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SPEAKERS

Guest, Jamie, Amy, Stump The Chump

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 00:50

Hello, everybody, and welcome to this segment of Two Bees in a Podcast. Today, I am excited to be introducing Dr. Kaira Wagoner, a research scientist with the Department of Biology at the University of North Carolina at Greensboro. She's also the CEO of Optera, a company that's commercializing UBeeO, which some of you may have heard of, but I'll let her discuss this a little bit more in her introduction and telling us a little bit about herself. So Dr. Wagoner, thank you so much for joining us today.

Guest 01:19

It's a pleasure to be here. Thank you.

Amy 01:21

All right. So all of our listeners know that when we have new guests that come on to the show, we always ask them a little bit about yourself. Tell us about yourself and how you got into the honey bee world.

Guest 01:31

Well, I actually started with mosquitoes. So I've been a biologist all my life, grew up in nature loving birds and animals and being outside. But I was working after college with, actually, ceramic water filters in the developing world teaching potters to make these life-saving filters that can essentially turn dirty river water into safe drinking water. And a mentor of mine for this work contracted malaria while working at a filter factory in Nigeria and ended up passing away from the disease. So I actually decided to go back to grad school to study malaria-carrying mosquitoes, not honey bees, in honor of my friend Ron. Through that work, I got really interested in insect communication. I was actually doing some analysis of chemicals on the surfaces of mosquitoes. And when I finished my master's program, I was interested in kind of continuing that work with insects and with biochemistry, but I wanted to start working with a beneficial insect. So I switched over to honey bees working with my advisor Olav Rueppell. That's kind of how I jumped into honey bees.

Jamie 02:48
Well, we're really appreciative of you joining us today because you're going to be talking a little bit about some of the research that you and your colleagues have conducted. And you mentioned early on that you're a CEO of a spin-out company called Optera. You guys have a product called UbeeO. But that's all based on research that you have conducted. So let's talk in detail about this research. So you are the first author on a paper entitled "Hygienic-Eliciting Brood Semiochemicals as a Tool for Assaying Honey Bee Colony Resistance to Varroa." So for all our listeners out there, we're going to make sure and link to this paper in our show notes. So check it out there. But Kaira, if we can start from the beginning, what are semiochemicals? And what do these have to do with honey bees at all?

Guest 03:33
Sure. So, semiochemicals are chemicals that convey a signal from one organism to another, so as to modify the behavior of the recipient organism. So there's a couple different types. These can be pheromones, which are chemicals used to communicate between members of the same species, and allelochemicals, which are used between different species, members of different species. So the compounds I'm working with are actually pheromones. And pheromones are really, really important not only to honey bees, but to lots of different animals, and especially social insects. And there's lots of different types of pheromones. They drive all types of different behaviors. There's alarm pheromones, which, if you're a beekeeper, you're probably pretty familiar with. Smells like bananas, and you don't want it to be in the air when you're working in colony. There's aggregation pheromones, recruitment pheromones, sex pheromones, all different types of pheromones. And what we discovered with this paper is there are these certain class of pheromones, a certain type of pheromone that is released from honey bees that are unhealthy. And so we went on to show that these honey bee pheromones are released from brood that have been infested with Varroa mites, but also, that are unhealthy for other reasons, like they have a high virus load even if they don't have a Varroa presence. So there's some recent research that just came out that showed one of the same compounds that we found that is elevated in honey bees that are targeted for hygienic behavior is also elevated in ants that are targeted for unpacking, which is essentially what they call hygienic behavior in the ant world. And so these compounds that we found in honey bees are related to unhealthy bees. There are signals that are sent out when bees are unhealthy. We found that the nurse bees that are detecting or patrolling the hive looking for problems in the cells can actually detect these compounds. They can smell these compounds, and these compounds trigger hygienic behavior, which is the removal of those unhealthy bees from the colony. And that behavior is really, really important for honey bees because it allows the honey bees to kind of rid themselves of pests and pathogens from the colony. So they make a sacrifice of these sick brood on the individual level, and that small sacrifice, in terms of removing the unhealthy individual, leads to a healthier colony overall, better chances of survival, lower pathogen loads and fewer pests.

