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SPEAKERS

Guest, Stump The Chump, Serra Sowers, Amy, Jamie

Jamie 00:10
Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast.

Amy 00:43
Hi, everyone, welcome to this segment of Two Bees in a Podcast. Today, have Dr. Meghan Milbrath who has actually been on our show a couple of times before, so we are happy to have her back. She is the Assistant Professor in the Department of Entomology at Michigan State University. And she just published a paper called "Validation of diagnostic methods for European foulbrood on commercial honey bee colonies in the United States." So thank you so much, Dr. Milbrath for joining us today.

Guest 01:20
Thank you for having me.

Amy 01:21
I know you just got back from Sweden just a week ago or so. Right? So could you just tell us a little bit about what you were doing in Sweden and maybe some of the highlights that you had during your time there?

Guest 01:31
Yes. So I was working at Swedish Agricultural University or SAU on a variety of projects, and I was there for about a year. So I came last winter in December, and then stayed through one full beekeeping

season and worked on projects relating to viruses and VSH behavior. Then at the end, they actually had a European foulbrood outbreak so I got to work on a little bit with EFB as well.

Amy 02:06
That's so crazy. How many colonies had ESB in order to be called an outbreak?

Guest 02:16
Well, the definition of an outbreak is a higher number than you normally find. And in Sweden, they had basically not seen EFB for a very long time. So the fact that they saw any was really, really interesting, which is very different from North America. And I just would like to point out that I did not bring any equipment over and it was not me. So the fact that they found it at all was really interesting. And I think it is really interesting for European foulbrood in general in that it does seem to kind of go away from regions and then come back to different areas as well. So they found it as part of this study they called the baseline study where they were going out and testing hundreds of different colonies. So they worked with the inspectors who brought in samples, and they tested them in the reference lab, and I don't think they've published it yet. It wasn't an enormous amount, but the fact that they were finding it at all is really interesting there.

Amy 03:22
Yeah, so we brought you on because you had just published a paper on the different diagnostic methods for looking at European foulbrood. And so before we actually jump into your research, can you just kind of discuss again, what European foulbrood is and why it's such an issue and why we should be worried about it?

Guest 03:43
Yes. European foulbrood is a bacterial disease. It's one of the more serious bacterial diseases for honey bees. So we hear a lot about American foulbrood, and they're not related at all, biologically, but they both cause brood disease that makes it smell foul, which is why they get that name. And the only reason that it's called European versus American is really, one was studied more in Europe, originally, and one was studied more in the US, but they're both found all over the world, effectively. As I mentioned before, there are some pockets that don't seem to have it or that don't have it for decades, and then it pops up, which we see more in Europe, but it's a bacterial disease. It affects the larva and it affects them when they're in their third to fifth instar. So those are the larva, not the itty bitty ones right when they're eggs, but as they grow up over a couple of days you start to see signs. Basically, they eat the bacteria, it gets in their guts, it replicates, and then the larva dies in a variety of ways between when they're middle-aged larva and when they're capped or pre-pupa stage.

Jamie 05:03
So, I've been keeping bees for a while and I've seen EFB for years and years and years and the longer I'm in bee research and working with bee pests and diseases, the less I trust my eyes when I'm working in a colony, and I see something I think is EFB. But to me, it could be a lot of different things. So really, diagnostic techniques are critical for beekeepers to be able to combat EFB. So can you discuss a little bit about what the common methods are and what you examined specifically in the study since you

were comparing them? So maybe also talk a little bit about what methods are known to be more effective versus less effective for validating this particular bacterium.

