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SPEAKERS

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

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 00:48
Hi, everybody, welcome to this segment of Two Bees in a Podcast. Today, I'm actually joined by Dr. Cameron Jack as my co-host. So hello, Cameron.

Cameron 00:57
Hello. Hello. Happy to be here.

Amy 00:58
Thanks for joining us today. I'm also joined by a very special guest. And this is Micaela Buteler, a researcher at the CONISET National Institute for Science and Technology in Argentina. And Mica for short, right Mica?

Guest 01:17
Yes.

Amy 01:18
So Mica did a publication called acute toxicity of microplastic fibers to honey bees and the effects on foraging behavior. And so I'm really excited to discuss this because I feel like microplastics are really kind of a new and upcoming thing, right? We don't hear about microplastics that often. So I'm really

excited to discuss this with you Mica. But before we go into this, can you tell us just a little bit about yourself?

Guest 01:44
Well, I am from Argentina and I am a researcher. And I study insect behavior and effects of pesticides on honey bees. And now we're focusing on this new type of environmental, let's say, toxic compounds that is on that, to which animals are exposed to. We have become aware of this issue recently. So that's what we are doing now, looking at the impact of these microplastics to bees. Given that I am an entomologist, I focus on insects as the model organism.

Cameron 02:29
It's very cool. I mean, Mica, you told us before we even logged on that you had spent some time in the United States. I'm just curious, where were you? And what were you doing here?

Guest 02:38
Well, I got my PhD at Montana State University, my PhD in land resources and environmental sciences. When I started studying here in Argentina, I was working at a lab where we looked at the effect, like I said, the effect of pesticides on honey bees. But then when I went to Montana State, I switched to study chemical ecology and behavior of solitary wasps that is a pest of wheat. So I kind of switched insects a little bit there. And then I came back to Argentina. And I continued study, I went back to bees and other social insects.

Cameron 03:23
Well, bees have a way of doing that, bringing us back and sucking you in. I totally understand that.

Guest 03:31
Yeah, social insects are so much more fun.

Cameron 03:35
They are so interesting. That's super fun. Well, I wanted to ask you a little bit. I read through your article, and it was really interesting. And I will admit, I don't know a lot about microplastics. I know that they tend to be talked about more when you're talking about marine environments. But can you tell us a little bit about microplastics, what they are and maybe why they're catching so much media attention lately?

Guest 04:05
Okay, yeah, perfect. So let's start by talking about what they are. Microplastics are basically tiny fragments of plastics. Anything that is smaller than five millimeters would be termed microplastics. Now, where do they come from? And how do they form? Well, there are many sources of microplastics. Some are called primary microplastics. That's small pieces of plastics that were fabricated that way and the way they were designed to be small like nurdles or beads that are used in cosmetics. The nurdles are the raw material for making other plastic products. I don't know if you've heard about those, but they're basically tiny beads of plastics. So those would be what are called primary microplastics. And

then we have secondary microplastics that are formed from the fragmentation of bigger pieces of plastics. This happens because plastics do not biodegrade. That is, they're not transformed into organic matter by microbes. So if you throw away a plastic bag, it won't biodegrade. But that doesn't mean that it will remain in the environment. In fact, forever, it will degrade and fragment that UV light and heat and friction into smaller pieces. And these smaller pieces, yes, will remain in the environment. And that's what we call the microplastics. Now, they become smaller and smaller as time goes by. And then another important source of microplastics are our clothes because most of them are made of synthetic plastic fibers. So as clothes become worn or every time you wash them, they're going to be releasing these tiny microfibres into the environment. That's the big picture about what microplastics are.

Amy 06:01
So I actually went on a field trip not too long ago, maybe a couple of years ago, and I learned about microplastics. And it was really kind of crazy to see, like how small they were because we had different vials that they gave to us as samples. And then they were showing us that they were microplastics, like, even in our toothpaste, like toothpaste, cosmetics, as you mentioned, and with clothes, and so I just I realized, and I learned from that training, that they were just everywhere, which was kind of crazy.

