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SPEAKERS
Amy, Stump The Chump, Jamie, Serra Sowers, 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 00:47
Hello, everybody. Welcome to this segment of Two Bees in a Podcast. Today, I am joined by Dr. Nuria Morfin, the British Columbia Technology Transfer Program Lead with the British Columbia Honey Producers' Association. She's also an adjunct professor in the Department of Molecular Biology at the University of British Columbia. And I'm excited to talk to her about Varroa. Of course, we're always talking about Varroa, right? Jamie, I don't know if we've ever had an episode where we haven't brought up Varroa.

Jamie 01:18
I know. Our listeners probably get so excited about new Varroa information. And today's topic is incredibly important. So we're fortunate to have Nuria with us joining to be able to discuss it.

Amy 01:30
Yeah, so we brought Nuria on because there's a publication that she published called "Surveillance of Viruses in Varroa destructor Samples Collected from Honey Bee Colonies in Ontario, Canada," and I'm excited to hear a little bit more about Varroa and some of the Varroa controls and chemicals that they use in Ontario versus what we use. But before we do that, Dr. Nuria, can you tell the audience just a little bit about yourself, your experience with beekeeping and honey bee research?

Guest 02:03
Absolutely, Amy. Thank you for the invitation, Amy and Jamie, and I'm very glad to be here with you. So I'm currently the Lead of the Technology Transfer Program. What we do, all the provinces have a technology transfer program and the aim is to connect the beekeeping industry with research and education. So I do both applied research and also extension programs. Before this, I was working at the honey bee research center at the University of Guelph. And I was also a bee inspector for the Ministry of Agriculture in Ontario. In my beekeeping experience, back to when I was in university, I took one course on honey bee biology, and I decided to start beekeeping. And then bees took over, and I just went for that, basically, research, education and more beekeeping.

Jamie 03:04
So, Nuria, as Amy mentioned, you did some work on trying to do surveillance for synthetic acaricide efficacy against Varroa across Ontario. In other words, you were looking for pockets of resistance, you were looking for how good these products were against Varroa when you were doing this work. So before we kind of dive down into the meat of your research, could you tell us a little bit about Varroa resistance and why this is an issue at all?

Guest 03:32
Of course, so, resistance. We hear that bad word a lot, but what it means is that Varroa mites acquire an ability to tolerate synthetic acaricides and that results in an increased survival of the mites when they are exposed to these chemicals. So acaricides in Varroa populations, it can be first noticed as a failure of the commercial product to reach the expected levels of control. So that could be a sign that resistance can be happening. In the science world, resistance has been very interesting because it has allowed us to study these mechanisms at a molecular level, for example, microevolution. But it also has practical and economical implications. In beekeeping, the clear example would be the development of resistance to synthetic acaricides by the ectoparasite Varroa destructor. And I agree, I think beekeepers, we talk more about Varroa than we talk about hive products or even honey. But these Varroa mites are a very damaging parasite. As we know, it causes extreme colony losses. It's the number one cause of overwinter mortality in the northern hemisphere. It weakens colonies, causes immunosuppression, the colonies that are parasitized produce less honey, 50% less honey than healthy colonies. And we have limited options to control this mite. And one of the most popular options, still, is the use of synthetic acaricides, such as Amitraz, tau-fluvalinate, and flumethrin. So, we've been applying these chemicals for maybe three decades now. Varroa mites were introduced into the Americas in the late 80s, early 90s. And we were lucky back then to have these chemicals that we used, and we were able to control Varroa mites very well. When they came into the market, they had more than 90% efficacy. And perhaps, most of the beekeepers have used or have seen these products. They come in a plastic strip, and the plastic strip is impregnated with the chemical. So you hang these strips in between the frames of the brood chamber, and then the bees passed through the strips and the mites get in touch with these chemicals, and they have a neurotoxic effect. That means that they affect the central nervous system of the mites, causing, for example, paralysis and death. That's how they act. But in some cases, and some practices that we do as beekeepers or even nature, because pathogens will always be looking for a way to survive and to thrive, they can create resistance. That means that by getting in touch or getting exposed to these chemicals in the long-term, they can develop