Guest 05:40
Yes, and your point about EFB being hard to visually diagnose is really important, and that is one of the main motivations. So I mentioned that larvae that die of EFB can do so at many different ages. And because of that, one that dies younger is going to look very different from one that dies older. And so American foulbrood, AFB, is really, really consistent in how it prevents presents visually. So you see the sunken caps, you see the ropey brood. EFB, on the other hand, is all over the place. And we actually have these photos and this chart that we use to visually diagnose because we record what types of larva that we see for visual symptoms, and we've got a whole list of them. So they can be twisted, they can be yellowing, they can be brown, they look like they're melty, and you can see a scale, you can have them affected in the caps. So one of the ways that you can diagnose it visually is, or at least that you would suspect it is that you see many different types of things and many that can even be on the same frame. So you can have a larva that has visual signs like you can visibly see the trachea through them, you can have one right next to it that's yellowing and kind of corkscrew, and you can have one right next to it that died after it was capped. And so that's one of the characteristics of diagnosing EFB. The other thing is that it does have a really strong seasonality. So it can look similar to how bees that are suffering from parasitic mite syndrome present. But, for me being in Michigan, you see parasitic mite syndrome when mite levels are really high, which for us is normally in the fall, whereas European foulbrood has a really strong seasonality of really coming in June, and then you'll see fewer and fewer cases as the summer goes on. So the seasonality is a big part of it. Once you suspect it, it is important to do further testing to know what it is and what you can do. So the three techniques that we investigated were PCR, microscopy, and then the antigen, the little field test for it. We looked at all of those together, kind of on the same samples to see how they compared.

Amy 08:13
I have so many questions for you. Well, the first question I actually have is probably an "Amy really silly question." But I mean, you're talking about the seasonality of the foulbrood and so I'm just wondering if the bacterium goes dormant during certain times of the year, or like, what is the reason for it being more prevalent during certain times of the year?

Guest 08:34
This is such a good question. And this is where I'm really interested. So I think European foulbrood is one of the most interesting diseases, and I'm trying to get everybody to study it because it's also so profoundly understudied. So it has, I'm going to just get on the soapbox a little bit for EFB and then I'll go back to why the seasonality, but it does have such huge economic impacts, because of the timing. So for Michigan, it's hitting right when beekeepers are on their pollination contracts. And usually after that, they go out to make honey production. Well, if you have a whole group of diseased workers right before you go to honey production, you just lose your whole workforce. And so there aren't any economic estimates in the US that I know of, if anybody does know, please let me know, but Alberta just did a really big study and found that it's, I think they said about $500 US equivalent per hive. But I think with the loss of pollination contracts, it could be much higher in the US, but there's a lot about it.

So the reason that I talked about that is it's so profoundly important. It causes such high damage to colonies. And then there's just all of these really, really basic questions that we don't know because we do see it in the same operations over time. But those operations, they'll have breaks in the brood cycle and you'll have it in the same area. But it's not like the flowers, in Michigan, I can tell you that the flowers don't stay here all year, it's covered in snow outside. So something is happening to allow the bacteria to persist. And whether or not it's just in the bees and it gets passed from nurse bee to nurse bee or whether or not it's just in the food or whether or not it forms a biofilm on the frames. These are questions that I'm actually working on grants to try to look into. What I think plays a big part of it is, and I'm just going to keep talking about EFB until you cut me off, I tell you, I'm so excited about this disease right now. What I do think plays a big part of it is shifts in nursing care and in brood care. So when we see it a lot is timed with blueberry pollination in Michigan, which for us usually starts about the second week of May, and then goes into early June. And there is a paper from 1983 or a thesis that someone did that was linking it to blueberry pollination and kind of talked about, oh, blueberry pollen has such low protein, and it's really high acidic so it's probably related to the diet during blueberry pollination. So we investigated that and just presented on that last week at the American Bee Research Conference. And basically, we went out in 2018-2019 and put pollen traps on all of these hives that were in blueberry pollination. And they brought back in just boatloads of very diverse pollen. And we're in the process of actually looking into the protein-lipid ratios because we know that high quantity doesn't necessarily translate to high quality. But the bees in Michigan at least have access to large quantities of diverse food sources. We also investigated by putting in pollen patties at the same time to see if that would affect the rates, and there's no significant protective effect of putting in pollen patties. So it doesn't seem to be related to a protein, or lack of nutrition issue at that time, at least in Michigan. We also put colonies on blueberry fields and not on blueberry fields and didn't see a difference between the two.

Amy 12:36
Yeah, it's almost like you're basically just trying to eliminate all of the above, just to try to hone in to figure out what actually is affecting it.

