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EPISODE 209 TRANSCRIPT

Jamie

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

Hello everybody, and welcome to this segment of Two Bees in a Podcast. Today, we are being rejoined by Professor Dirk de Graaf from the Laboratory for Molecular Entomology and Bee Pathology in the Department of Biochemistry and Microbiology, Faculty of Sciences at Ghent University. His beekeeping outreach events are identified as the Honey Bee Valley, and so that's what the beekeepers are kind of known for as far as the extension arm of his lab. And today, we are interviewing Dr. de Graaf about the Better-B Project. So, thank you so much, Dr. de Graaf for joining us today.

Dr. Dirk de Graaf

Hello, hello to all of you. Yes.

Amy

So, we've had you in the past before, but sometimes our listeners will listen out of order. So, we're wondering if you could just share a little bit about yourself and how you got into the beekeeping world.

Dr. Dirk de Graaf

Well, I'm professor at Ghent University and I'm leading a laboratory that is focusing especially on colony losses, and I have approximately 10 PhD students and all are covering different topics, but all focused on bee losses. I am also coordinator of two major projects of the European Commission, one is called B-Good and the other is called Better-B. So, B-Good was on sustainable beekeeping and the other one is on resilient beekeeping.

Jamie

Dirk, I've known you for many years and I really just love hearing about the research that you and your team do. You guys are so productive. One of the things that I really appreciate about your lab is that you're very beekeeper focused. You guys try to find solutions for beekeepers, of

course all around the world, but also specifically in Europe. And you were talking about these two large projects. You have Better-B and B-Good. Today, we are inviting you to come in and talk about Better-B specifically. Both of these are great projects. But if you don't mind, could you tell us a little bit about the background of how the Better-B project began?

Dr. Dirk de Graaf

Well, it was a call from the European Commission from 2022 on resilient beekeeping. And at that moment, we were already working on the B-Good project where we were doing experiments with the hive monitoring system and to try to find out whether they could give an indication of the honey bee health so that you have, let's say, automated data, the data that are collected from a hive and that are then interpreted and give an indication when the colony is doing bad. So, we thought that maybe this technology could also be used just for the purpose of selection.

Another thing that was playing a role was the fact that I had some PhD students in Africa. In Ethiopia especially, the Varroa mite is also introduced, but it cost only for a few years of problem and that after the colonies were completely, let's say, in balance with the Varroa mite – in fact, the things that we further developed for this call of the Commission was that we wanted to use, let's say, sophisticated technology, advanced technologies, but also returning back to nature, let's say, to combine these two things to make bees resilient again.

Amy

So, can you tell us about the project objectives for the Better-B project?

Dr. Dirk de Graaf

So, our proposal was on restoring harmony and balance within the colony and between the colony and its environment, and therefore, looking especially at what happens in nature.

But the call was written as such that you could choose to have a focus on biotic factors or on abiotic factors. So, with our consortium we have chosen for abiotic factors. And then there are different themes that were developed in different work packages. The first one was on pollinated ecology where we worked on landscape carrying capacity. The other was on the resilience to chemicals. And there we have had two focuses, one on where we looked whether the ecosystem itself, where a colony is placed, can have an impact on the resilience of the colony. And so now we are doing tests with a gradient of ecosystems to see whether that plays a role. And the other was more molecular on the insecticide target side. And then we had another package on the resilience to climate and heat stress, a lot of genome sequencing there, critical temperature limits and also hive construction. So, really trying to understand how you can construct your hive the best to avoid problems with heat stress, for instance. And that was an important work package on Darwinian selection, where we give natural selection a chance. The last one was on the future of beekeeping, where we worked on better beekeeping practices and also on invasive species, for

instance, what is the risk that they will go to the north in Europe or that they will leave Italy, for instance. So yeah, that's a bit what we are planning to do.

Jamie

This sounds like a really large effort, and you mentioned all these work packages, these kind of sets of objectives that you have on the project. So, I'm assuming that this is a fairly large team of people who are working on it. Could you talk a little bit about the institutional organization? Are there faculty from multiple universities or beekeepers involved? How is the team organized?

Dr. Dirk de Graaf

In total we have 18 partners. Two of them are out of the European Community since the Brexit. So, the partners from the UK are no more part of the of the European Community, and also Switzerland is out. So, they are so-called associated partners. We have quite a multidisciplinary team. For instance, the team of the UK is more involved in physics, let's say, than in beekeeping, but we have some extension labs as well, or academic university focusing on bees or insects in general. And then we have one partner that is giving us support for the management of such a large consortium.

