# Episode 83 Mixdown PROOFED

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**SPEAKERS**

Amy, Stump The Chump, Jamie, 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. Hello, everyone, and welcome to another episode of Two Bees in a Podcast. In our first segment, we'll be joined by Dr. Yahya Alnaggar, who's a post-doc fellow at the Institute for Biology at Martin Luther University in Germany. He'll be joining us to talk about honey bees being at risk from microplastics in the environment. In our Five Minute Management, Amy and I will discuss how to process wax, and in today's podcast, we'll finish with our famous question and answer segment. Hello, everyone, and welcome to another segment of Two Bees in a Podcast. Today, we are talking about a very interesting topic. We are talking about the potential risk that microplastics are to honey bees. And here with us today to discuss that is Dr. Yahya Alnaggar, who's an Alexander von Humboldt Research Scientist at the Institute of Biology at Martin Luther University, in Halle, Germany. He's also an Associate Professor in the Faculty of Science at Tanta University in Egypt. Yahya, thank you so much for joining us on Two Bees in a Podcast.

**Guest** 02:08
Oh, it's my pleasure. Thank you so much for inviting me here.

**Jamie** 02:13
Well, we're excited to have you. You and your team and your colleagues just recently published a manuscript titled, "Are honey bees at risk from microplastics?" We're going to talk to you all about that research. But before we do, do you mind telling our audience a little bit about yourself? How did you originally get started researching honey bees?

**Guest** 02:35
Yeah. I's now 10 years ago, when I started doing my research with bees. So during my Masters, we use the honey bee as a bioindicator of environmental pollution with heavy metals. And from there, I started to learn more about bees and beekeeping. And it was a very good start for me to get this track. And later on in my PhD in University of Saskatchewan in Canada, where I also used the honey bee as a bioindicator for pesticide exposure, and till now, it's been my best-loved insect. And yeah, so it's 10 years now from the beginning of my research with honey bees.

**Amy** 03:25
That sounds great. Every honey bee researcher, we are very obsessed with honey bees. We love honey bees. It's our favorite insect. Right? So you're talking about how you are working with honey bees as bioindicators, and you also looked at honey bees with pesticide exposure. So how do you actually use honey bees to monitor environmental quality? So, what do you look for? How do you even begin looking at that?

**Guest** 03:55
Actually, this is a good question. But before I can say why I use the honey bee as a bioindicator it's very important to firstly mention why any organism or any species can be used as a bioindicator or what is the meaning of bioindicator? So, a bioindicator is any living organism that can be used to detect the quality of the environment and the changes that might have been done over time. So different species have been used for that, like frogs, earthworms, different crustaceans, some benthic organisms used for the quality of water. But for bees, it's different because it represents a unique terrestrial bioindicator for many reasons. For example, if you can imagine a hive that contains thousands of individual bees, for example, like 40,000 in the hive, a quarter or 10,000 of these bees can be used as active pollinators or foragers going outside collecting or looking for nectar and pollen and the propis. So, if the surrounding environment, if the soil or the water or contaminated with any different contaminant, it can easily reach the nectar and pollen and be collected by bees back to the hive. So, bees are doing sampling for us. In addition to that, bees also go foraging for up to two to three kilometers away from the hive, and sometimes up to 10 kilometers, according to the floral resources. So, a wide range of area is now collected or sampled by bees. In addition to that, also the body of the bees is covered with a lot of hair. So, it can collect any airborne particles or particulate matter and take them back to the hives. In addition to that, or we can say most importantly, honey bees are very sensitive to toxic chemicals or contaminants, and this is something very important for any organism to be used as a bioindicator. For example, if we, around the highest level, found that a lot of bees die, we can imagine pesticides have been sprayed or used in the surrounding environment. So, there is a good indicator for us that there is some intoxication around the hive. Recently, also, it has been used to detect any changes in agricultural landscape. A nice study has been published using honey bees as a bioindicator for the source of COVID-2, which is a causative agent for COVID-19. And this study is a very nice study where they used bees during the third wave of the pandemic in Italy to detect the environmental contamination was this virus. And, what he did, he just brought swipes into the hive entrance and once a forager is coming from outside, they can touch the swipes and then they collected there after one day and they check for any genes for COVID-19 or SARS-COVID-2, and they found it is positive. So it again confirms that bees can be used as a useful bioindicator for airborne human pathogens. Yeah, at the end we can

say it has been used frequently as a bioindicator for environmental pollution, heavy metal, with pesticides, and even with radioactive materials.