Guest 12:46
Yeah, and there is a paper that just came out last week, and I just read it yesterday, and I can't remember the authors' names, I can look it up, and you can put it in the show notes. They looked at seasonality related to Apis cerana and European foulbrood and found that there were some relations to weather, which, again, could be related to blooms. But also what I think is more likely happening is that it's related to shifts in nursing care. So one of the things that we saw when we were out looking, so one of the benefits of this research is I've been able to see literally thousands of sick colonies. And we would see some that were just starting to get sick. And sometimes, we noticed that it would only be in the drone brood. And so either the drone brood is more susceptible, which could be, or we all know that when you have a shift in responsibilities in the hive, drones are going to get neglected for feeding first. When you think about stress, one of the things we know about Melissococcus plutonius is that it's found a lot in hives, even when you don't see disease, which is why we think that there might be these stress triggers. And when you think about stress, we think like, "Oh, well, there's so much food that the colony is not going to be stressed." But we're actually concerned about whether or not the larva is stressed.

And if a larva is getting food withheld, because, let's say what we see in Michigan is this huge nectar flow turns on and you may have bees that go out who used to be involved in a ton of nursing care and now shift more towards foraging duties and that can even be exacerbated by, as we heard at the ABRC, a lot of precocious foraging relating to fungicides or other co-infections. You have precocious foraging, you have workers fall off of nursing care and then you start to have stress larva and then you can have the disease pop up again.

Amy 14:55
Yeah, so, with all these factors taken into consideration, let's move forward to discuss your data collection. So, when did you collect data? I know that you worked a lot with the commercial beekeepers. And so what were you guys doing? What were your methods?

Guest 15:18
Yep, so we had gotten funding through a program called MSU Green, which supports agricultural industry-related research in Michigan. And we had been looking at this larger project, looking at blueberry pollination, and so we were doing the protein studies, but we're also doing other things with growers as well in collecting pesticides. What we wanted to do was just confirm our visual diagnoses. So that was the original thing. We just wanted to know whether or not we could confirm them. And we had been working with Jay Evans and Sam at the USDA lab and sending them samples. And one time, Jay and I were just talking and we were trying to evaluate whether or not the antigen lateral flow tests were actually useful and whether or not we had to do PCR. And so we were trying to just actually practically figure out what we could use to confirm our visual diagnosis. We realized that they really hadn't been validated, the lateral flow devices hadn't been validated in the US. And also, I'm really interested in the usage of microscopy, because having more veterinarians involved and needing veterinarians in order to access antibiotics for treatments, a lot of them don't necessarily have access to PCR machines, or the time or the resources to do that but they're very well trained on microscopic diagnoses. So it was important for us to try to figure out, for practical reasons, which tools are actually useful. So, for that research, we were looking at, I think, 14 different locations, and we had nine hives in each location. And then we took all of the samples that had visual signs of disease that we were suspecting to be European foulbrood and sent them to the USDA lab, and that's where they did the comparison between microscopy, the lateral flow device, antigen testing, and then the PCR.

Jamie 17:32
So, Meghan, I've got a couple of questions. Ultimately, I'm going to ask what your results were, but, for our listeners' sake, could you describe what the lateral flow device is? After you do that, I've personally never done microscopy for European foulbrood, so could you describe that process a little bit as well, and what you're looking for to distinguish, specifically, this particular bacterium from others that you might suspect are there?

Guest 17:58
Yes. So the lateral flow device, we used to always say looks like a literal pregnancy test, basically.

Jamie 18:07

That's usually what I call it, yeah.

Guest 18:08
Yeah. I mean, now I think the better one looks like an at-home COVID test too.

Jamie 18:13
I was thinking the same thing.