Amy

Dr. de Graaf, we're talking about Better-B, and then you talked about B-Good for the sustainable beekeeping. And I'm wondering if our listeners would be able to have access to maybe a website or where could our listeners go to learn more about this project?

Dr. Dirk de Graaf

Yeah, we have for both projects. We have a website, and I think if you just Google the word and then beekeeping as a second term, let's say, you should easily find it.

Amy

Definitely. And for our listeners, we can add those links to our additional resources on our website as well. So, I want to talk about some of the major outcomes of the Better-B project. It sounds like a lot of things that you all are working on, it sounds like a lot of projects that are happening, and as you said, it sounds like there's a lot of collaboration on the team. So, what are some of the major outcomes of the project so far?

Dr. Dirk de Graaf

So, with respect to the landscape carrying capacity, the major task is in fact the development of a resource model for the bees so that we can make a prediction in which region, how much food that is available for the bees. So, it's based on maps, it's based on habitats and on the plants in these habitats, and how much pollen they produce, how much nectar they produce. So, this is in

full in its developmental states, but what we could finish already now in the first reporting period that's after 18 months, we have launched a citizen science project. It is called BeePlants.au. So, that's website and where citizens, beekeeping people interested in the environment, let's say they can just record about flowers that they see that are blooming and when there is a visit of a pollinated, they can describe whether it's a bee, a bumble bee and or another wild bee and just send that record. So, we have a lot of data from the field, from citizens that help us to validate the model that we are developing now. So, this is something that we could finish already.

Now, with respect to the resilience to chemicals, we ended a large study on mutations in insecticides. So, the idea is that, so a lot of these insecticides, pesticides, they work in fact on the communication between neurons. And so there are receptors receiving signals coming from another neuron and a lot of these pesticides work on this interaction. So, what we are trying to find out now is whether you have, if there are, in populations somewhere in the world, mutations in these insecticides show the receptors that could give them a kind of innate immunity or protection against these pesticides because they would not influence the normal functioning of these communication between the neurons.

So, we found about 10,000 mutations in these receptors and then we could, let's say, reduce that number to a short number of mutations that seemed quite promising. And the idea is that we can use these mutations as an indicator, first of historical contamination, because it might be that there was quite a lot of pressure because of the high use of chemicals and that because of that, the mutations were developed. Or that it can also be an indicator of indeed a kind of innate immunity or protection that these bees have and that we can screen our populations, whether we can find bee colonies with similar mutations.

And then with respect to the resolution to climate and heat stress, we have now done quite some genome sequencing, 532 whole genome sequencings done on a total plant of 1500. So, the idea is that we try to find out whether adaptation to the environment, to a certain climate, whether that has a specific genetic signature with respect to the critical temporary limits. We look at the colonies all over Europe to see whether they can resist heat stress, meaning higher temperature, but also cold stress, so very low temperatures. But that was quite remarkable. So, we expected that in Mediterranean countries they would be better adapted to heat stress, but that was not really the case. In fact, what we saw is a very widespread outcome even in a single colony. So, that makes the finding of the genetic origin of heat stress a bit more difficult. But OK, that's how it is. That's science. Sometimes, you have a plan and it doesn't work or the science behind it is a bit different.

And then with respect to the Darwinian selection, we had a plan to start up Darwinian selection in nine countries. So, Darwinian selection is that you don't feed the colonies and that you just look at which colonies survive. And then the next year, you breed among those that survive and then try to further improve, let's say, the genetic constitution of these colonies. Remarkable. So, we found out that in three countries it completely failed. So, the setup was you start with 25, you

split them each in four so that you have in total 100 new colonies. And then they have to survive the winter. Now, here in Belgium, all these 100 colonies, they died in the first winter. And most probably it is because we have here in Belgium, let's say, very little genetic diversity because there is a propagation of, let's say, a very limited number of breeding colonies, meaning that we have all more or less the same genetics. And then on top of that, we all go to the same mating islands, narrowing our genetic diversity even more. So, we have to start it up again. But we will make some corrections this year. In fact, what we will do is that we will put our colleagues not all on the same spot because 100 colonies on the same spot was also a supplementary stress that was given to the bees.

With respect to the last work package, Future of Beekeeping, we have developed an online tool where you can test the proper Varroa treatment for your region based on climate conditions. Some products need evaporation and there are ideal temperatures. And it's more or less based on the best working conditions for all these products. And so, you can easily look on the map and then ask the tool, let's say, I wonder what is for my region the best Varroa treatments you can select.