**Jamie** 08:15
When honey bee colony losses started increasing in 2006 in the US, I remember a lot of people were talking about honey bees as bioindicators, and it really began to fascinate me. And just listening to you talk about how they can be used to screen for heavy metals, for human pathogens, for radio isotopes, and pesticides is really fascinating. In your recent publication, you and your team were focusing specifically on microplastics, and that's a term that I hear quite a bit now in the news, can you tell us a bit about microplastics and how they enter the environment?

**Guest** 08:55
Well, yeah. Microplastics are now considered a newly emerging pollutant. It gets attention from both the scientific community and the public and the news media. And it could be defined as any fragment of plastic that is less than -- any fragment of any type of plastic that's less than five millimeters in length. Also, it could be classified into two subgroups, which are primary and secondary microplastics. For those in the primary subgroup, they are mainly produced as microscopic plastic particles and usually used in consumer products like detergents and like personal care products. For secondary microplastics, on the other hand, it's mainly produced from the degradation or the breakdown of large plastic particles that enters the environment or the aquatic system. Different examples have been identified as significant sources for microplastics in the environment that include tires, like synthetic textiles, marine coatings, route marking, and, as I mentioned, personal care products and also their wastewater. So microplastics, nowadays, are everywhere. Scientists have found microplastics in deep oceans, in Arctic snow, in shellfish, in table salt, and even in milk and recently, in honey. So, some estimates are that the human can consume around 50,000 particles per year and this is something very alarming. And we have to work together to regulate that or to prevent that.

**Jamie** 11:10
It's funny, you mentioned the human consumption of it, Yahya, because one of the things that I heard, I think last year, is that the average human consumes a credit card's worth of plastic every year. And I'm not sure if that's true, but it certainly illustrates --

**Amy** 11:23
Gross.

**Jamie** 11:23
Yeah, but you know, people were talking about it everywhere. The article I had read specifically was about people who drink tea. And tea bags often put microplastics in the tea, depending on what the tea bag is composed of. So it was interesting. It's kind of scary.

**Amy** 11:41
Yeah, so there's a group here in Florida and in the United States, and it's a group called Sea Grant. They work a lot with aquatic systems with the ocean. And we have a specialist that works with

microplastics. And I remember going to a training that she did, and she had all of these things, like makeup, she had toothpaste and was just saying that there are microplastics in toothpaste, and that's something that we use every day. Not all toothpaste, but a lot of the toothpaste that we use. So, it's really interesting to hear you say that there are microplastics in tires and just all the other things that are out there. So we talked about microplastics and where they come from, but why should we care? What is so alarming about having microplastics in the environment, especially since they're so microscopic, they're so small. Why should we be alarmed?

**Guest** 12:38
So, yeah, these are also very important questions, why microplastics are now considered as an alarming environmental pollutant. Yeah, because microplastics can affect our environment in so many ways. And it is still something that we don't fully understand. So we still don't know a lot of information about microplastic toxicity. And for that, there are tons of studies that have already demonstrated the adverse effects of microplastic on the aquatic biota. In addition to that, there is an increasing body of evidence indicating that microplastics can interact with terrestrial organisms that mediate significant ecosystem surface and function, for example, invertebrates like earthworms and terrestrial fungi and animal pollinators. More importantly, recently, microplastics have been detected in human foods. So we know that it's in our bodies, it's accumulated. So in addition to that, also, a very recent study found microplastics in human placenta, so microplastics are now in our bodies. But to be honest, we still don't know if it's a risk of exposure of human to microplastics or not. Most of the studies are now going in aquatic organisms and some terrestrial but it's not till now some studies are aligned on some on rats, but till now, no study about the effects of microplastics in human hands. But this is not the main issue. The main issue of microplastics is that it can serve as a carrier of microbial pathogens and toxic chemicals. So microplastics themselves may or may not measure toxic pollutants, however, they may carry other pollutants. They may interact with other environmental pollutants, and this may make the problem worse. In addition to that, microplastic is not like heavy metals or pesticides. They are different shapes, different sizes, and different polymers. So, if you have one microplastic, you can have different shapes. You can have a regular fragment, you can have microfibers, you can have synthetic fibers, you can have film, and these different shapes may show different toxicity. So, it's not easy to say if it's toxic or not. So, still a lot of data needs to be provided to be able to know if there is a risk or not. And till now, it still represents an alarming environmental pollutants.