Amy 06:14
Yeah, that was actually leading into my next question. I wanted to talk a little bit about that hygenic behavior of honey bees. So, as beekeepers, we hear about hygenic bees often. We also hear about Varroa resistant bees. And so my question is, hygienic bees, does that mean that they're Varroa resistant? And if not, what are the differences between the two?

Guest 06:35
Sure, so I actually added a slide to a recent presentation that said, not all hygiene is created equal. So I think there are a lot of different tools out there available for selecting for hygienic behavior. And so there's a lot of different ways to, essentially, arrive at hygienic traits in your colony to select for hygienic traits. But you don't get exactly the same product, exactly the same bee every time. You don't get exactly the same bee when you're using different selection methods. So for example, freeze-kill brood is a common way of selecting for hygienic bees. This method uses liquid nitrogen or a section of freezer-killed frozen bees. And you're looking at the response, the ability of those adult nurse bees to respond and remove those dead frozen brood from the colony over a period of time. But what we've learned more recently is that there are compounds released from dead brood, these dead brood smells, and those differ from these unhealthy brood odors, that living but unhealthy brood release. So dead brood smells, and what we know about dead brood smells actually go way back to the famous biologist E.O. Wilson, who discovered that oleic acid, this compound oleic acid was actually released from ants when they were dead. What E.O. Wilson noticed was an ant could die in a colony and would pretty much be ignored for the first several hours that it was dead, and after a certain amount of time had passed, the other ants seem to all of a sudden recognize that this was a dead ant, pick it up, and remove it from the colony. So this behavior of removing dead animals is called necrophoresis. And since then, we've found some work from McAfee showed that these same compounds like oleic acid are released from dead frozen honey bee brood. And we know now that those dead brood chemicals differ from the unhealthy brood chemicals that we found in this study.

Jamie 08:50
Kaira, it's just really fascinating to hear you talk about hygienic behavior and that it's not all created equal and what your answer about semiochemicals a few questions ago was. As we kind of circle back around, then, to your specific research that ultimately led for you and your colleagues the development of UBeeO, could you tell us a little bit about the background for this project? What got you to do this project in the first place?

Guest 09:13
Sure. So it actually started with a question from Olav Rueppell. When I first went to talk to him and tell him I was interested in joining his lab and working with honey bees, he kind of looked at me and said, "Well, okay, what are you good at? Go home, think about what are your strengths? What do you know how to do? And we'll start from there." And so I came back to him a couple days later, and I said, "Well, I know how to use this gas chromatography machine that I used in my master's," and he said, "Great. Have you ever heard of hygiene?" And it kind of started with that. He kind of had the idea of we know that honey bee adults that are hygienic are better at smelling these disease brood odors, but we don't really know what it is that they're smelling. So we started my PhD out looking for these compounds. What compounds are unhealthy brood releasing into the environment that is being detected by these

adults? And so the end of my PhD work was that we had found these compounds, we had identified the compounds, we are starting to learn about them, and we were like, "We can't stop here. This is super exciting." And so we actually got some funding to continue the research. As a postdoc in his lab, I continued working on this project. We got some chemists to synthesize these compounds in the lab. So they can actually be produced in the lab exactly as they are produced in nature. And then we spent several years, about four years actually making mixtures, doing tests, figuring out how to combine these chemicals, apply these chemicals in a way that they can actually be not just the scientific discovery, but something that was really applied and useful for beekeepers as a tool. And so that's kind of where this study that you're asking me about comes in. We really developed what mixture we needed to get a response. We've continued to develop since then. But really, this paper kind of laid the groundwork for the tool that we now call UBeeO.

Amy 11:23
That's amazing, Kaira. I'm thinking about, like, I don't work in the laboratory, so I'm thinking about just being able to identify compounds and what that whole process even looks like. I would love to ask you that first. How do you identify compounds? What was the laboratory doing to be able to identify compounds? And then let's talk a little bit about the methods that you used to conduct your research.