mechanisms that make them resist -- well, I couldn't find a better word, but yes, these chemicals. For example, in general, in arthropods, there are different mechanisms of resistance. For example, reduced penetration, they even changed the way their cuticle is formed, and there's less chemicals going into their bodies. Then there's increased sequestration or excretion of these chemicals. For example, there would be enzymes that will bind to these chemicals and hide them in parts of the body where they cannot reach their target site. Then we have metabolic resistance, which is shown as an increase in the production of a certain enzyme that is in charge of metabolizing the chemical, and we also have alteration of the target molecule. So the receptor is modified to trick the chemical and they cannot find the target site. In the case of Varroa destructor, we have found or there's confirmation of these two last mechanisms, metabolic resistance and alteration of the target site. And this is relevant for beekeepers because it can change the way we have to control the mites. It can change the recommendations that we use, or even regulatory aspects of beekeeping.

Amy 08:12
Well, I think you just hit the nail on the head. I think you've just covered it. It's always interesting to me. I feel like every time I talk about Varroa, something new sticks with me. And I love the way you described Varroa and the problems that we're having as beekeepers. We have limited chemical controls, they used to work, they don't work anymore, or they're not working as often anymore, or as well anymore, right? And so, it's kind of a struggle for beekeepers, and whether you're in the United States and Canada, all over the world, really, we're struggling with Varroa and how to deal with Varroa and how to manage them. With your studies, specifically, can you go into detail about your study, with what you were looking at, and your methods, specifically?

Guest 09:00
Of course. So this study started because we were hearing concerns of beekeepers in Ontario saying that Amitraz was not working as it used to. And we were hearing all these anecdotes and observations, but we always need a way to confirm that what we're seeing is actually true, that is not a coincidence, for example. So we need a protocol, we need a method, and we need numbers to make sure that that was happening. We also knew that the last time that a resistance test was done in Ontario was in 2003. It was done by the Technology Transfer Program. And so we knew it was time to do another study. So we had three teams partner. The study was funded by the Ontario Animal Health Network, and we had collaborations from the Ministry of Agriculture, the Provincial Apiaries, Paul Kozak and also Tim Pasma were there in the team. From the University of Guelph, we had Dr. Ernesto Guzman and Tatiana Petukhova. And from the Technology Transfer Program in Ontario, we have Les Eccles and Devan Rawn doing fieldwork as well. So the first step was to ask beekeepers to volunteer, and we had a good response. We were aiming at commercial operations. And at the beginning, Devan screened 130 honey bee colonies using alcohol wash. And this is because we need, well yeah, we need Varroa mites to test if Varroa mites are resistant or not. So the first step was to screen these colonies and identify the ones that had five or more mites in 300 bees. And from this screening, we ended up with 12 apiaries that could participate in the study and 22 honey bee colonies. So we conducted a bioassay that was described by Jeff Pettis in 1998, with some modifications that the technology transfer team did. And in summary, for this test, you have to go to the yard, open the hive, make sure that your queen is safe, you can catch her, put her aside, and then shake three frames from the brood chamber into a bucket.

And then using a scoop of one-quarter scoop just like the ones you use in the kitchen, you scoop the bees and place them inside a modified mason jar. One-quarter of a scoop of bees is approximately 150 honey bees. So you place them in the jar, and this jar has to be modified, you have to change the lid. Instead of the normal lid, it has to be a wire mesh lid. And the holes have to be big enough to let the mites go through, but not the honey bees, of course. And then inside of these mason jars, we place two centimeters of the plastic strip, of the commercial product, of the acaricide that we were testing. In our case, we tested Amitraz, tau-fluvalinate, and flumethrin, and we also had a control group. And then the jars were placed upside down and on top of a Petri dish that had little holes to allow air to flow. And it had, also, a filter paper that was covered with Crisco, so a sticky material like a little tiny, sticky paper. And we left the bees there for 24 hours at room temperature, that meant between 22 and 28 Celsius. And then after that, we stroke the bottom of the jars with the palm of our hands, basically, we spanked the jars three times. And then we counted the mites that were on the filter paper. After that, we recorded the numbers. And then we did an alcohol wash with the remaining bees, the bees that were in the modified jar, and we counted the mites that were in this alcohol wash. Then we used these numbers to calculate the percentage of mites killed by the acaricide. At the end, we conducted 352 tests. We did four repetitions for each of the treatments. And we found that Amitraz was the most effective. And then tau-fluvalinate, and flumethrin were not as effective as the first one. And we also found differences between the regions. For example, the East and the Niagra regions had a lower percentage of mite kills by the acaricide.