Guest 06:32
Yeah, exactly. For example, I started reading about the issue of microplastics only a few years ago, because, before that, everybody thought that microplastics were in the ocean, like, it was an oceanic problem. But recently, they started identifying them in freshwater bodies and in the air, in the soil. Like I mean, pretty much anywhere you look, you're going to find them. And that's when I thought that we should look into what is the effect or the impact of these microplastics and, and insects, which are such an important organism. They provide so many ecosystemic services. And using these as a model, I think works to try to get an idea of what is happening with animals exposed to these microplastics.

Amy 07:31
Right. So that was actually my next question for you. What was the motivation of just looking at microplastics and honey bees? I mean, microplastics are one thing. And then of course, working with honey bees, we love to do how, what was the motivation between meshing them together and examining that?

Guest 07:49
Well, because now microplastics are seen as a new contaminant to which we're all exposed to, they are found in all the environments and compartments, air, water soil, and given that bees are particularly fragile, and they have been used as a model organism to monitor the effects of other contaminants and pesticides, and that's what I have been studying in the past, I thought that it would be very interesting to study what is going on with them and microplastics.

Cameron 08:23
Well, and you mentioned that these microplastics are just everywhere, soil, water, air even. Are there some specific avenues that you think that are there ways that honey bees specifically are picking up

microplastics? And if they are picking up some microplastics, what are these potential implications for being exposed to them?

Guest 08:48
Okay, yeah, that's a great question. We were saying, this is such a novel topic. And there are a few studies that have been published, but it's all been like in 2021 and 22. They have found, for example, some studies have found that, okay, let's rewind a little bit. So we know that the microplastics are in the air, in the water. So you could think that honey bees would be exposed that way through the water they drink, or even they found microplastics in nectar and in the air. So then, some authors have found that microplastics attach to the cuticle of bees, which suggests or shows that they are picking up these microplastics from the air through their cuticle. So that is like a way in which they are getting exposed to these. Also, I think that they might be ingesting them through the water and even the nectar maybe too. So those would be the three pathways or the two pathways in which they're exposed to.

Amy 09:59
So, Dr. Mica, you were looking at microplastics and honey bees. So what exactly in this study were you looking at? And how did you go about your research? So what were you looking at? And what was your method?

Guest 10:12
Okay, first of all, knowing that these microplastics are in the air and in the water, hypothesizing that the bees are going to be ingesting them and picking them up from the air through their cuticles. Well, we wanted to know, what was the toxicity of these microplastics? What happens if bees ingest microplastics that might be present in the water or nectar that they're drinking? And so we conducted a laboratory bioassay to test the acute toxicity. So we exposed honey bees for a short term, like 48 hours. That's the regular acute toxicity bioassay let's standardize protocol. And we found that microplastics don't pose really any acute mortality. That's kind of what is seen in other studies and with other organisms. It's not that microbe ingesting microplastics will kill you, the acute toxicity is very low, which is good news, I guess. Then the other question that we wanted to answer in this particular study was, well, what happens if, let's say, a bee has to drink some water, let's say, a river or lake, and there are microplastics there. Will the bee detect them, will they avoid drinking sources that are contaminated or not? And that's why we did some preference bioassays, offering the bees with these solutions, water or sugar solutions that had microplastics and seeing whether they avoided them or prefer them or what happened there. And what we found was that it's like, they don't mind. They will drink from microplastics treated solutions or not, it's like, they don't care that they're there, which tells us that they're not going to be avoiding the contamination, right? If contamination is in the environment, they will be exposed to them. It's not like, behaviorally, they're going to be avoiding the issue. And another interesting thing that came from the study was that, even though they were not avoiding the sugar solutions that were treated with microplastics, it took them a while longer to drink, to consume those solutions than solutions that were untreated. So there is an impact on feeding somehow there maybe because of the presence of the microplastics, something physical goes on, it's harder for them to drink those solutions. It takes them longer. So those are the things that we found out in this particular study that you mentioned.

