's great. And hopefully the general public is listening.

50:06

Yeah.

E Ed Zaworski 50:09

We're gonna try harder. And, and I'll have you do so do your acknowledgments here. But I have some reminders hit set here for myself. While I'm speaking on that note, I want to remind people, if you're a listener of this podcast, and you want to give us a helping hand, remember, if you know you can rate the podcast, you can comment, you can subscribe, tell your friends. And also remember, you can email us with any questions, comments, concerns at crop protection. network@gmail.com. But with that, Marty, this has been awesome. I haven't seen you in a while. It's been great seeing you and talking to you. But with that, any shoutouts you want to give acknowledgments resources for people how they get ahold? Yeah,

50:52

I mean, yeah, there's, I mean, the Crop Protection Network, right, we have good articles up there, if you want to dig into some of this for disease management, or just sort of understanding what we're talking about a bit more. There's a bunch of people, I'm not even going to try naming them because obviously, people but there's technicians, graduate students, postdocs that have worked on this, there's been a bunch of people, you know who you are. Yeah, we couldn't have done it without them. So thank thank you very much to them. And also, I do want to shout out for funding sources, right. So commodity groups do help with some of this funding. So Michigan soybean committee, north central soybean Research Program, as well. And USDA, various various other entities that have assisted with funding for some of that work. We just couldn't do it without without funding support. So

E Ed Zaworski 51:36

thank you. Gotcha. If people want to learn more about you and your lab, Marty, where can they find you? And we'll post links as well. But yeah, just

51:45

google me, I guess. Crazy enough to find, right, unfortunately. Pretty easy to find. That's already

E Ed Zaworski 51:54

hit up Google Scholar and you can look at all of Marty's publications and read about them and then email me and tell me you want to hear more of him. So sure. All right. Awesome. Thank you so much, Marty. And folks, keep listening. We'll see you next time.

B Brandon Kleinke 52:19

I see dead plants bridges. The gap between plant science research and the impact it has on our daily lives is brought to you by the Crop Protection Network. An extension is sponsored in part by the USDA National Institute of Food and Agriculture. For more information on the topics covered today check out crop protection network dot o RG remember this information is for entertainment purposes only statements made in this podcast should be interpreted within the limited context of particular topics being discussed. Contact your state extension program for local information on testing for the full non discrimination statement or accommodation and police go to crop protection network dot o RG backslash about Thank you for listening to it did