Guest 11:46
Sure. So the GCMS, or gas chromatography mass spectrometry, is a machine that basically allows us to look at a sample and figure out what chemicals are present and how much of each chemical is present. So we actually started by taking brood that had been soaked in a solvent that pulls off the chemicals from the cuticle, or that the outer layer of the brood, and we would take those extracts that we pulled, those chemicals off of the brood into these extracts, we would take those extracts, analyze them using GCMS, and it would tell us how much of each compound was there and what compounds they were. One of the things that really surprised us, when we started, we thought we were looking for these novel compounds that were going to be on the unhealthy brood, not on the healthy brood, and we didn't find any. So all of the compounds that we find on these unhealthy brood are the same compounds that are on the healthy brood. But what we noticed was there's a certain class or structure of pheromone that, those compounds, when a brood is unhealthy, those compounds are slightly elevated in quantity. So I think it's why it was so difficult to find. It wasn't like there was this glaring new chemical present on our screen. When we looked at the computer, it was more like these really subtle changes, which apparently aren't so subtle to the honey bee olfactory system. The honey bees can tell the difference, but it took a good bit of work for us to find them. So the way the UBeeO assay works is we isolate a small region of capped brood cells. It contains about 50 cells. We use a little PVC ring to do this, and then we apply pheromones to this area. We put the frame containing the treated cells back into the colony for two hours. And then we just pull it out, and we look at how many of those cell caps have been manipulated by hygienic behavior. So either the cell cap has been just removed, which is typically the case, or in some cases, we actually see removal of the whole brood. And so we quantify the response of those hygienic adults. In the lab, I'm essentially soaking brood, pulling off those compounds, injecting them into a machine that tells me what's there, and then looking very blankly, staring at an Excel screen for hours and hours to try and figure out differences and what's going on. So lots of computer time, lots of indoor time. And I'm happy to say now, mostly, I'm working outside in the field, and that's a little bit easier on the eyes.

Jamie 14:26
I can certainly imagine. I was listening to you talk about that. I'm like, gosh, this has got to be a lot of analytical work, and then you just confirmed that that's the case. All right, Kaira, with all that background, then, what were your principal findings? What came out as a result of this research?

Guest 14:40
So with this research, we took a group of over 70 colonies. And one of the main questions we wanted to ask was, while we compared UBeeO to this mixture of unhealthy brood odors with a more traditional hygiene assay, the freeze-killed brood assay, and one of the main questions we wanted to ask was can we use these assays to really predict Varroa resistance and disease resistance in the colony? And so can we use these hygiene assays to predict Varroa resistance in the colony. We tested these 70-75 colonies for using both the UBeeO assay and the freeze-killed brood assay. And then we looked later at the Varroa levels in those colonies, and we looked at which of those tests that we performed in June, the UBeeO test and the freeze-killed brood test, which of those tests better predicted the August parasite load or Varroa mite load. And the other thing we wanted to look at was overwintering survival. So we took a subset of the colonies in the study that were completely untreated for Varroa mites, and we left them through the winter to see whether they survived or not. And then we looked at the scores, the UBeeO, or freeze-killed brood scores they had received the year before and looked again at which was a better predictor of survival. What we've found is that if a colony can uncap or remove 60% or more of those treated cells within two hours, the colony is really able to maintain, throughout the season, a much lower Varroa load. So in the experiment that we ran with the 70 different colonies, what we found was the colonies that scored 60% or above on the UBeeO assay had a overall infestation level of 1.6, on average, when we tested them in August. The colonies that scored low on the UBeeO had an average infestation level of 7.2. So we really saw a pretty huge difference between the two tests. And one of the most exciting parts of that difference or components was that this was an indication that UBeeO really allows you to distinguish the colonies that probably need treatment to survive, a Varroa treatment to survive the winter, and those that don't need treatment. So typically, we think of infestation thresholds of about 2%, or 3% is when we need to intervene as the beekeeper and do something about the mite load. But what this study showed us is that the high-scoring UBeeO colonies really could maintain Varroa populations below that treatment threshold of two to 3%. When we looked at the results, the same exact colonies, how they scored on the freeze-killed brood essay, again, we saw the same thing. We saw that freeze-killed brood high scoring colonies had fewer mites, and the low scoring colonies on the freeze-killed brood assay had higher mite loads. But the difference just wasn't as significant as it was with UBeeO. So in the high freeze-killed brood colonies, we saw an average of 3.2% mite load, 3.2% mite infestation in August. And so that's really kind of right on that border between colonies that that need to be treated or don't need to be treated. So, this comes back to that point I made earlier that not all hygiene is created equal. So there's a lot of different ways that arriving at a hygienic colony, at scoring colonies for hygiene, but you don't always get the same results using these different methods. And when we looked at the survivor data, we saw something very similar, and this is probably related to those Varroa numbers. But what we saw is that the colonies that scored high on the UBeeO assay were over 40% more likely to survive the winter than the low scoring colonies. With the freeze-killed brood test, the survivorship was up over 20% if they scored high on the freeze-killed brood tests, but it just, again, wasn't quite as good at parsing out which of the colonies really were Varroa resistant and likely to survive from those that weren't.