**Amy** 16:09
That was a great explanation. I think that was a really great explanation. And it seems like the microplastic could potentially be a vector for some of those pollutants. So thank you. That was great.

**Guest** 16:23
Thank you.

**Jamie** 16:24
So Yahya, your paper that you and colleagues just published literally has the title, "Are honey bees at risk from microplastics?" And for you listeners out there, we're going to make sure and provide the link to this manuscript in our show notes so that you can go back and read it. But Yahya, do they negatively

affect honey bee health? What are some things that you and your colleagues have found? What were the key findings? Just tell us a little bit about this issue.

**Guest** 16:51
So yeah, this is, I think, the most important question, today, for a lot of people need to know. So, before I can mention if there is any risk from microplastics to honey bee or not, we need to explain how bees or honey bees can be exposed to microplastic. And as I mentioned before, honey bees just go outside looking for nectar and pollen, and also other different environmental sectors. So if the surrounding environment is contaminated with microplastics, they will ultimately be introduced into honey bees and other hives. And this is the first part we need to be sure of, how bees can be exposed to microplastic. And the story started in 2017 when some researcher detected microplastics in honey, however, there had been an active debate about this study because the researcher was unable to confirm their results or to reproduce the results again. However, recently, there is a new study published where they found microplastics in 12% of honey samples collected from Ecuador. In addition to that, there are also another two studies. One from Copenhagen in Denmark and another from China where they found different types of microplastics on honey in the body of the honey bees collected from different provinces in China and also, from different urban and rural areas in Copenhagen. And this again confirmed the exposure of honey bees to microplastics. So, back to that main question, is there risk from exposure to microplastics? Well, till now, there are only two studies that show some adverse effects of exposure of honey bees to only one type and the one shape of microplastic, which is polystyrene microplastic and is independent on the spherical microbeads, which are primary microplastics. In the first study, so you expose the bees for two weeks to this microplastic. However, they found no stress and survival. On the other hand, they also found some sublethal effects. For example, they found significant changes on the gut of the honey bee, on the honey bee gut microbiome. Also, they found significant changes on the expiration of some detoxification and immunity genes. In the other study, they investigated the consequences of exposure to this type, also of microplastic, which or polystyrene or PS microplastic, using histological and a sequencing approach. And they found that this microplastic can aggregate in the midgut of the bees and can impact the tissues of the midgut, like it shows some adverse effects on the peritrophic membrane, and also can be located to the trachea and the malpighian tubules of bees, and it makes bees more susceptible to acute paralysis viral infection. And this is very important because, yeah, if we see microplastic may be itself, the main toxin, it may interact with other environmental and ecological stressors and may make bees more susceptible to others. But, however, in my recent review that you mentioned, I also highlighted some gaps that are some research questions that urgently need to be addressed to be able to answer this question if there is any risk from exposure to microplastic on bees or not. For example, we still don't know the effect of different plastic polymers, different shapes and different sizes of microplastic on the larval development, and on also, adult survival and longevity. In addition to that, also the potential adverse interaction effect of microplastic was other stressors found inside pesticides, heavy metals, and also pathogens. More important is to see the adverse effects on the colony, because honey bees are superorganisms, there are thousands of individuals living in one colony working together. So maybe the effect is that we might have found, in our lab experiment, that it cannot be easily detected under field or colony experiment or colony conditions. Therefore, we need to know if there are any potential adverse effects on, for example, brood pattern, or in Queen laying, and drone vitality, or in the whole

colony is very, very important and will be very critical to be able to conclude if microplastic will carry any potential risk or hazard to bees or not.

**Amy** 23:18
Well, it sounds like there's a lot of work to be done still. Lots of projects and lots of suggestions. So what is your next project? What follow-up studies do you plan to do next?

**Guest** 23:31
Actually, we are now waiting, hopefully, while we're submitting a grant proposal, and we're waiting to see the results. And if we are lucky and we get the funding, then we'll start a big project to see the adverse effects or potential adverse effects of microplastics on honey bees, and we'll consider all this I mentioned one minute before.

**Jamie** 24:01
All right, this all sounds great. And your answers have been perfect and succinct and clear. So it really leads to this point here, and I suspect I know your answer, given, kind of, the early status of the research field in general. But given that we all have a lot of beekeepers listening to this interview, what do you think are some take-home messages for beekeepers? Should they be worried? How should they approach the potential impact of microplastics on honey bee colony health? Is there enough information out there right now to act on it? Or is it just kind of a sit-and-wait-and-see-what-happens moment?