Cameron 13:25
Yeah, this is really interesting. And I mean, I suppose for everybody listening that cares about honey bees specifically, they're probably glad to hear that there was not really an acute, like, after a short-term exposure to microplastics there didn't seem to really be much of an effect on bees, which is great to hear. But can you think of a scenario where there might be long-term chronic impacts or chronic exposure? If the bees are constantly consuming nectar that's contaminated, do you, based on your experiences, do you expect there could be some kind of an effect?

Guest 14:08
Yes, we have conducted chronic, after that study would have was published, the next step was to do chronic toxicity studies. And we did this at the highest level to see whether it would cause any chronic effects that we were not detecting in the short term. And we did not find any major differences between treated hives and untreated hives. So it doesn't seem like the ingestion of microplastics for amount in this case, didn't appear to be causing any major consequences in the functioning of the colony. But some other authors have found that after -- and these are laboratory studies -- they found that after chronic exposure, like 14 or 21 days, exposure to microplastics, there were effects of the gut microbiome and immune defense, immune genes changed, and detoxifying genes were turned on. So there is an impact that is sublethal. It's not going to be causing any major effect. But there are some sublethal effects that in the long term, coupled with other things to which the honey bees are exposed, because there are other pesticides in the environment and other toxic compounds, so this adds up to all the suite of contaminants to which they are exposed, and it could have an impact in the long term.

Amy 15:49
Yeah, I mean, that was my next question. Do workers even live long enough to have this chronic effects of microplastics? So I think you answered that one. Yeah.

Guest 16:00
Apparently, it does. Yeah. But it's hard to detect. Well, like you said, like the hive, for example, we expose the hives for only one month to these microplastics. We don't know what is happening for a hive that lives several, it's going to be drinking these microplastics for years. So we don't know what is going to happen at that point. Right?

Amy 16:20
Right. And it's kind of interesting to think about it. I mean, with the size of the microplastics, let's say that it's in my toothpaste in the morning, and I'm consuming it, but I don't know that I'm consuming it. I wonder what the ratio of just that microplastic? Of course, I'm way bigger than a bee, right? So can honey bees even know? I mean, is it huge compared to them? Would it be like a huge softball or beach ball size plastic in comparison to a honey bee do? Does that size matter as far as you know honey bees and whether they prefer microplastics or whether they know that the microplastics around them?

Guest 17:08

Yeah, interesting. Yeah. The microplastics to which we expose the honey bees were varied in size. That's what I'm thinking is, some microplastics would be so big that they won't be able to ingest them, others will be small enough that they will be ingested and then excreted. And others might be in the mid-range where they ingest them, but then maybe they're not able to excrete them if they're like, big enough, so it all depends. And there's a wide range of sizes of microplastics out there. So it's hard to know what will happen with each size range. And then there's also another issue with microplastics. Because one could think, "Okay, I'm going to be ingesting them, excreting them, no big deal." But other contaminants attach to microplastics in the environment. And so when you ingest microplastics, it's not just inert plastic, because there might be other contaminants that you are ingesting together with them. Also, plastic has additives and dyes in them that have their own toxicity. They might be more toxic than the plastic itself. And that's such an unknown area because we don't even know the additives that they put into the plastic when it's made. So that's another like issue in Toxicology that is being looked at right now. Like, what are the additives? How toxic are these things that are put into plastic when they make products, because you, I don't know if you've heard about BPA, for example. The BPA-free bottles that we try to drink our water from, the BPA is an additive that was found later to be an endocrine disruptor. So it's not good for our health. And so, after it was known, then the plastic industry started making BPA-free baby bottles or drinking water bottles so that we would not be drinking BPA with our water. That's just one additive that we know. There are many others that we don't know about. And so there's that issue about the additives in the plastic and then bacteria that might grow, like microplastics are in the water, they're sitting there, microbes and bacteria might grow on their surface. And so when you're ingesting microplastics you're also ingesting those bacteria. So what's the toxicity from those bacteria? That's another issue. And so it's kind of like a complex thing where these microplastics are very hard to study.