Jamie 13:47
One of the statements that you made early in that previous answer was that there there are limited compounds that can be used to control Varroa. And so I'm curious, why did you choose the three compounds you chose? That would be Amitraz, tau-fluvalinate, and flumethrin. Are these labeled for use against Varroa in Canada? And what about some of these other compounds such as oxalic acid or formic acid? I'm curious about your choice of compounds.

Guest 14:14
Sure. So the concern of what we were hearing from beekeepers was a concern about synthetic acaricides. So we have three synthetic acaricides registered in Canada, which are these three, fluvalinate, flumethrin, and Amitraz. There are other registered products including oxalic acid, as you mentioned. So we chose these acaricides because we were hearing concerns from beekeepers about possible resistance to these products. So we focused on these for this study. There are other products registered to use in Canada including oxalic acid, formic acid, and other essential oils, such as Thymol, Hops, etc., yet we focus our energy on these three. And I guess, testing for resistance for oxalic acid or other treatments would require other types of bioassays. And also, because of the nature of oxalic acid, how it works, there are no reports so far of resistance, and it's unlikely that this will happen. So, that's why we chose these three.

Jamie 15:34
So, Nuria, you mentioned that replication is important. So I want to make sure that this is clear in my mind. You say you want to do three to four reps each time. Now is that three to four colonies per chemical? So for example, you do an Amitraz rep in colony one and colony two and colony three? Or

do you need to replicate each chemical within a colony to get a better colony reading? So you have three cohorts of bees from colony one, all tested for Amitraz, and three cohorts from colony one all tested for tau-fluvalinate as an example? So could you explain a little bit what you mean by replication?

Guest 16:09
Absolutely. So this is a very good question. And one of the challenges of testing for resistance is the variability. So we used 22 colonies for treatments, so the three acaricides and the control, and then four repetitions within each hive, or for each colony. So at the end, with the 352 tests, that means that for each colony, we scooped the bees 16 times.

Amy 16:41
So I feel like Dr. Nuria, I feel like these are the methods that are pretty common with resistance studies in research. And so, researchers are conducting resistance studies, and I'm wondering, do you think that beekeepers should also be testing for their resistance in their own hives? And if so, how can beekeepers do this on their own?

Guest 17:02
I think it would be a great idea to test for resistance. We're used to observations and anecdotes, but it's way better to confirm what we're seeing. So beekeepers can do this bioassay that I just described. There are other ones that could be used, for example, Dr. Rassol Bahreini from the University of Alberta, he designed another bioassay, and it's also very good to use. We're thinking of using this bioassay across the provinces in Canada and start testing and have a standardized method to compare and be able to test for resistance across different regions or provinces. And beekeepers can do this. And I would recommend to not only do one repetition, but to do a number of repetitions, three or four, and make sure that the numbers are right, and if they are not sure or if they need some help, to contact their apiary inspectors or their state or provincial apiaries, or an extension program that they could assist and go through the protocols for how to do it. But I do think it's important to express what we're seeing, to share what we're seeing, but also to confirm what we're seeing. Because we can shape, we can edit our integrated pest management approach, we can shape our recommendations, and they could also have regulatory implications. For example, moving bees, if we have a population of Varroa mites that are resistant to the synthetic acaricides, we don't want those mites to spread and move into other regions.

Amy 18:46
So something that we always recommend is monitoring for mites before and after treatment. For beekeepers, is that similar to testing for resistance? Or are there differences in that? What do you think?

Guest 19:00
Well, I guess the aim would be different. I guess if you use a bioassay, it would be to confirm the efficacy with numbers, the percentage of mites that were killed. But we also recommend, as part of an integrated pest management, to monitor mites before and after treatment and make sure that your

control method worked and you have mite levels below the Varroa economic threshold. So that's an excellent point. And that's something that we recommend as well.