We have also a topic on low-stress beekeeping, and it is based on a survey among beekeepers, just that they give their own impression, that kind of appreciation for different beekeeping techniques and which way they disturb the colony.

But we also have an experimental confirmation. And this is quite interesting because the plan is that we will compare different methods of, for instance, oxalic acid treatment and that we then put sensors in the colonies and we look how the colony responds. One of the most promising sensors is that it measures vibrations because in the B-Good project we saw already that if you give a knock to a colony, meanwhile you measure the vibrations that are sent out by the colony, the bees are always making a bit of noise, I call it, but it is, it is more vibrations. But when you give a knock, the background stops immediately and then it starts over again. And you have a certain pattern that you can follow. And the pattern is different when colonies are healthy, or colonies are under stress. We are using this technique now to validate whether different techniques done on bee colony have different levels of stress. And with the goal that eventually we select those techniques that are causing the lowest stress so that we have a kind of low-stress beekeeping practice that we can promote.

Jamie

Well, I think you guys sound like you're trying to tackle a lot of different things with this project. It sounds really amazing. And partially, you've already answered this next question, because I was listening to you talk about all the things that you guys were doing and all the ways it was helping beekeepers. So, I'm just going to ask that question and see how you frame it. But I know you're early in this project as well, but how can your results help beekeepers? That's the end goal. How can your results help beekeepers keep their colonies healthy and productive?

Dr. Dirk de Graaf

Well, I think that the situation is a bit like this. After the Second World War, we saw that the intensive beekeeping practice becoming more and more popular, it's present and what most of the beekeepers do. As scientists and people involved with beekeeping started realizing now more and more that there is a lot of stress and a lot of things that are not in line with the biology of the insect, let's say – and so I think there is a tendency to make this intensive beekeeping more harmonious. I mean, there is more harmony and balance in the colony and with the outside world. What we are trying to do is indeed to make these minor changes to the intensive beekeeping practice so that the colony suffers less from our own practices, so that in total they are better equipped to cope with the environment and that they survive better. And so, this is in fact the overall plan that we have. I think very practical, the low-stress beekeeping guidance that we could give can help any beekeeper. On the other side, I think landscape carrying capacity, if one of the stresses that we cause to the bees is that sometimes we have simply too many colonies in a certain area where there is only little food, we should balance that much better. So, I think that the model that we are developing can help that so that before you start beekeeping, you simply have a look at your region and what is the capacity of this region and that you then set the number of bees that is in balance.

Yes, Darwinian selection, okay, this is of course a bit tricky. I don't want you to do exactly the same what we did and lose your 100 colonies. That's not okay, but okay, we have to learn from it. But the same thing that we are doing now, with respect to the low-stress beekeeping, we are doing also in the Darwinian selection, meaning we have also these sensors there. We hope that the sensors at the end can help to make selection in your breeding program so that you don't have to do all these testing anymore and that you simply rely on sensors for selecting those colonies that are doing the best.

And then, yeah, well, I'm looking at all the things that we have done. Each and every point has or eventually can have a contribution for the beekeepers. But some of them are rather far away plans or advantages that we can offer. But we started to look at all kinds of stressors and try to understand them better so that later on we can have a beekeeping practice that takes them into account.

Amy

Yeah, I think that's all great. I'm just thinking about all the applied research that you all are doing, and I think it's just really great for the beekeepers and understanding the resilience beekeeping, right? We've talked about Better-B, which is this newer project that we brought you on for, but you also brought up the sustainable beekeeping project called B-Good, which is an older project that you had. So, I know we were going to talk just about Better-B, but I would love to hear about B-Good and some of the main outcomes and accomplishments in that project as well.

Dr. Dirk de Graaf

Well, the idea and B-Good was just to determine a health status index based on data sets that we collect in so-called mini apiaries. These are colonies that are apiaries that are part of the partner institutions of our consortium, let's say. So, in parallel to the automated data collection by the sensors, there were also sampling plans to measure the disease levels, Varroa levels, the brood development, colony demography, all these kinds of data were collected, and then the idea is to put them, let's say, to develop a kind of algorithm that should determine the health status of that colony. And what eventually came out is that the weight of a colony is quite an important parameter to predict the health status of a colony. This was unexpected because it was so simple. But the only problem was that, especially the data rather late in the year, in the bee season in fact, were important or the most important to determine that health status index. So, in that sense, it was mostly too late to intervene in the colony and to make corrections. And then like I said, this vibrational data recording was an accelerometer and then a knocker and it was an electromagnetic knocker that gave a knock on a colony, seemed to be a much more powerful tool to measure the health status. I think this was the most important outcome.