Amy 20:11
Yeah, I can imagine.

Cameron 20:13
So Mica, I mean, it just sounds like there's still so much to learn, and so much to know about how microplastics are affecting and polluting the environment, and maybe what impact that might have on organisms that we care about, especially honey bees. So if you had more money to do continue on your research, what do you think are the reasonable next steps to investigate the relationship between honey bees and microplastics?

Guest 20:42
Yeah, that's a great question, I think we need to have a better picture of the sublethal effects from these microplastics. A lot of their studies conducted out there are made with spheres because that's something that you can buy, like, that is like standard microplastics of a certain size. But most of the microplastics that are out there are fibers. Fibers can be more toxic than spheres. So I think we need a better picture of what is out there, like, what's the concentration of these microplastics in the water and in the air? There are a lot of studies, but I think monitoring the microplastic contamination is something that we need to keep doing to understand what we're dealing with. And also looking at the sublethal effects on honey bees, for example. Then also like looking at, for example, if there are any impacts on

honey bee behavior after being intoxicated with these compounds, and then yeah, like monitoring the presence of microplastics in the environment, because toxicity depends on the hazard, but also on the dose. So more like those response studies, I think.

Amy 22:16
What I always tell people is that the more I learned about honey bees, the less I know. I mean, you've just given so many examples of different projects that can happen, right? And so, it's always so interesting to see what people focus on as their specialty. And I'm really looking forward to see the publications and ongoing research that are going to happen with microplastics, but related to honey bees specifically, but I'm happy to hear that, for now, they don't have a huge effect and aren't impacting honey bees too much. Right?

Guest 22:50
Yeah, right. You're right, they seem to be having some sublethal effects at the gut microbiome, which is, I think, super interesting, because the microbiome seems to be gaining so much importance in science, in all the fields of science in general, and even in like human health. We're realizing how important our gut microbiome is for our health and immunity and so knowing that the microplastics have an impact on honey bee microbiome makes me think well, that may be something that is happening to us as humans too when we're ingesting these microplastics. Think about how it is important to study what is going on in other animals to get an idea of what is happening to us as well. But yeah, it seems just for honey bees and for us in general, microplastics are not going to kill us, but they are out there and they have some impacts and we need to study further to understand better since the problem of plastic pollution is not going away. As time goes by, we're producing more and more plastic products each day and so plastic pollution in general, not only microplastics, but also like just regular microplastics out there are a big issue when we need to do something about it. So there I give you like more research projects.

Cameron 24:38
Well, very cool, Mica. Thanks for talking with us today and giving us such great information. I wish you the best with all your your future research and keep up the good work.

Guest 24:52
Thank you. Thanks a lot for having me and for listening.

Amy 24:55
Oh Cameron, was that a new topic for you? I mean, I know toxicology isn't a new topic for you. But were the microplastics a new topic for you?

Cameron 25:23
Yeah, it was. I mean, like you said, toxicology is not new to me. So the methods that Mica talked about in her paper, that was actually very similar to what we do with pesticides. Just this time, she was using microplastics. So I really haven't read a lot about microplastics. This is the first time I've read about it in honey bees. And I guess, I feel like, as beekeepers, we needed a win. And this kind of sounds like,

finally, like somebody's talking to us that's like, "They're all gonna die," This was the first time it's like, "Yeah, it's alright. It's not a big deal."

Amy 26:00
Well, but it's still new, you know? So yeah, we're just gonna eat plastic and be okay.

Cameron 26:05
Yeah, I mean, at least right now, with just feeding it straight up and looking at acute toxicity, this doesn't seem to have much of an impact. But unfortunately, it's a lot of the chronic sublethal effects of things. And that's what honey bees are facing so much of is one thing in itself doesn't usually kill a bee, it's just being exposed to Nosema plus amoebas plus microplastic plus there's just a million other pluses of things that can then start to have a big impact on bee health. But at least for the most part, it seems like, at least just chronic or acute exposure to this doesn't seem toxic, which is a good thing.