**Guest** 24:40
Actually, it is a very important question, but also, it's the hardest question to answer. Because beekeepers alone won't be able to do anything or will not be able to regulate or avoid that issue. We have to have all of us working together to regulate or to prevent this international problem. So we need to stop using plastics that are not necessary. We need to use a simple and more transparent recycling system. Also, we need to change our lifestyle. We need to change our single-use lifestyle. So I was talking with Professor from a university in Frankfurt about that, and how we can help beekeepers or what beekeepers can do to protect bees from microplastics. And he simply answered that he detects synthetic microfibers in honey collected from the hives from the university apiary. However, he said, "I'm not sure if it's a contaminant, or it's a contaminant from a beekeeper himself." Maybe it's a contaminant from the beekeeping tools, or from their clothes, or from the bee suit, but maybe, as we dip in pathogens, we have to have our beekeeping tools clean and sterilized, maybe. In addition to that, maybe we can get more attention about the pollen substitutes that should be clear, clean or free from microplastics. And because, also, microplastics have been detected in table salt or maybe in sugar, then it may be also the sugar serum that's used for our colonies during the autumn times, or maybe during the early summer that should be also free or cleaned from microplastics. And yeah, that's it. I'm not sure what more we can tell them to do, but yeah, because we still didn't know much information. So I'm sorry, I will not be able to say more in this area.

**Jamie** 27:20

I think your answer was good. Yeah, I think your answer was great. I really appreciate the point that you made that maybe not all microplastics are coming in from with the bees. There's probably a lot that we do as beekeepers that might introduce these into our colonies through, like what you suggested, potentially, food supplements or some of the other equipment. So that's really great. I really appreciate all the insight that you shared. Well, Yahya, thank you so much for coming on and talking to us about this very important topic. I really like how you left this idea that there's a lot of research ongoing, that this is a potential problem for honey bees, but we still need to know more. So thank you so much for giving us your time today.

**Guest** 28:02
Yes, thank you so much. Yeah, it's my pleasure.

**Jamie** 28:04
Everyone, that was Dr. Yahya Alnaggar, who's an Alexander von Humboldt Research Scientist for the Institute of Biology at Martin Luther University in Halle, Germany. He has another appointment as well, he's an Associate Professor in the Faculty of Science at Tanta University in Egypt. And we discussed, are honey bees at risk from microplastics? Make sure you go to the show notes and look up the manuscript that Dr. Alnaggar and colleagues wrote. It's a really good review of the topic, and I think you'll find it very informative. Thank you so much for joining us on this segment of Two Bees in a Podcast.

28:57
For more information about this podcast check out our website at UFhoneybee.com.

**Amy** 29:25
It is our Five Minute Management time. In the last episode, we talked about collecting wax and how to do that. Today, we'll be talking about how to process wax, and Jamie, I guess, really the first question I have, and I'm going to start the timer after I ask the question is, is processing wax and rendering wax the same thing? And go.

**Jamie** 29:49
Amy, to me, it is the same thing. So, basically, you're just getting the wax ready for whatever its future use is. So let me just give a brief little story here. When I was a young kid keeping bees, I didn't necessarily want to use my own wax to make candles and Christmas ornaments and things like that. What I instead would use my wax for is a lot of the bee equipment supply companies would allow you to send your wax to them to use to make a foundation. So they would then take some of the price off of the foundation. So it was a way for me to just produce bulk wax and get a discount on the foundation I was using. So a lot of commercial beekeepers simply sell bulk wax. They're selling it back to the equipment supply companies, etc. So why would you want to process wax? Why would you want to render it? Maybe you just want to get rid of the bulk wax for the purposes of getting discounts on the foundation. A lot of folks, though, Amy, want to take it and get it ready and process it all the way you would do to honey. You don't just sell it in barrels, you want to put it in a fancy jar and sell it direct to consumer. So a lot of people approach beeswax the same way. And so how do you get it ready to sell it