We developed also different tools, for instance, to find genetic markets of traits that are defensive for the Varroa mite, the suppressed mite reproduction that we developed a quick laboratory test for. There was also a lateral flow device, which is this kind of predictor where women, when they think they are pregnant, they can use to have the outcome. Well, these kinds of tests were also used or developed to test for neonicotinoids, and it allowed that in any matrix of the bee colony, you can easily check whether there is a contamination by neonicotinoids. It was also tested for plant material. So, if you buy plants somewhere in a shop, then you could if you want to just check whether the plants were ever treated with neonicotinoids, or you can test your seeds if you want. So, there was a quite a central goal, but there were also quite some site projects where we develop smaller things that were nice to be used in research in beekeeping practice.

Jamie

So, Dirk, I just have to say that's it's really amazing you guys are doing so much through this project, so much through the project that you guys have already finished. We're going to make sure and put links to the websites in our additional resources. So, all of you listening to this podcast episode can follow up on those websites and see everything that you want to know about Better-B and B-Good. Dirk, I just want to thank you so much for joining us on this episode of the podcast. I really think beekeepers everywhere are going to benefit from your team's work.

Dr. Dirk de Graaf

Thank you very much.

Amy

It was good to have Dirk de Graaf back on today to talk about the Better-B project. While he was talking to us, I was just thinking about the size of the project with all the collaborators on it, and I'm just thinking, do we have anything here that's similar as far as the project, the types of projects and things like that compared to the Better-B project?

Jamie

Well, we do have some things that I would consider comparable, but maybe not as common. For example, there are these huge, what we call CAP grants. I believe CAP is an acronym that stands for Coordinated Agriculture Project Grants, and those could be up to $5 million. And within those, they usually go out to very targeted issues. Let's just say honey bee losses. The first CAP grant of which I was ever aware was this one on honey bee losses, you know, almost 15-20 years ago now. The thing about those CAP grants though, is, still, the objectives are kind of thematically connected. When I hear about these massive projects that Dirk and colleagues are doing through the EU funding like Better-B or B-Good, they have what they call these work packages. You heard Dirk refer to it. These work packages are internally consistent. They may be about pesticide impacts on bees or pathogen impacts on bees or something like that. But from work package to work package within the same funded project, they can be quite different. And if you heard Dirk talking about it, the work packages that they were doing as part of this Better-B project were really just diverse and, I think, impactful.

So, as someone who's from the United States and gets grant funding in the United States, when I look at my European colleagues, especially folks like Dirk who are coordinating these massive things that are really just these sweeping efforts to look at honey bee colony health or beekeeping resiliency, etc., I'm always amazed at how they can do it and the contributions that they're able to make. And also, you know, given the density of the population in Europe, the number of folks who are bee scientists there, they really have good opportunities through these huge funding programs to make big contributions to beekeepers in Europe. And not only that, but we get out of those projects things that we can use here. So, these are really big internationally impactful efforts. Of course, Dirk's led a few of these and it's because he's been so successful with it. So, it's really great to have him all hearing him talk about Better-B and the success that they've had through that project.

Amy

Yeah, definitely. They have so many projects. I just decided to do a quick Google search on Better-B, and you know, he has an article on Bee World, and so we'll be sure to link a lot of the websites that he was talking about and the publications that he has, and hopefully our listeners will be able to go and read a little bit more about their work.

Stump the Chump

It's everybody's favorite game show, Stump the Chump.

Amy

Welcome back to the question-and-answer segment, Jamie. The first question that we have was actually asked by an 11-year-old yesterday at a workshop, and I thought it was a really fun question. He had really great questions, but he asked, when we were talking about Varroa monitoring, we talked about powdered sugar shake, we talked about the alcohol wash and dish soap wash, and he asked what does powdered sugar do for Varroa and monitoring? So, what's the point of using powdered sugar?

Jamie

I actually know this answer.

Amy

Great.

Jamie

Yeah, maybe I often know the answers, but this one I don't even have to look up because it's close to home, and I'll tell you why. There are really two things that are the leading suppositions for how powdered sugar is effective when we're trying to knock Varroa off of bees. And of course, this is being referenced in context of using powdered sugar in these powdered sugar shakes to be able to estimate Varroa populations on bees anyway, right? The idea is that you put bees in a jar, you put some powdered sugar in the jar, and the bees get coated in powdered sugar. Then, you invert the jar and the Varroa will fall through the lid of the jar, which is now screen mesh. And so, you can count the Varroa, count the bees, and say you've got a Varroa per bee estimate.