Guest 18:14
Yeah. They are incredibly easy to use, and they are incredibly affordable as well. I think they're somewhere around the $15 range. My only complaint, and I hope Veda is listening, is I really wish they had different colored labels for their AFB and their EFB one because they look incredibly the same, but they have them both for EFB and for AFB, and you can buy them from the Bee Supply Company. Especially, veterinarians, it would be great if they had them on hand. And nobody's paying me to say this, but also, it's a nice thing for a beekeeper to have on hand, because they work within minutes. And so what you do is you take larva, and one of the important things that's noted in our study, and then also there is an accompanying article that Alison McAfee wrote about it that describes the these in further detail, but basically, you take a swab of a sample and we used larvae that were just barely sick. And I think that is an important point for beekeepers. So I think there's a natural tendency to go for the grossest, most sickest thing because you'd think that that would be the one that would likely have the most bacteria but with European foulbrood what we see is that the Melissococcus plutonius comes in and then it affects the larva, it makes it all diseased, it starts to die, and then you have, in a lot of cases, all these secondary bacteria. And so sometimes, if you take one that's too diseased, you'll get the secondary bacteria and not necessarily the one that you're looking for. That test is designed to look for the bacteria in particular, and the way it works is it has antibodies in there that link to the bacteria, they'll stick to it, and then they're pulled through a wick through the test kit, and then you'll be able to see it. You'll basically see a fine line really within minutes in there. So for the microscopic testing, that's something that is usually called the hanging drop method. And we didn't do that, Sam did that at the USDA. But basically, what you do is you mix a small amount of the larval sample with water on a coverslip, it's dried, it's stained with a specific dye, and then inverted on a slide with a layer of oil, and then you view it under a microscope. And if you know what you're looking for, like Sam does, or like a lot of veterinarians can do with training, then you can do a diagnostics visually with that. Like I said, it does work well. Our results showed that there was a really high relationship between the microscopic results, what could be determined visually, the PCR results, which is what's determined molecularly, and the lateral flow device, which is what's determined with the antigen. There were a few cases where the antigen test gave us a false negative, meaning that we had a report of the bacteria with the molecular device or with the microscopic devices, those had a very close concordance, but it didn't show up on the antigen test. So what a beekeeper can take away from that is that if you have a positive, you can trust it's positive pretty well. But if you have a negative, you may not. It could still be a positive, it may or may have been missed. Like I said, it was really good. We were about 90%. So 90% of the time it was catching it. But one of the things that a beekeeper can do, too, is always send a sample to the Beltsville laboratory. So there are really good instructions on the web. If you Google

"USDA Honey Bee Lab Beltsville shipping instructions," it tells you exactly how to send them in, and then you can get your own confirmation of it as well. And they can do the microscopic tests there.

Amy 22:37
So, you kind of mentioned this in what you had just said, so what do you recommend for beekeepers? I mean, what do you recommend for them to have, what do you recommend if they start seeing clinical signs of AFB or EFB?

Guest 22:53
So I think the first thing is, yes, to make sure that they are inspecting the brood nest often and to make sure that they're looking at the open larva and the capped larva both and to look for anything that is out of the ordinary. Like I said, EFB can present in multiple different ways. I do like having those test kits on hand, just because it's so much nicer when you're out in the field to just be able to know right away. When we studied it, we looked at whether or not it was good to be positive. We looked at the sensitivity, we didn't look to see if it was something else, if it would show up as EFB. But we said if you have a case of EFB, the lateral flow device does a pretty good job of testing it. There is one that we found that later didn't have EFB, that it was negative, but it had chalkbrood instead because the early chalkbrood does a lot like EFB. So I would say to make sure to have the tests on hand, make sure you know kind of what you're looking for. The other thing that you can do ahead of time is to set up a relationship with a veterinarian, even before you have the disease or even before you have a problem. So if you do want to use antibiotics, you have to work with a veterinarian, with which you have a valid client-patient relationship, a VCPR. So that's what they need in order for them to prescribe antibiotics based on their license. But you can call them ahead of time and say, "Hey, I want to set up a relationship with you. So if I ever do have a problem, it improves the amount of access." So it depends on your state, what is required for the VCPR, and whether or not they can use telemedicine or whether or not they can do it based off of a photo. But in a lot of places, if you had a really good relationship with a veterinarian, you could show them a photo of your positive test, you could show a photo of the visual signs, and that may be enough for you to actually get them to call in an order for antibiotics, and you can get them right away. So if you have that relationship set up that can really speed up your treatment options. So Meghan, you're actively working with European foulbrood. You've alluded to that throughout your interview today. So I'm just curious what's next for your research? What's on the horizon from your perspective for this important disease? Yes, I'm very excited about it. So one of the things that we're really interested in is the different strains. So we know that there are different strains that are circulating, and we don't have a good sense of which ones are going around the US. So we do have funding for a prevalence study, just looking at what's there and also, we're looking further into the ones that didn't test positive on the antigen test to see if they are different at all. One of the differences between the strains is a plasmid vector, or a virulence plasmid, and we're looking to see the prevalence of that as well. Because, as I mentioned, the larva die at very different stages. So we do see a wide range of virulence and we see a really wide range of hive outcomes. So you can have the presence of bacteria and a colony being perfectly healthy, and then you can have the bacteria and the colony crashes and dies. And so I'm really interested in that question about, first off, how much is actually out there? Then also, what types are actually out there, and what is really driving these different hive outcomes? The other thing that we're really looking at is antibiotic resistance. So we work a lot with this