Amy 26:57
Yeah. She was talking about just taking them longer to drink when they had microplastics in them. Do you think that the consistency and adding microplastics to a liquid had anything to do with that? I didn't know what your thoughts were.

Cameron 27:10
Well, I mean, she said the sizes potentially could have something to do with it. I mean, if it's a bigger chunk of microplastic, then maybe bees just like physically can't ingest it. But I guess we'll see. I don't know, I think that probably still needs to be explored.

Amy 27:29
Yeah. Well, I'm excited to see where the researchers take this research.

Cameron 27:34
Yeah, absolutely.

Stump The Chump 27:40
It's everybody's favorite game show, Stump the Chump.

Amy 27:50
We are at the question and answers section. And Jamie, honestly, I don't even know how we ended up with like three questions per session.

Jamie 27:59
Probably because I end up answering them so long, gosh, the segment ends up being 15 minutes, and maybe people are tired of hearing me by that point.

Amy 28:09
It's funny, it just wasn't part of the plan when we first started this podcast.

Jamie 28:13
I know, we get so many questions, too. There are so many that we just have been unable to answer. I'm scrolling down our question list and just see all the ones that we've had to overlook just because of time. It's just crazy. I mean, if we do, I don't know, 40 some odd podcasts a year, and we do three questions in each one, we're doing 120-150 different questions. And we still have more questions. It's good that our listeners love sending questions and we are happy to answer. We're just sorry that we can't do them all.

Amy 28:45
Right. So the first question that we have for today, so this beekeeper had noticed that there are some bubbles in the stored honey. So in nectar, in capped honey, basically, there are bubbles in capped and uncapped honey. And so, first of all, I guess, what does this mean? Does this mean it's fermenting or what's going on with that?

Jamie 29:08
Okay, it's a little tricky answer because there are a couple things that can lead to this and I'm going to tell you about the non-harmful one first, and then we'll deal with the harmful one second. So when bees bring in nectar, nectar has a very high water content. It's roughly 80% water and 20% sugar. You guys have heard me say on this podcast before that honey is roughly the opposite of that. So it's 80% sugar and 20% water. So bees are bringing in something that is a high water content, 80% water, and you can actually shake frames that have a lot of freshly stored nectar in it and introduce bubbles into the nectar by shaking the frames. And this is harmless, it will self-correct. It is not a problem. On the other hand, wet sugar has a high probability of fermenting. That's one of the reasons that bees convert nectar to honey because honey is far more stable of a sugar product than is nectar. Being so high in sugar content and so low in moisture, honey can last in the combs for a very long period of time and on the shelves and jars for a very long period of time. How does honey get ruined though? It gets ruined when the moisture content is too high because that can cause fermentation. And in fermentation, basically, yeasts are converting the sugar in the sugar substance to alcohol, and you can get bubbles. So you can actually get nectar fermenting in the combs if the conditions are right, high humidity, maybe the bees aren't able to process it fast enough, maybe the moisture content of the nectar they collected was unusually high, maybe the nectar flow stopped before the bees were able to process the nectar that they already had, on and on and on. So you can get bubbles in nectar, you can get bubbles even in, quote, capped honey. It's an indication that there's fermentation happening in that nectar or even in that honey in the combs.

Amy 31:21
So that kind of makes me wonder, do bees cap honey, or do bees cap nectar if it's not within the range that we would like to see?

Jamie 31:31
So, Amy, we like to see a range that's like fifteen and a half to 18 and a half percent moisture. That's like ideal for us. But it's routine to see capped honeys in the 19, 20, 21, 22% range. And we know, as

people who have looked at fermentation for a very long time, we, the scientists and extension specialists, know that at those upper moisture levels, honey will ferment. Bees, on the other hand, will cap honey in quite a broad range, not like ridiculously high, not over 30% moisture or something, but still higher than what we consider the ideal of 18.5%. And then that 19, 20, 21, 22% range, which they'll cap, it can still ferment under that. Now, more often than not, bees are really good at getting that moisture content down, and honey will be capped and it will be very stable in their hive but they can cap wetter than usual honey that can ultimately produce this kind of fermented honey in the comb.