How does that stuff cause Varroa to fall in the first place? Well, it's probably these two things I keep superficially referring to but not telling you. So, let me tell you now. One is it no doubt increases bee grooming behavior. So, they're trying to groom this stuff off of themselves. So, that causes them to, in the process, brush mites off of their bodies. But the reason this question is near and dear to home is because years ago, so long ago now that I forget the years, I've been at UF almost 19 years, I had a postdoc, Dr. Kamran Fakhimzadeh, years ago and he actually looked at the question of how powdered sugar could cause mites to fall off bees. He did this with scanning electron microscope images, and what he did is he looked at the feet, as it were, of Varroa. He was showing that when bees are dusted with powdered sugar, the Varroa's feet, their tarsi, the hooks on their feet, etc., they can get clogged with this powdered sugar, which we hypothesized, made them lose their grip. So, you couple that with the fact that the bees are grooming themselves, then you get Varroa that become dislodged.

Now, I did have a colleague years ago who made the point, when people started doing these powdered sugar things, they would call them powdered sugar shakes because the idea is that you

had to put the powdered sugar in the jar and then you shake the bees to facilitate this dislodging. But he made the argument, Marion Ellis was his name of a former professor at University of Nebraska, he made the argument that it's not necessary to shake the bees, that if you just dust them with powdered sugar and set the jar down for two minutes, they would walk and tumble all over one another, and this was enough to thoroughly coat them and initiate that grooming behavior. And then Cameron's further evidence, clogging the feet, as it were, of Varroa, causing them to dislodge from the bees, at which point you could gently shake them out of the screen mesh lid of the jar.

Amy

That's interesting, I didn't know about the clogged feet for Varroa thing before this.

Jamie

Right. Once we finish the Q&A, I can actually show you the pictures from that.

Amy

Cool.

Jamie

It's not something we can do easily over a podcast, but basically it gives the Varroa dirty feet, and they can no longer hang onto the bee.

Amy

That's so funny. All right, so for the second question that we have, this one is a really interesting one, I mean, all the questions we have are interesting and I love them. But this one was asking about, you know, working bees and periodically they get into some defensive colonies. We all have probably. And then this person gets covered with stinging bees, right? So, there are stingers that are left in their veil and their clothes, everywhere basically. And the question is, is there anything related to excessive bee stinging? So, basically, like the bees will sting, the venom shoots out, there's a scent, there's a pheromone that is being released. Is there anything that shows that that pheromone or that scent will have a negative effect on human health?

Jamie

I'm not aware of any research that has shown that anything other than the physical sting itself going into your body can cause a problem. So, I'm thinking about this kind of out loud. So, you guys now are all going to fall victim to my kind of stream of consciousness here. So, this individual is saying, OK, I'm getting stung a lot, but besides the stings physically going into me, are there pheromone or other volatile issues that I might experience? Not from the sting, venom physically going into me from the sting, but just the association of being stung.

I'm not aware of anything at all other than what the venom itself can do. So, if you had asked me this question, I would say five years ago, I would have said 100%, venom has to be injected into you in order for it to be a problem. However, I do know I am aware of one individual who was collecting venom, and maybe we've talked about this on the podcast. I can't remember.

Amy

I think we have.

Jamie

Yeah. But the way that venom is collected, or at least this particular collection device, is you can coerce bees to stinging a sheet of glass. The venom gets on that sheet of glass and dries on that sheet of glass, and the way that you would collect it, you would use a razor blade to scrape that dried crystalline venom off the glass and into a container. Well, the individual who was doing this was either breathing it in, which is what I assumed, or absorbing through his skin in large amounts that he actually – he didn't have a hospital-esque reaction to it, but he definitely seemed to be feeling the effects of collecting venom that way. I don't know if it was through touch. I think he wore gloves while I was doing this. So, I presume that he just might be breathing in harmful amounts of this venom dust, right? But that was very concentrated on this sheet of glass, and I don't think that that would be duplicated just by the sheer – a lot of stings going into your bee suit or into your bee clothes. So, I would argue for most beekeepers who are just being stung, the greatest threat of stings is the stinger going into you and releasing venom. I do think when you are collecting venom using venom collection devices, you just need to be aware of the other ways that you might get exposed to venom in those contexts. But for the average beekeeper, you know, myself included, because I don't collect venom, I think getting physically stung stingers going into our body would be the threat associated with it. I don't think it would be the threat associated with alarm pheromone or venom volatilization at the time you're being stung.