direct to consumers? Well, there's basically four things that you have to do to render beeswax. The first thing is you have to separate the honey from it. Almost all production of wax is going to be accompanied by a little bit of honey residue. So a lot of folks will wash wax, they'll rinse it with water, they'll drain that water from it, they'll dry the wax off. They're just basically trying to rinse the honey off of it. Now, the honey will come off in step two anyway, if you elect not to rinse the honey from it. And that step two is the melting process. You don't ever want to melt wax directly exposed to heat. You don't want to put a pot of wax directly on something hot. Instead, you want to use the double boiler method. Basically, you want to put wax in a pot that is, itself, sitting in a pot of boiling water. So the boiling water heats the pot that contains the wax, so that will melt the wax and help avoid scalding the wax. And when you melt the wax, it is naturally going to separate out later, anyway, right? So even if you don't rinse honey from it in an earlier step, by the time you are doing step two, and later on in step four, when you're cooling the wax, the honey and the other debris will separate out. So now that in step two, you have this molten wax, you've got to filter it. Now, I learned to filter it using cheesecloth or something very fine. But I have a beekeeper friend of mine who actually enters wax into a lot of competitions, honey judge competitions, they'll judge wax as a category, and she filters the wax through T-shirts, standard T-shirt cloth material, she'll pour that wax right through it, and it will get out a lot of the debris. Why do you have to filter it anyway? Well, wax has a lot of debris in it. It might have bee parts in it, or when you're scraping off the frame, it might have little pieces of wood, all of that stuff needs to come out of the wax. And you can do that by filtering it. Now, a lot of people will skip step three, because if you just pour molten wax into a mold, all the junk is going to settle to the bottom anyway. And so once that happens, you can separate the junk, you can scrape the junk right off. But if you filter it, it gives you a better-finished product. It's 99.9% beeswax and you don't have to scrape away the debris or impurities. So that's step three. Step four, then you just have to cool the beeswax in a pan or a mold. Now, if you're wanting to just sell it to equipment supply companies or in bulk, then it doesn't matter to you how it's cooled. But if you're wanting to process it later, if you're wanting to sell it as a really nice beeswax cake was what we would call it, like a perfectly molded beeswax piece, you're going to have to slowly cool it. If you cool it very quickly, it's going to crack, and again if you're selling it in bulk, that doesn't matter, but if you want it for show purposes or for use later on, you can slowly cool it in a pan or mold in an oven where you're slowly cranking down the oven temperature over time. So the four steps again: You want to drain or rinse away the honey, you want to melt it in a double boiler, you want to filter it with cheesecloth or a T-shirt or something very fine to remove the debris, and then number four, you want to slowly cool that beeswax in a pan or some sort of mold. And once you have that, that nicely filtered, nicely cooled beeswax block or beeswax cake, then you can use it for whatever purpose that you have intended for. So it's a really fun thing to add to your beekeeping enterprise, the manipulation of wax for purposes of making candles, etc., so that you can generate additional income from your bees.

**Amy** 35:01
All right, and that was the Five Minute Management. You did it in five minutes, Jamie, congratulations.

**Stump The Chump** 35:14
It's everybody's favorite game show, Stump the Chump.

**Amy** 35:30
Welcome back to our question and answer segment. Jamie, the first question we have, so here in Florida, and I think in Texas, and I want to say Arizona, maybe California, we have Africanized bees. So, most of the time it's illegal, especially here in Florida, it's illegal to keep Africanized bees. And so the question is, why is it illegal to keep Africanized bees? And for using smoke, does this smoke not just calm them? Because we've heard that Africanized bees can be a little bit more defensive than the Western honey bee.