Amy 32:29
So is there anything else that could lead to this?

Jamie 32:31
Absolutely, Amy, there's the third thing that I was just thinking of as we were kind of going through this series of questions. Small hive beetles are notorious for causing honey in colonies to ferment especially in the latter stages of these population explosions of small hive beetles. There are yeasts associated with small hive beetles. And as these small hive beetles go about the hives, the adults are defecating, their larvae are deprecating, and there is this fermentation of honey associated with high infestations of small hive beetles. I'm not claiming that's what's happening in this case. My guess is in this particular case, it's just honey fermenting naturally because it's got a high moisture content. But small hive beetles can also cause this as well just by their feeding habits and the yeasts that are associated with them.

Amy 33:22
So, let's say a beekeeper goes ahead and they harvest their frames, and they find that it is a very high moisture content or that there are bubbles. What can they do to help this? Is there anything that beekeepers can do to make the moisture content get lower?

Jamie 33:38
Yeah, so there are really two ways to look at it: way number one is what do we do in a hive if this issue is in there and we don't have an intention of extracting that honey? Or what do we do if we intend to extract out honey and we remove it? Well, a lot of commercial beekeepers have strategies for reducing moisture content in frames that are uncapped, which is an indication that it's still nectar, when it has too high of a moisture content anyway. And what they will do is they will run it through dryers or they will keep the supers in a very warm room, something that's above 90-95 degrees, as hot as they can make it in that room. And they'll put in a dehumidifier and a fan, both of which kind of dry that moisture off of the honey. It's usually easier to deal with wet honey prior to it being extracted than it is afterwards. So prior to it being extracted, you can dry the supers off with a dehumidifier and a fan and a hot room. Obviously, the smaller the room the better because it's easier to make a small room hot than it is a big old warehouse hot. And so a lot of beekeepers will do that. There are industrial dryers that you can pass your honey through. We even have one here courtesy of Dadant & Sons here at the UF Honey Bee Research Extension Laboratory. And you can pass your extracted honey through those and it'll remove a percentage or 2% moisture off every time the honey passes through that dryer. So there are ways to deal with it after it comes out of the comb. I will tell you though, a lot of beekeepers will dilute it

as well. They'll take honey that they know is very dry naturally, maybe even prone to granulation, which is the opposite end of the moisture spectrum where it's too dry and the sugars come out of solution, and they'll mix some of this slightly wetter honey with drier honey to try to put both of those two honeys within that 15.5 to 18.5% range. And a lot of honey that is too wet, naturally too wet, maybe there's a floral source that produces a wet honey that's prone to fermentation, a lot of those honeys end up going into wholesale baker-grade type honey. Honey that you wouldn't necessarily put in a bottle and throw on one of your biscuits. But instead, it would go into some sort of food company's food product that contains honey. And those companies often have ways of trying to dry it off. But really the best way for beekeepers to handle it is to not extract it in the first place unless it's 80 or 90% capped. And that usually solves the problem. In this particular example, the honey is bubbling. And so you'll probably have to go to those extra steps. Now, what happens if it's in the colony and you have no intention of removing it? Well, question number one, does it smell fermented? It can have bubbles in it and not be fermented. And you just want to make sure that you're not overreacting to something that's not actually a problem. So take out one of these combs, smell it closely, does it smell fermented? If it's not just leave it on the colony and the bees will usually sort it out themselves. But if it does have a fermented smell, fermented honey can be bad for bees. And so what I would do, if I were you, in this case, I would take out those frames and I would just wash them out with a water hose and let them dry. And then you can put those combs back into the colony and bees can reuse them. But it has to really smell fermented to me before I would try it still.