Amy

Yeah, I think that makes total sense. So, for the third question that we have today, this individual currently has four hives. Out of those four hives, three of them are pretty good. Out of those three ones, really strong, but is aggressive, very defensive. They're wondering, if they swap that defensive hive with the fourth hive which is the weakest hive, will they do anything with the queen? Would that be okay, basically? Can you take the weakest hive and try to requeen into a more defensive hive to change the temperament of that colony?

Jamie

Yeah, I've had to think this through a lot over the years myself because colonies have different temperaments, and anytime you do manipulations between colonies with different temperaments, you're worried about these kinds of issues. It sounds like this beekeeper is really just kind of

doing the age-old equalization task of swapping the place of a strong hive with a weak hive in the middle of the day so that the strong hive is now sitting where the weak hive was sitting and the weak hive is sitting where the strong hive was sitting. And as a result, the weak hive gets boosted by the strong hives, bees going back to that spot, and then the strong hive population gets reduced a little bit. But that's okay because it's all in the name of equalization.

Well, the concern here is that the beekeeper's saying, well, I'm going to be moving not just a strong hive to the weak hive spot and the weak hive to the strong hive spot, but that strong hive is where the weak hive was, the weak hive is where the strong hive was and that strong hive's bees were defensive. So, if that weak hive with its queen is sitting where the strong hive that happens to be defensive was, are all of these defensive workers that are coming back to their original nest site and beefing the population of that weak hive, do those defensive workers pose a threat to the queen in that weak hive? I would argue, not an abnormally high threat. I know that people have done this type of equalization for decades and decades and decades, just swapping places between strong and weak hives, and I've not heard of any case, and in my own case, I haven't even seen it with my own eyes, where that weak hive moved into a strong but defensive hive spot would incur a greater loss of queens.

In other words, I think it's going to be completely okay if they do this, and they also make the point that once they move the strong hive, again, which is defensive, to the weak hive spot, its population should drop a little bit. And they want to use that as an opportunity to go in and find the queen in that defensive colony and requeen it. I think both of those are acceptable. I think swapping places between the two hives is okay. I think once you do that, you can go into that formerly strong hive in the weak hive's spot to find the queen and requeen it to try to mitigate that defensive behavior.

Now listen, if you listen to this podcast, you've heard me say a billion times that biology's messy. I cannot guarantee that the queens will survive this and that life will be good. But I will say, most of the time when you pull off this stunt, it's okay. So, I have no reason to believe that you're going to be assuming a heightened level of risk associated with this.

Amy

Yeah, absolutely. I would be interested for the listener who asked this question, try it out and let us know how it worked for you.

All right. Well, there you have it, those three questions. Again, we're always looking for questions. We love your questions. Jamie, I think about it sometimes, I always try to take myself back to when I first became a beekeeper. There were so many things I didn't know, so many mistakes that I made. I think everyone kind of goes through that as they're beginning and trying to figure everything out. But it's always fun to kind of talk through some of the things that people

are struggling with or just thinking about. “I wonder if I do this and I can do this.” I think beekeepers are the best problem solvers and just such a creative group.

Jamie

I agree completely. I think one of the things that makes beekeeping fun is just this never ending well of information that honey bees are and they're always throwing us curves. But the good news is there's so many beekeepers. We could all learn from one another and we've got plenty of advice to dispense. And I tell you, the longer I'm in beekeeping, the more convinced I know nothing.

Amy

Yeah, me too.

Jamie

So, I'm learning all the time and it's a really fun thing to be able to do.

Amy

Absolutely. All right, listeners, you know what to do. Send us an e-mail with those questions or send us a message on one of our social media pages.

Hey everyone, thanks for listening today. We would like to give an extra special thank you to our podcast coordinator, Jeffrey Carmichael. Without his hard work, Two Bees in a Podcast would not be possible.

Jamie

Visit the UF/IFAS Honey Bee Research and Extension Laboratory's website, UFhoneybee.com, for additional information and resources for today's episode. Email any questions that you want answered on air to honeybee@ifas.ufl.edu. You can also submit questions to us on X, Instagram, or Facebook @UFhoneybeelab. Don't forget to follow us while you're visiting our social media sites. Thank you for listening to Two Bees in a Podcast.