group in Canada at Saskatchewan. There's a group of veterinarians up there that are doing some really amazing work on it, and they just reported a case of oxytetracycline resistance in Melissococcus plutonius, which means that, while it doesn't seem to be widespread, we don't really know. But there is the potential for antibiotic resistance, which is hugely important when we look at what our treatment options are. So yeah, I think the first question, like I said, it's so under-studied, we don't even know how much is out there and what it's doing. We don't know if someone has it in their operation, if you see disease in one hive, what does that mean for the rest of your operation? So there is research from Switzerland from 2010-2014, that shows that when you have a case that has lots of visual signs, you also find the bacteria in the midguts of the nurse bees in colonies with no signs of disease. But we don't really know. Does that mean you should treat at the yard level? Do you treat at the operation level? Do you have to burn all your frames? How do we actually manage the disease? So there are a lot of really interesting basic things to do, really, to just even understand the burden of the disease in the US.

Amy 28:12
Well, I'm really excited to see what you end up doing in the future and some of the publications and the research that you'll be doing. I know that you're going to be doing lots of good things. So we're excited to be working with you on that.

Guest 28:25
Thanks. I'm excited, too.

Amy 28:26
Alright. Is there anything you'd like to add to let our listeners know before we sign off?

Guest 28:33
I mean, I think it probably came across, but I am really excited to talk to people about European foulbrood. I do think the burden of disease on beekeepers and the economic costs and the damage to all of the animals is really underappreciated and I want people to take it much more seriously. And I'm happy to talk to beekeepers and to answer questions on it, or other researchers too, because I do feel like it is something that we could manage with effort.

Amy 29:03
Yeah, absolutely. So what we'll do if you don't mind, I'll go ahead and share your contact information. I'll put this publication up on our show notes so that people have access to be able to email you.

Guest 29:15
Wonderful, thank you.

Amy 29:16
Alright, everyone. That was Dr. Meghan Milbrath, the Assistant Professor for the Department of Entomology at Michigan State University. Thank you so much for listening to this episode of Two Bees in Podcast.

Serra Sowers 29:32
Enjoying our episodes? Support our programming and the UF Honey Bee Lab by adopting a honey bee, queen, or hive. Your monthly gift can help support research and programming and help more people learn about honey bees. Check out our website at UFHoneyBeeLab.com for more information.

Stump The Chump 30:00
It's everybody's favorite game show, Stump the Chump.

Amy 30:14
Alright, it is that question and answer time, Jamie. I think these questions that we have today are very new to me. I don't think I've even thought about these questions before. I mean, maybe the first one.

Jamie 30:25
Hopefully, they are not too new for me. This may be a Stump Chump segment.

Amy 30:33
Okay, so the first question. Okay, so this one I have thought about before, but when bees are swarming, do the bees determine the swarm size before or after finding a suitable location?