**Jamie** 36:02
Yeah, so all these are great questions and good comments. So we do have Africanized honey bees here in Florida, principally in the southern half of the state. And of course, in the US, we have them in Southern California, New Mexico, Arizona, Texas, places like that. We know that these bees also exist throughout Central and South America. And of course, this subspecies of bee that we're talking about, Apis mellifera scutellata is native to the southern half, roughly, of Africa. And so there are a lot of other African honey bees, African subspecies of honey bees in southern Africa, but Apis mellifera scutellata has probably the most widespread distribution there. So why, then, is it illegal to keep them in some parts of the US? So I want to throw out just kind of one quick caveat for people who are listening from around the world. Every state has the ability to make their own rules regarding this. Here in the state of Florida, it's illegal to keep them but that's not necessarily true across the country, although many states do take the policy that you shouldn't keep it. The Florida Statutes, I believe, use the terminology, it's illegal to keep an unwanted race or an unwanted subspecies or unwanted stock. It's one of those three words but regardless, it's this idea that there are managed subspecies of honey bees that we want to use. And then we want to stay away from a few subspecies of honey bees, particularly in this case, Apis mellifera scutellata or hybrids of it and other bees. So why is that a problem? Well, the questioner asked does smoke calm them? Well, we'll start kind of backwards. Yes, smoke calms African honey bees and Africanized honey bees. My PhD is from an institution in South Africa. I used smoke to calm bees there. The bees did respond differently to the smoke. When I smoke European-derived stocks of honey bees, you tend to get bees that will stay in the colony, they won't fly around too much, right? And you can kind of subdue them that way. I remember when I was in South Africa, I would smoke the bees there, I would often have every bee leave the nest except the queen. They'd all be flying in the air in response to the smoke. But nevertheless, you can use smoke to call them. I mean, remember, beekeepers in Central and South America and in Africa, keep this bee. This is the bee that they use. So you can do a lot of standard management practices using this bee. People do it really in those three places, routinely beekeepers make honey with them, they might use them to pollinate crops, they keep in many of the same ways that we would see kind of in the commercialized settings that we're used to, for example, here in the US. So then why is that a problem? Well, it's a problem, because these bees are more prone to be defensive than are the stocks of managed bees that we typically use. And so why is that a problem? Right? We're beekeepers, we can deal with the defensive behaviors. Well, that's true. The problem doesn't lie as much with beekeepers, but lies more with the general public. So for example, let's say that I'm a hobbyist beekeeper and I live in Orlando, just picking out a place randomly. And I live in a subdivision, and I have three colonies in my backyard, all of which are Africanized honey bees. So when I go out there and smoke the bees, it's okay, I keep my dogs away from them. Maybe they're fenced off, maybe they've got bushes around, and etc. It's not a problem. But my neighbor is not

a beekeeper. Right? He or she may be cutting grass right on the other side of the fence. They may have kids at a pool party right next door. And so just because I can manage and control the bees when I'm working them doesn't mean that they're always going to quote, behave for the people who live around me. So in the US, at least certain places in the US, have taken the stance, it's better to not keep them than to keep them, especially given that we have alternatives available to us, like all of these European-derived stocks. So I think that that's one of the reasons that they don't want us to keep them, just because of their heightened defensiveness and the threat that that poses to animals, humans, things like that. The next thing I'll mention, too, is that these bees can, though, impact our beekeeping operations. They're not just defensive. They're very flighty. They make smaller colonies, they swarm more regularly, and they produce a lot of propolis, which is not a problem for everybody, queen management can be difficult, and when you overmanage them, they're prone to absconding, completely abandoning the nest. So there's a lot of management-related drawbacks to using these bees as well. And if we just kind of willy-nilly adopted the widespread use of these bees, those traits would make their way into the managed populations that don't necessarily have these negative traits associated with them. So I think, collectively, all of these reasons are reasons that a lot of states have just taken the stance that we don't want beekeepers keeping these bees in the state. I mean, a lot of it boils down, frankly, to just litigation, right? We're a society of people who like to sue other people. So, when you get stung by someone else's bees, especially if you knew they were Africanized bees but didn't address it, then it could be a problem, just from a legal standpoint.

**Amy** 41:27
Yeah, I think that's definitely fair. Okay, so the second question we have, we received this question from a group that was just touring our facility recently, and they were wondering, okay, so what makes honey bees good pollinators? We hear that they're great pollinators. But what about other pollinators like wasps, bats, moths?

**Jamie** 41:47
Yeah. Yeah. This is a fair question. It's a really good question because we, of course, Amy, you and I are honey bee people. We're here on Two Bees in a Podcast. We're talking about honey bees, we love honey bees, and we enjoy working with them, and want beekeepers out there listening to us to enjoy working with them as well. But there are tons of other types of pollinators. Wasps and flies can be pollinators, beetles, and ants, we're just here in the insect grouping. There are also bats, like you mentioned. Mammals can be pollinators. So I will say a few things first. Just because honey bees are good pollinators and bees, in general, are good pollinators, doesn't mean these other things aren't. These other things can be great pollinators. In fact, these other things can be the dominant pollinators of specific plant types. For example, there are a lot of wasp-orchid mutualisms where certain orchids rely exclusively on wasps moving pollen around. We know the same is true for bats. There are a lot of plants that require and rely heavily on bat movement of pollen around. So these things are great pollinators. But really, what makes bees, in general, and honey bees, specifically, great pollinators, is that bees, in general, and honey bees, specifically, eat pollen. They go to flowers for the purpose of collecting it so they can take it back to their nest or their hive and make more bees. And because they have to collect pollen, they're built to collect pollen, their bodies are covered in branched hairs that pollen sticks in while the bees are visiting these flowers, there's even some evidence that as bees fly,