Amy 34:08
Alright, so for our second question. I would say that we receive a lot of emails towards the wintertime with people asking about queens and we know that queens kind of slow down their egg-laying in the winter. But something that I have been receiving a lot lately because it's been so hot outside is basically how does temperature affect the queen's ability to lay eggs? And does this affect brood rearing at all? I mean, is there a maximum temperature that bees will just stop rearing brood?

Jamie 37:00
Yeah. So this is an interesting series of questions because we've got this question when it's so hot. And we live in Florida, where it seems to be hot all the time. And I know that there are places around the world, for example, I was just speaking with colleagues in Northern Europe, so for the record, we're recording this question and answer in August 2022. And back in July of 2022 some folks in Northern Europe were having just record high temperatures, it's just hot. So this beekeeper sending this question is basically saying, "I've got three queens who shut down. What's going on?" And I would argue to you to remember that the worker bees are keeping the core nest temperature at a steady temperature of about 34 and a half degrees Celsius, roughly 94/95 Fahrenheit. So the queen is largely insulated from ambient temperatures outside of the hive. As far as she's concerned, it's mostly the same temperature most of the year. Right? So she is probably not reading these environmental cues and deciding whether or not to lay eggs. On the other hand, the workers are reading these environmental cues and determining whether or not they want to rear brood. So workers are probably the ones making this decision more so than the queens. The queens may be laying eggs and the workers may say, "We're having a hard time maintaining the internal nest temperature." Usually, when it exceeds 36 degrees Celsius, 38 degrees Celsius, the brood just can't develop, and so it sets a really small range by the

way. If the optimum temperature is 34 and a half degrees Celsius, and we're talking like a two-degree change in that temperature, it can kill brood. A four-degree change in that temperature and all the brood's dead. You can understand that in certain circumstances if bees are having a hard time maintaining the internal nest temperature that brood won't be reared. But it also may be something related unrelated to temperature at all. For example, we're getting this question in August, where in a lot of places around the world, there's just a huge pollen deficit this time of year, so maybe the bees just aren't bringing in enough pollen to rear brood in the first place. So I would argue in this particular case, it has less to do with the queen making decisions whether or not to lay based on the external temperature, and more to do with workers deciding they don't want to rear brood and aborting the eggs or workers keeping her from laying or there's maybe not resources available for them to rear brood in the first place.

Amy 39:28
That makes sense. That makes sense. So the last question that we have, this one makes me laugh a little bit. So the question is, beekeepers have seen honey bees up close, we've seen photos of honey bees, we've seen honey bees, we work with honey bees, and this person is asking about the bees claws and how they're curled upwards. So you think that they'd be curled down to grip a surface, right? But when you look at the bee up close, it looks like their bee claws are curled up. So what is going on? How do bees even walk around if their bee claws are curled up?

Jamie 40:41
Okay, so I think there's a pretty simple answer for this. So the simple answer is that they are not, in fact, curled up. The bees' legs all end in a segment we call the tarsus. The tarsi are these, I'm going to call them feet, but they're not really feet, and these feet at the end of bees' legs have these tarsi, these claws on the torso, there's like two of them, right? And both of these claws go up from the foot and then curl back down and end in a point. And they use these to grip the surfaces on which they walk to hang from combs, etc. So the questioner is asking about this as if these tarsal segments were the other way around. And what I would argue is that probably this individual just saw a picture that was flipped upside down or something like that, because the segments are, in fact, curled to where the points are facing down, and the curved part is facing up, making it where these little points act as little hooks as they're walking on the surface of whatever they're walking on. So I think that's just one of those easy answers. It's just an orientation thing from seeing the picture.

Amy 41:56
Sounds good. All right. So those were our questions and answers for today. If you have more, we are happy to try to answer them on air. As Jamie mentioned, our list is getting longer and longer. So we do our best to take our questions and try to help as much as possible, so be sure to send us an email, send us a social media message, or give us a call.

Serra Sowers 42:22
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.