Jamie 30:46
This is a good question because it contains two parts. The first part I'm actually stumped on, and I'll make an appeal to our listeners to help me out with. The second part I do know because there are two implications here. Number one, how do bees determine the size of the swarm that they're going to issue from the colony? And number two, do they do this before or after finding a suitable location in which to move? So let me answer the second one. First, there's clear evidence to suggest that before a colony swarms, scout bees will actually begin the process of canvassing the countryside for potential new nest sites. It does not appear that they make the decision before they swarm. In other words, they haven't found a home that they've voted as the to be the place that they want to live. So they don't swarm out of their original hive and go into the second new nest site without first forming that bivouac, that cluster that they continue to use as a scouting opportunity. So I would say the answer to the second question is the bees are not determining how big the swarm is going to be based on the location that they are going to move to because they don't finalize the location they are going to move to until after they have swarmed. They make that decision from the cluster. So the decision to make a sized cluster has already been made. But the first question is the one I don't know the answer to, which is how do they decide what the size of the cluster is going to be? In other words, if you sit there and are watching a colony swarm, how do they know when to stop? You've got all these bees in the nest, and some are left behind and some go with the swarm. I know Tom Seeley has talked about this in his research and summarized that well in his book Honey Bee Democracy. We know how they initiate the swarming process, how they warm up one another, and how they get one another ready and excited to fly out of the hive, but how they know when to stop and what the adequate size of the swarm should be, I don't know. So if you're a listener out there, and you've read somewhere how bees determine the size of the swarm, shoot me and Amy the answer in one of our social media platforms, and we'll make sure in a future Stump the Chump segment, we'll make sure to answer that question about how bees decide

what size or swarm should be based on what it is you guys provide for us as feedback. I'd be happy to answer that. But I do know that it doesn't have to do with the decision of where the nest site is. They don't say, "Oh, we're going to move into a big nest site. We need to take a big swarm." That decision to move into a new nest site comes after the swarm has already happened.

Amy 33:40
I mean, I feel like there are so many factors to it, right? I mean, like the weather, sometimes we have swarms that leave and then go right back into the original home. And then, sometimes we have our queens clipped and so maybe the original location that they thought they were going to move in they couldn't get to. Sometimes, they'll end up like right under the hive. So it is really interesting to know where they end up landing, especially during their first stop in the middle of a swarm.

Jamie 34:07
This question really brings up the brilliance of bees. I mean, if you think about it just this way, let's say there are 10,000 bees in the nest and 5,000 of them leave with the swarm. What makes that 5,000 and first bee decide not to go versus to go? What makes the first 5,000 say, "Okay, we're the ones leaving with the swarm. You guys stay." How was that decision made? What's the trigger that stops it and says, "Okay, enough bees have left. I don't need to go," or, "No, I really want to be the one who goes with the others." How does that happen? The whole process is remarkable.

Amy 34:48
You have a very stressed coordinator in the colony.

Jamie 34:53
Yeah, someone's like, "Okay, now you go, but you stay."

Amy 34:55
"We need 50,000!"

Jamie 34:57
"Not 50,001! You stay behind." But Tom Seeley has done a really good job summarizing what we do know about swarm biology in his book Honey Bee Democracy, which, of course, is an amazing book, but I just don't remember reading that part in the book. So either we don't know it, or I just forgot it, both of which are possible.

Amy 35:18
That's fair. Okay. So the second question we have today is when the workers lay in the colony, the drones that they produce, are those viable for mating? So if drones come out of a laying worker's unfertilized egg, can he mate? And what does this look like as far as spreading the genetics?

Jamie 35:37
Yeah, so this is also an interesting question. I've been asked this a few times over the years. The short answer is yes. The drones that laying workers produce are viable drones, they are capable of flying to