Jamie 19:32
So I'm curious about one of the statements that you made about efficacy. You had said that Amitraz proved to be the most efficacious compound in the test across Ontario, and that's kind of what I would have expected. For example, if we did that here, there is evidence of Amitraz resistance in pockets around the US. It's even growing, but like in your case, what was still the efficacy? So you mentioned Amitraz was the most effective. What percentage of Varroa was it able to kill? And I'm curious about your tau-fluvalinate and flumethrin control percentages as well because you said there was evidence of resistance for those. What does that look like? Was Amitraz killing 80% of the mites but those other two controlling, killing 20%? So what are the numbers you were seeing?

Guest 20:17
So, for Amitraz, we saw that it killed 92% of the mites. And in comparison, flumethrin killed 78%, and tau-fluvalinate, 72%. Now the main question here, and we were discussing this with other elites of the Technology Transfer Program, and also with Dr. Bahreini from the University of Alberta, the question is, we are used to these high numbers and high efficacy of synthetic acaricides, but we cannot rely only on one single product. It would be better to have different methods or different aspects of integrated pest management to use, and make sure we decrease the number of mites below the Varroa economic threshold. For example, in that study that was done to test the efficacy of Thymol and ApiLife Var, they saw that their efficacy was 85%, if I remember correctly, and 50% for the other product. So that doesn't look like a lot. But if we monitor before and after treatment, if we apply different methods, or if we use cultural or mechanical methods to reduce the mite levels to less than the Varroa economic threshold, then we can keep the Varroa mites under control.

Amy 21:48
So something else that I noticed on the publication was that it was mentioned that the efficacy of Amitraz is lower in the United States. And so it's really interesting just comparing the US to Canada, and we have podcast listeners from all around the world. But can you discuss that just a little bit more? I feel like beekeepers are saying this, that the efficacy of Amitraz is not as good as it used to be, and so how do we kind of move forward from this and out of this cycle?

Guest 22:21
That's a great question. And I think there are a lot of similarities between Canada and the US, and we also have a commercial relationship. So, we have a common interest. So the conversation about resistance has been going on for some time now. And not only for mites and Varroa, but also in other areas, even of human and animal health, for example, antibiotic resistance, and this has been a discussion on how to move forward, what do we need to do to prevent or to solve this problem? So there are basically two approaches. The first one is to develop another molecule to which pathogens have no resistance or low likelihood of developing resistance. And the second one is to avoid practices that can lead to resistance. For the first option, it's quite difficult. We need a lot of research lab work and then transition from lab work to fieldwork, so it's quite complex. However, we're happy that Dr.

Erika Plettner from Simon Fraser University in British Columbia, she's working on a novel acaricide to control Varroa. Also, these novel products have to be different enough so we have less chances of seeing cross-resistance, for example, between tau-fluvalinate and flumethrin. In flumethrin, we started to see resistance early and this could be because the molecules are similar. So there was this indefinite and Varroa mites were prepared for this chemical. And then the other option to tackle or to work against resistance is to prevent its development through good management practices. And this could be, as beekeepers, to give the complete treatment, so don't break the strips, don't give half-doses, respect the time of the treatment, remove the strips when the treatment is complete, rotate the acaricides, that means don't use the same treatment over and over again throughout the season or throughout the years. And don't rely on one synthetic acaricide, use an integrated management approach and use as many tools as you can to control the mites.

Amy 24:49
So something that I learned when I first became a beekeeper was that we should be just treating twice a year. I don't know if that's really the case anymore. So there are a lot of beekeepers out there who I think are still on this regular schedule of treating. And so what is your recommendation for that as far as how often we should be checking for resistance? Should we be doing this every time we go into the colony? Should we do it four times a year? Should we do it once a month? What are your recommendations on that?

Guest 25:20
Oh, so how often should we be testing for resistance? That's a tricky question because it's time-consuming. So if you suspect that you can do it, I would say do it, if there's a reason for that approach, but if not, like you mentioned before, test or check my levels before and after treatment. And the other thing that I would say is beekeeping depends a lot on seasonality and weather conditions. So we have to be flexible and not go by the calendar, but take into consideration what the colony needs. So if we monitor for mite levels constantly, or throughout the season, we will be able to identify when treatment is needed, when we need to have an intervention and do something to control mite levels. So if you're starting beekeeping, and you're not very familiar with Varroa growth, with how it works, you can check for mite levels every month and see how they are doing. And you have to take into consideration different things, for example, mite levels, outside temperature, if you have super senior hives or not, there are limited, very limited options to treat mites during the summer when we have the super sun. So take all that into consideration and do your best to control the mites throughout the year.