they build up an electrostatic charge, opposite of the pollen on the flower. So when bees touch, the flower pollen literally drops off the anthers of the flowers right on to the bees' body, those branch hairs capture it. Bees have special parts on their legs that help them comb the pollen from their bodies and put it where it needs to be to transport it back to the hive. And even as good as bees are at collecting pollen, they can't get all of the pollen grains off of their bodies. So these branched hairs on their bellies, on their legs, on their backs, etc. continue to hold pollen so as bees move from flower to flower to flower, they're spreading this pollen around. So bees are super pollinators because they're built to collect it, given they eat it. A lot of these other things are great pollinators, but they're not there to collect the pollen. They're there just to get the nectar. And by virtue of being there to get the nectar, they're spreading it around. But bees have to have it. There are 20,000 species of bees in the world. They have to have it, and they're out there moving pollen around in an effort to collect it. And so honey bees have all those traits. Another couple of reasons that makes honey bees unique, number one is that they are manageable. You can move them, you can manage them to be strong, and you can manage them to have lots of bees that are healthy to be available to pollen. And finally, a lot of people specifically like honey bees, because they nest in such large colonies. Bumble bees are great pollinators too, but a bumble bee nest might have 100 to 300 individual bees in it. A honey bee nest might have 40,000 to 50,000 bees in it. So numbers, management, and the fact that bees are built to collect and carry pollen make bees, in general, but honey bees, specifically, such great pollinators.

**Amy** 45:40
So is it true that a honey bee will leave, let's say a forager leaves, and if she goes out to a watermelon, is she going to continue going from watermelon to watermelon to watermelon? Or do the worker bees kind of bounce around? I mean, I've also heard that, but I'm not quite sure if it's true.

**Jamie** 45:57
Yeah, I mean, that's such a great follow-up. So the term for what you're asking about is called flower constancy. And honey bees exhibit flower constancy, which means if a honey bee is out there working watermelon, that's what she's going to work. She's not going to hit watermelon and on the way back to the hive, stop by some gallberry just to top herself off before she gets there. She's there to work watermelon. Now, there may be bees in the hive that are working gallberry or whatever else might be blooming at the same time. But the bee that's working watermelon is going to collect watermelon pollen, and that's what she's going to do. And so that's one of the benefits of honey bees is that flower constancy. A lot of bees will just kind of bop from species to species to species, whatever flower is available right in front of them. But honey bees tend not to do that. And that really helps them move large amounts of the pollen you want moved around, around. And so they're really great at that. Great point.

**Amy** 46:56
Awesome. Okay, so for the third question that we have, this person, they followed our rules, they followed the label because they knew it was the law when they were treating for mites. And so they had basically treated for mites and then found out just a little bit later that there was some sort of pesticide that was sprayed. And so this person knew about the pesticide, so I'm just gonna say it was Bti for mosquito control. We have a lot of mosquitoes here in Florida, and Bti is not supposed to be harmful to

honey bees. But she's following the label, and then Bti was sprayed, we're wondering, was there any sort of relationship between the combination of those two things that may have had an effect on her honey bees? Because she did end up losing a lot of honey bees. And so has anyone looked at this research? And whether we're looking at individual ingredients or a combination of these, what does that look like? And what are the effects of this?