drone congregation areas, and they're capable of mating with and fertilizing a queen. They are. All of the answers to that are yes, yes, yes, yes, yes. Now, we do know that drones produced from laying workers are smaller and that probably has a lot to do with the environment in which they are raised. It's not like laying workers are saying, "Well, I'm only capable of producing unfertilized eggs, therefore, I'm only going to lay in drone-sized cells." Laying workers seem to lay everywhere. So the vast majority of drones that laying workers produce are derived from eggs that were first oviposited in worker-sized cells. So you get these smaller individual drones being produced from laying workers. And again, it's one of those things, a gene versus environment thing. Is it because laying workers produce smaller drones? Or are they smaller drones because they grow up in a smaller cell? It probably has more to do with the latter than the former. Nevertheless, those drones do seem to be completely reproductively capable. Now, an interesting question for which I don't know the answer is, what percentage of drones mating with queens out there, what percentage are actually derived from laying workers? And my guess is, it's actually a really small number. I mean, think about it in your own operation. If I have 10 colonies in my backyard, and do nothing with them throughout the year, naturally, maybe one of those will produce laying workers, at some point in the year. Maybe one of them becomes hopelessly queenless and tries to produce laying workers. That means just right off the bat, over 90% of the drones that I'm producing in my own apiary are going to come from queens. And furthermore, the colonies in the environment surrounding my colonies, there's an overwhelming percentage of those that are going to be produced by queens. So it would be an interesting research question to ask, even though drones produced by laying workers are viable, what chances do they have, statistically, of actually mating with a queen? What representation do they have at drone congregation areas, or even in the worker patrol lines in any given colony? And my guess is it's really tiny. Nevertheless, they are capable of doing it. And I will tell you, on top of that, the question is like spreading the genetics of a hive even when a queen doesn't exist, that's one of the explanations for the production of laying workers. "Hey, we're hopelessly queenless. We're doomed. But we're still going to throw our genes out as much as we possibly can. And the only way we can do that at this point is to throw out as many drones as we can do." So a lot of people offer that as an explanation for why laying workers exist.

Amy 38:31
Very cool. Alright, so our third question, this one's kind of a long one. And so I'm going to try to summarize it but basically, I don't even know how to summarize this. Okay. So the person is asking if fly maggots excrete or create a medicinal environment to aid wound healing, which I had no idea that was a thing before I read this question, they're wondering if small hive beetle larva slime could potentially be medicinal or beneficial, or are small hive beetle larva just really gross, smelly, and stinky?

Jamie 39:07
Yes, for sure the last things, they're definitely the last things. Okay, there's a lot embedded in this question. But for those of you listeners out there who don't know, there has been some work over the last few decades about using maggots to help wounds heal. There's maggot therapy. The idea is that the maggots will eat the dead flesh. So on a really bad wound that is not healing so well you can put these sterilized maggots on the wounds, they'll eat the dead flesh and help that wound heal. I've not heard that their excreta actually can create an environment that will aid wound healing, although, I would not put anything past biology. Biology just seems to be amazing. So the questioner is saying,

given all of this for flies, is it possible that maybe the small hive beetle larvae slime is also medicinal? So the most direct answer I can get to that question is yeah, it's possible that their slime is medicinal. The question is, is it probable that their slime is medicinal? I just would hesitate to venture a guess. Let me talk a little bit about this slime and then we can speculate a little bit more about it on top of that. So when small hive beetle larvae feed in a colony, they're feeding on pollen, they're feeding on stored honey, they're feeding also on immature bees, they'll eat the immature stages of bees that can't escape, they're just sitting ducks in these cells as they develop and the beetle larvae will eat them. Well, we all know that when small hive beetle larval infestations are high in a hive there is this fermentation and slime associated with these high infestations.

Amy 40:59
It smells so bad.

Jamie 41:00
It does. It's really gross. I've seen pictures of infestations that were so bad that the honey was bubbling and bleeding out of the joints of a hive.

Amy 41:08
That is so gross.

Jamie 41:09
Yeah, and I've lived in an area with small hive beetles present the last 20-25 years, and I've just not seen that with my own eyes, but I've seen pictures of it. I have seen really bad slime. We, beekeepers, call it slime outs. I've seen it really bad when the beetle larvae will go through a lot of the frames and the honey, frothy, sticky mess when the larvae are tunneling through that stuff, they're picking it up on their body and they're sliming it everywhere. There was a great series of projects done actually just down the road from the University of Florida. There's a USDA lab just down the road from our lab here at UF. And the USDA lab had a team of scientists there led by Dr. Peter Teal, who is now deceased, and he and his team were able to show that there is a yeast associated with small hive beetles. When this yeast is deposited on pollen and maybe other things, it can potentially lead to the fermentation of this bubbly, slimy, sticky, frothy nastiness that we all associate with small hive beetle larvae. So it's gross. Now, the questioner is saying though, is it possible that this stuff might be beneficial or medicinal? I would say it's possible. It's just that, to my knowledge, no one's looked at this stuff. Nobody wants to work with it. Everybody's kind of repulsed by the idea. But nevertheless, I mean, if you mine down into the question, it's like, well doesn't some of this stuff end up in our extracted honey? Maybe that's not good.