Jamie 26:52
I think that's really good, sound advice. I have some follow-up questions about some of the things you were talking about with avoiding resistance. You spoke quite a bit about rotating chemicals. And I'm looking specifically at your results in Canada where you had somewhere in the neighborhood of 92% kill with Amitraz and then flumethrin and tau-fluvalinate were in the 70-something percent kills. And so when you've got a few active ingredients, in Canada's case, the three synthetics that you mentioned, plus a couple of others, talk a little bit about how you would design a treatment program that would help you avoid resistance. And number two, how often should compounds be rotated? So, I'm thinking kind of as a beekeeper here, if I looked at my treatment options, and Amitraz is 20% more efficacious than

the other compounds, I might be just tempted to use it all the time, rather than ever rotate into a chemical that's going to give me kind of subpar control. So could you talk about, just generally, how you would recommend avoiding resistance, and how you would recommend rotational treatments be administered?

Guest 28:07
Sure, and that's a very interesting question. And I have a feeling that sometimes, when we're doing workshops, beekeepers want a straight answer of what is the calendar, what do I do, and a formula on how to manage mites, but mites are complex and managing them is tricky. So I would recommend what I mentioned before, and also to check the regulations of your state or province. So there might be differences and different recommendations. For example, in British Columbia, we don't recommend a specific thing, but we recommend an integrated pest management approach. Don't rely on only one synthetic acaricide. Use other tools and leave synthetics like a last resort, for example. In other provinces, what they are saying is if you chose to use Amitraz in the Spring for some reason, then choose another one for the Fall treatment. For example, oxalic acid, in other provinces, they are suggesting to avoid the use of synthetic acaricides for now until we resolve what's happening with resistance. So it depends on your area and what regulations or what recommendations they are doing based on the evidence that they have. So some years ago, they would recommend, if you use Amitraz on year one, then use tau-fluvalinate or flumethrin or another synthetic acaricide on year two. But now, since we have more pressure, we can even say rotate or switch them around in the same season, in the year. So if you use Amitraz in the Spring, avoid using Amitraz in the fall. But again, as beekeepers, we have to be flexible and consider all these variables and make the best decision that we can.

Amy 29:56
I think that's all really good advice and you can never hear it enough, as far as Varroa management and decision-making in your apiary. Was there anything else that you wanted to add? Or any last words, comments, questions?

Guest 30:12
Sure, I guess I would say there will always be a race between pathogens and us. We will always be competing between pathogens and their hosts, in this case, honey bees. So I would say let's not take what we have for granted. We have limited options of synthetic acaricides. Let's use them wisely, so we can still have them as part of our tools to control Varroa mites. Another comment would be never trust the mites. They are smart, they adapt and they are damaging. So keep an eye on them. Never trust them. Monitor before and after treatment and use an integrated pest management approach. And also, check your area. Beekeeping is very regional. So join a beekeeping club, keep yourself updated, contact your provincial or state apiaries if you can to see what are the recommendations and what's happening. And if you don't have that available, get in touch with a university or an extension program to see what's happening in your region.

Amy 31:19
I think that's so funny. Right when you said, "Never trust the mite," I feel like that should be turned into a t-shirt or something. Like I want to challenge our listeners to design me a shirt that says, "Never trust

the mite on it" I think that would be really funny. Dr. Nuria, thank you so much for taking your time out with us today to speak to us about Varroa and Varroa monitoring and your study on synthetic acaricides.

Guest 31:46
Well, thank you for having me. It was really good to be here with you. And thank you very much.