**Jamie** 48:00
So this individual's asking a very interesting question. I've never really had it posed to me this way. Kind of the way they ended their question was, they ended their question with a statement, which is in the future, I'm going to time my Varroa treatments not to coincide with general pesticide applications I know to be happening in the environment. The point in this very specific case is, I know that there are times when Bti is being put out to control mosquitoes, and I will avoid potentially treating for Varroa during that period. So there's so much to unpack here. So I'll just try to make it as succinct as I possibly can. So let's just start by explaining a few things for the benefit of our listeners. Bti is Bacillus thuringiensis, and the I stands for a particular subspecies, the bacillus is the genus, thuringiensis is the species, and this is just BT. BT is a bacterium that produces a toxin. And the toxin, depending on the strain of BT, might be toxic to moths or beetles, or in this case, mosquito larvae. So the idea is if you put this out to control mosquito larvae in the water, the mosquito larvae will get exposed to it and die. So there's been a lot of research on BT impacts on honey bees. And it's, of course, an incredibly debated topic, less so from the science world, but more so from the general public. And the research cumulatively suggests that BT is innocuous to honey bees. There's just no impact of BT on honey bees. Now, there's, of course, lots of opportunity in the future for folks to find out otherwise. I don't want to suggest that the book is closed here, but the best evidence we have at the moment is that BT doesn't bother honey bees in significantly measurable ways. Now, remember, two, there are different strains of BT and the strains tend to be specific toward insect groups. So something that's bothering mosquito larvae wouldn't bother as much malts or beetles and vice versa. So the reason I'm pointing that out is these strains are developed for specific types of insects, which makes it even less likely for it to impact honey bees. But in this particular scenario, and again, I didn't see the bees, I didn't see the colonies, I wasn't able to do a pesticide analysis, I don't know who was exposed to what, but in this particular scenario, I would expect BT Varroa treatment to be the least possible of all possible synergistic impacts in honey bee colonies. So I would think in this particular case, it was just a coincidence that the individual saw with their Varroa treatment a high loss of bees. It might just be an incorrectly applied Varroa treatment. This particular one happened to be formic acid, which is easy to incorrectly apply. And if done outside the temperature range, whatever, it could impact bees. But that said, there's a better theme running through this question besides the very specific BT formic potential interaction. It's this idea of, if I know that pesticides are being sprayed in an environment, say I'm pollinating a crop with my bees, and I need to treat for Varroa and there are compounds being put on the crop to control X, Y, & Z, how should I time my Varroa treatment? And I would argue that there's not a lot of research on that. It's actually a really great question to think about, but there's not a lot of research on it. I know that when pesticide analyses, screening analyses are done in honey bee colonies, it is very common and very easy to find whatever compound the beekeeper was using to control Varroa. So we'll start there. Number two, it's also easy to find things that are coming in from the outside. What I would argue is that if everybody is following the label, both the person who's applying the compounds in the field, as well

as the individual who's treating their colony with the Varroa treatment, then everything should be okay and the risks should be mitigated and minimized. And then I'll just throw in one more statement, Amy, which I really believe to be true. Varroa are really bad for bees. So hitting a Varroa threshold that's really high, say 4, 5, 6, 8, 10, 15 mites per 100 bees during a time of the year that you know things are being sprayed around your bees, and then not doing anything about those Varroa, mean that you're putting the bees at greater risk to die from Varroa than you might encounter from a potential synergistic interaction between what's environmentally available versus what you're putting in your hive. So I would say that, in this particular case, it's unlikely that the interaction that was proposed, BT and formic, actually impacted bees. But generally speaking, I wouldn't make Varroa management decisions based on environmental applications of pesticides. I would make it based on, do my colonies have Varroa populations that need to be controlled now? And if so, I need to do something about it. The only thing that might come into play here is if you really believe that there's a potential synergistic interaction of what's going on in the environment with what you use, then try to use something in your colonies that, itself, would be something that would be expected to have a very negligible impact on bees. And frankly, if you follow the label of any of the Varroa-sides, that should always be the case for all of them. I know I really talked a lot there and rambled around, but there's a lot there. And I just wanted to make sure and say controlling Varroa, I think, is incredibly important. But I didn't want to overlook the question being asked, because this is a fascinating question. How should we time our management related to environmental applications and pesticides that we know are happening? That's a really great question.

**Amy** 54:12
Yeah. I mean, as I'm looking at the question, I have a couple of other questions. Did you monitor before you treated? So we don't actually know what those numbers were beforehand, and then also Formic Pro was used, and were chemicals rotated as far as Varroa treatment went? So I guess those are just two other things that you probably have to ask the questioner to see what that kind of looks like, whether they had been using Formic Pro every single time they were treating, whether they looked at mite loads before and after, but that's something that we really push for, is to monitor before treatment to see if you need to treat, and then after the treatment to monitor for your mites afterward. So I guess those are just the things that I would add to that. Alright, so those were our questions and answers. Thank you so much for listening, and we hope to see more questions from you all. Dr. Ellis and I were just talking about how we've answered over 200 questions, probably, in our podcast. And so, we're waiting for you all to run out of questions, but you haven't done that yet. And so we're very excited and look forward to hearing from you. Hi, everyone, thanks for listening today. We'd like to give an extra special thank you to our podcast coordinator, Chelsea Baca, and to our audio engineer, James Weaver. Without their hard work, Two Bees in a Podcast would not be possible.