Amy 42:35
Oh, I didn't even think about that.

Jamie 42:38
Well, think about it, Amy.

Amy 42:39
Yeah, no, it's true.

Jamie 42:39
A lot of beekeepers, especially commercial beekeepers, don't necessarily pull honey and extract honey on the same day. They might spend all week pulling honey and the honey supers just stack up in the honey house. And they might spend next week extracting it. So in that time, you could get a super or two that might be slimed out. Or you might get a couple of cells on any given honey frame that is slimed out by larvae. Well, inevitably, this stuff finds its way, in at least tiny amounts into honey. So what are the long-term implications for honey stability if it's got a little bit of slime in it? Or how is it good or bad for humans? But I will tell you, if it makes you feel any better, small hive beetles have been in the US for 25 years now, and I've never heard anybody complain at all about any of that type of stuff.

Amy 42:40
Not until now.

Jamie 42:42
But again, the questioner is asking a really benign question. Is it possible the slime is good for us? Yeah, sure. It's possible, but I just don't know that anybody's looked at it. And I just don't know anybody will. It's just one of those things that people may think to look at a few years, maybe not.

Amy 43:45
So I'm going to add one more quick question to that then. So if you're a beekeeper and you've got small hive beetle larva slime, what are your management practices? What would you do with that? I mean, how do you take care of that? How do you get rid of it?

Jamie 43:58
You mean in a living colony or in supers that need to go for honey extraction?

Amy 44:03
Either way. Let's do the first.

Jamie 44:04
Okay, let's do both. Alright. Okay. So in a living colony, when an area of comb gets slimed out, the bees tend to avoid it. So let's just say for the sake of argument that we're using a standard 10-frame deep brood box. All right. So let's just say that there's one comb that's really slimed out. I would take out that comb, I would replace it with a pulled comb that's empty or a frame of foundation or something, but I would take out that one that was slimed, I'd freeze it for a couple of weeks, and then after I take it out of the freezer and thaw it out, I would just wash it out with a water hose. So I would wash that slime off, and then you can reuse the comb. The bees will reuse it and bring it back up to their standards. But while it remains slimed in a hive, the bees rarely fix that. Now, if it's an entire hive that's slimed out, which I have seen before where the adult bees are wet because they're also covered in the slime that they're walking through, I would move the bees over to a brand new fresh hive, new combs, new

foundation, new pulled combs, whatever, and then I would freeze all the combs that they left and wash them out like I described before. And then you can reuse it once you've washed it out just with a water hose. If it's in your honey supers, in other words, you've got the stack of supers and you're going through it and you find that this one has got a little bit of slime on one comb, I probably, personally, would not extract that frame. I'd probably freeze it and then return it to a colony to clean out on their own. I don't really like the idea of a lot of that stuff going through the extractor. So if it was a whole super, I'd do the same thing. I'd freeze it, I'd probably rinse it off, and then I'd let the bees clean it up. Again, I, personally don't want to send that through the extractor less because I'm worried about what it will do to humans, but more is it something that's going to spoil the whole batch of honey? If it goes into a settling tank, is it going to make the whole thing bubbly in 10 weeks? So I just wouldn't run that risk. I'd wash it out. I'd freeze it, wash it out, give it back to the bees, and just avoid issues related to that.

Amy 46:23
Sounds good. Alright. Well, those were fun questions. Thank you, Justin from Pennsylvania for sending us a small hive beetle slime question. That was good. That was a good one. If you have any more questions, feel free to reach out to us by email or on our social media pages.

Serra Sowers 46:43
Thank you for listening to Two Bees in a Podcast. For more information and resources on today's episode, check out the Honey Bee Research Lab website at UFhoneybee.com. If you have questions you want answered on air, email them to us at honeybee@ifas.ufl.edu or message us on social media at UF honey bee lab on Instagram, Facebook and Twitter. This episode was hosted by Jamie Ellis and Amy Vu. This podcast is produced and edited by Amy Vu and Serra Sowers. Thanks for listening and see you next week.