Amy 32:10
Jamie, we are always talking about Varroa. But at the same time, I feel like every time I talk about it, I think about it again, and I'm like, sometimes people are not very comfortable with monitoring for Varroa, so how do we get them to start testing resistance? That's just another added thing that we have to do with our bees and in the apiary, right? And so it's just been really interesting to listen to researchers talk about resistance. And I kind of wonder, do you think we'll ever change? I mean, do you think we're going to be stuck in this cycle? And how long do you think we're going to be stuck in this cycle for? What needs to change?

Jamie 32:48
Yeah, there's a lot to unpack here, because it's so tricky. The whole time I was listening to her talk about this, I kept thinking we need to do a yearly monitoring program in Florida. It would be a really cool project to just monitor resistance development over time. Because just like what you said earlier, it's hard to add this to a beekeeper's list of things to do, and a lot of them already don't monitor or follow-up the monitoring after they treat to see if the treatment worked. So I really feel like it would be a great partnership between beekeepers within a state or province or region, whatever your country's experience, and then working between the beekeepers in that area, and whoever the technical experts are from the academic side, or from the beekeeping club side, or from the extension side, etc, to just have these yearly monitoring programs. So the whole time she was talking, I was like we need to do this in Florida. And Amy, one of the things that gets me is that our industry is reliant on so few chemicals. Now, the listeners have no way of knowing this. But today, you and I are recording from our respective homes because the University of Florida shut down, and there's a hurricane that's about to hit Tampa, and then work its way up to us over the next 24 to 72 hours. This morning, my wife and I went for a jog. The weather was beautiful. It was actually kind of cool, it was nice, it was perfect. And it was just like this, you know what's coming, you know the storm is coming. But right now it's not so bad. Well, the resistance is like that, to me, it's like we're all that proverbial ostrich who stuck our heads in the ground. And we're like, "Well, we get a little bit of control. Instead of using the labeled treatments, we'll go find this active ingredient in another product so that we can increase the dose ourselves." And this is how resistance takes place in those operations, which is it takes a little bit more and a little bit more and a little bit more, and right now we might be getting adequate Varroa control and our colonies might be pushing through it, but it's that calm before the storm. If we ever lost Amitraz or fluvalinate or whatever it is the beekeepers are using, man, we'd be in trouble. It's like we all know what's happening, but we're not doing enough to fix it. And that's what makes me nervous, just kind of like this wait-and-see for the hurricane, it's like wait-and-see for Varroa resistance. So this is the type of situation where more is not better, right? Yeah, more is absolutely not better in this case. So when you buy a labeled product, the amount of compound put into that product is what had been vetted for efficacy against the

mite, in this case, and safety for bees. And so what happens is when you get misuse of the label product, they no longer work because there's not enough active ingredient. So beekeepers, like I said, will then go buy that active ingredient in other compounds and other formulations, and then they will up the dose themselves, and they'll be getting adequate Varroa control, but they forget that treatment doesn't just potentially impact Varroa, it potentially impacts bees. And the reason to use those lower doses in the first place was this is what it took to kill Varroa but not harm bees. And as you increase these compounds, you might be getting adequate Varroa control, but it's just a "for now" situation. It's "for now" you're getting adequate Varroa control. And then how much are you going to have to increase it in the future and then run the risk of hurting the very thing that you're trying to protect? And that's the big scary thing with the development of resistance.

Amy 36:26
Yeah, I think I'll just end it with this. I mean, don't trust the mites. I thought that was great advice.

Stump The Chump 36:35
It's everybody's favorite game show, Stump the Chump.

Amy 36:46
Welcome back to the question and answer segment, Jamie. These questions that we have today actually were from Kansas beekeepers. So I just wanted to say hello to my fellow Kansans, from Florida. But the first question we have, this person was asking about the fat bodies of winter bees, and they're asking, specifically, are the fat bodies of winter bees what allows them to live longer? You'd kind of assume maybe with the fat bodies, it would just keep the bees warmer during the winter. Is that the thought process behind it? What are your thoughts?

Jamie 37:19
All right. So my answer to this question is actually a bit of a story. So let me just tell it to you this way. Until about five or six years ago, maybe a little bit longer, I forget now, but until about that time, fat bodies were something that I'd really never heard of in honey bees. And this is me being a bee scientist, right? And I even co-wrote a chapter on honey bee anatomy and physiology for a book years ago, so I should have known about fat bodies but hadn't paid much attention. Obviously, fat bodies have come to the forefront in the honey bee world because Dr. Sammy Ramsey, when he was a PhD student in Dennis vanEngelsdorp's lab, collaborated with my lab and a few other labs to look at what Varroa feed on in honey bees. And of course, historically, people believed that they fed all hemolymph, that's bee blood. But Dr. Ramsey and our team and Dennis's team and other teams collectively showed that they feed, in fact, on fat bodies. And so this has exploded interest in honey bee fat bodies when they found that Varroa weren't feeding on hemolymph, instead of feeding on fat bodies. So the reason that I told that little backstory is in the story that Sammy and I and Dennis and other colleagues published together called "Varroa destructor feeds primarily on honey bee fat body tissue and not hemolymph," in that paper, we summarize a number of functions of fat bodies because we try to make the argument that when Varroa feed on fat bodies and honey bees, it's not just the depletion of fat body, the disappearance of fat bodies that's the problem, this has a lot of downstream effects because of what fat bodies do. So what do fat bodies do for honey bees? Well, this paper where it's focused on

Varroa in the discussion section, we highlight a lot of literature on what fat bodies do for honey bees. Just to give a very, very, very broad overview, that includes proper immune function in bees, it includes pesticide detoxification in bees, it includes overwintering survival in bees as well as a number of other essential processes in honey bees. So then you fast forward and ask me are the fat bodies of winter bees important for allowing those winter bees to live longer than summer bees? So just to explain that for the listener, we know, increasingly so, that there's a distinction between the worker honey bees that are produced in spring and summer and those that are produced in late fall or winter. Those in spring and summer usually work themselves to death in four, five, six weeks. Those that are produced in late summer, fall, that kind of go into winter, they can live many months, sometimes up to six to eight months. So these bees are physiologically different from the worker bees produced just a few months earlier in the colonies, so people have kind of given them the moniker summer bees and winter bees. And we know one of the key differences is just survival. They just live longer times in winter than they do in summer. So the questioner says, well, are fat bodies part of the reason this happens? And the short answer is yes. Among their many functions, fat bodies are important for overwintering survival in bees. So having adequate and appropriate fat body deposits, this tissue scattered throughout the bee, it's important for bee survival through winter. So go back, then, to what we talked about with Varroa control. Well, Varroa are taking these things out of the bees. And so you can imagine a situation where Varroa populations peak kind of late summer, early fall, that's when bees are producing, most of the colonies are investing heavily in the production of winter bees. You can now envision a situation where this collective depletion of fat bodies or this compromise of fat body tissue scattered amongst workers throughout the nest could lead to a cohort of winter bees that don't live as long or function appropriately as they would if they weren't heavily parasitized. So the short answer to the simple question, are fat bodies of winter bees what allows them to live longer, it's one of the things that allows bees to live longer in winter. So absolutely. It's not the only thing but it's certainly one of the things that's important to survival of bees throughout winter.

Amy 41:43
So the second question actually has to do with summer bees. And so the question is, can summer bees survive through the winter if they have access to adequate food stores?

Jamie 41:53
I think these are great questions. Because I really think, Amy, to date, we haven't even interviewed someone who's kind of got that summer bee, winter bee distinguishing expertise. So I really feel like we need to have someone on to kind of elaborate on this idea further because I'm certainly not an expert on that. But the question is, can summer bees survive the winter if they have adequate food stores? So this is a really tricky question because it's kind of completely hypothetical. Right? By definition, the summer bees wouldn't be around in winter.

Amy 42:20
They wouldn't be summer bees.

Jamie 42:21

Exactly, they wouldn't be summer bees anymore. So you got to think about it as a bell curve. The vast majority of bees die at a certain age, but you get some short-lived bees on one end of the bell curve and some long-lived bees on the other end of the bell curve. And in winter bees, that hump on the bell curve is skewed to the right, where you get older, generally speaking, older lived bees amongst the winter bee population. So there are some bees that maybe are produced and function in August, which by definition would be summer bees, but might be longer lived. And then by the time fall rolls around, early winter, they may live longer than, quote, summer bees ordinarily would be able to live. And there's no doubt that fat body composition that we just talked about in the first question, but also access to adequate food could do that. But it also probably has a lot to do with activity level. There are clear data that show that honey bees can only put so many miles on their wings. And after that, they use their life up. They essentially die. So you can get some summer bees, late-produced summer bees hanging onto winter and living a few months through winter. But it's the exception rather than the rule. And if they are doing it successfully, it likely has a lot to do with them being less summer bees and more that kind of interface between summer bees and winter bees and having adequate access to food reserves and activity level up until the point that they kind of go into winter. So there are a lot of factors at play. It's kind of a confusing field right now, which is why I think it'd be great to have someone on with this expertise.

Amy 44:06
Yeah, for sure. I need to find someone to come and speak to us about that because I guess, you're asking us Floridians about beekeeping when the winter and summers are totally different here too, right?

Jamie 44:16
What is a winter here?

Amy 44:18
What is winter? Okay, so for our third question, this person is asking specifically about nucs and using nucs as, basically, a resource for the survival of your other colonies. And so they're asking, when using nucs to kind of solve your problems throughout the year, how do you manage these nucs without them growing too much or, I guess, with swarming and yeah, so what are your thoughts on that? So maybe we could talk a little bit about nucs and just using them in general for their frames versus how do we actually manage these nucs?

Jamie 44:56
Yeah, it's funny because I feel like this question is coming from someone who probably has watched me, specifically, give a talk that I give on nucs. I have this talk that I give on nucs. It's been something I have developed 18-20 years ago. And it kind of ebbs and flows in popularity, and right now seems to be one of those popular times. So I get invited by a lot of beekeeping groups to talk about this particular topic. The talk is essentially entitled, how to use nucs in your beekeeping operations. In fact, I even have a document on it. I've referred to this document a lot in previous podcast episodes, but the short story is, I like to keep a few nucs on hand in an apiary to help solve a lot of the problems that may pop up in the apiary throughout the year. So the questioner is not asking how would I use nucs to solve

these problems, they're essentially going the other direction, which is, okay, let's assume you have no problems but you've got all these nucs on hand. How do you keep the nucs from having problems themselves? And what would be a likely problem for nucs? Well, it's really simple. Think about it this way. If you've got a nuc that you're carrying through the year for the purpose of requeening other colonies or donating bees and brood to other colonies, let's say those other colonies are queened right or that they have plenty of bees and brood, thank you. So they don't really need what the nuc has to offer. So how do you keep a nuc, a nuc? And that's an important question because nucs are basically smaller boxes inhabited by colonies that otherwise want to be big colonies. So they're constantly producing brood and bees and foraging. They have a strong swarming tendency because they're in restricted boxes, etc. So how do you keep nucs from overflowing or from swarming? So, essentially, throughout the year, if everything is otherwise going well in my production colonies, I might split the nucs to make more nucs and sell those nucs, right? One of the dangers of beekeeping is when you start producing colonies, you just can't stop and you end up with more colonies than you ever imagined. So if everything's going well, and you've got these strong, populous nucs, split them and sell the splits, right? You can sell the nucs or split them and use those splits to increase your old production colony numbers or take frames of capped brood and bees and feed your weaker colonies or colonies that need to be strengthened for whatever reason. Or you can take those nucs, and a lot of people call them up hive where you move them from five-frame nuc size into 10-frame, full-size, production colony size. So there's a lot of little things that I do, but they all kind of center around either making and selling more nucs or using those nucs to give bees and brood to other colonies or up hiving them and making them full-size production colonies of their own. So those are the three things that I would typically do. And that document I keep referring to, I think I mention those things as well, like when all is going well, what do you do with the nucs? Well, you do have to watch them because they have this tendency to grow. But those three pieces of advice would be really useful.

Amy 48:00
You basically just manage them like all of your other colonies, right?

Jamie 48:03
Yep. But it requires extra TLC, tender love and care, because they're a growing colony in a restricted space. So splitting is a really good way to increase your own colony numbers and to alleviate those pressures in nucs or selling those excess nucs that you produce. There's just a lot of things that you can do with them.

Amy 48:21
Sounds good. Alright, listeners. If you have questions, be sure to email them to us or send us a message on Facebook, Instagram, or Twitter.

Serra Sowers 48:30
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.