Amy 14:42
Great. So I wanted to bring this and loop it all around. I have my final question for you, which is, what does all of this mean for beekeepers? What are your recommendations for beekeepers? And what does it mean for them?

Guest 19:24
Well, I like to think of UBeeO as a tool for, essentially, democratizing selection of hygienic bees. So what I've tried to do in developing UBeeO is to really eliminate the traditional trade off we've had in selection methods that are either very effective at identifying Varroa resistant colonies, but they're difficult to use, very costly in terms of labor input. You seem to either have this high efficiency, low efficacy, or low efficiency, high efficacy trade off with traditional selection methods. So either the selection methods are easy to use, but not that effective at identifying Varroa resistant colonies, or they're very difficult to use, take some skilled labor a lot of time, but very effective. And so with UBeeO, one of the things we've tried to do is eliminate that trade off. We wanted to come up with something that's easy for beekeepers to use, but also very effective at identifying Varroa resistant colonies. Right now, I think UBeeO can be used by anyone. My focus right now is getting this out to breeders, queen breeders, because I think it's most important for queen breeders to have this tool, so that they can really get this trait of Varroa resistance into the queens that the rest of us are using. And so I see this tool as something that is most important for breeders, commercial beekeepers that really want to drive this trait into their bees. And within the next couple of years, I hope that more and more hobbyist beekeepers will find this tool useful because they'll actually see something if they run tests in their colony. Right now, the average colony from an unselected line of bees scores maybe 15 or 20% on the test. So the results aren't that exciting. But I think that we have a lot of room to grow in terms of how hygienic our colonies are across the nation. And there seems to be a lot of interest from breeders, actually, not only within the US, but we've now tested up to in eight different countries around the world. So a lot of breeders are really interested in this technology. I think we're going to have, very soon, more of this Varroa resistant trait, this disease resistant trait in our honey bee populations. We haven't touched much on other diseases here because it wasn't a part of this study. But we do have a lot of recent data that's really promising in terms of UBeeO's ability to predict disease resistance. So I have some data from the University of Vermont, Dr. Samantha Alger's laboratory, showing that high UBeeO colonies have lower Nosema loads, which was actually pretty exciting and surprising, considering Nosema is not a brood disease. But we also have evidence from Australia that high UBeeO colonies have lower chalkbrood loads. We have viral data showing lower virus loads of several different viruses, including deformed wing virus A & B in high UBeeO colonies. So really it kind of shows that these unhealthy brood odors are exactly that. They're not Varroa specific. They're really general signals of unhealthiness or stress that are coming from the brood. And if an adult bee is sensitive enough to detect that signal, they can really tackle any kind of issue coming from within that broad set, which is really exciting in terms of the implications for improving honey bee health. And also from a beekeeper standpoint, it's exciting to have my bees doing the work for me. In my high UBeeO apiaries, I don't have to use mite treatments. It's a lot easier to manage that apiary than it is my low UBeeO apiary. So I think there's a lot of benefits coming for beekeepers.

Amy 23:28
Absolutely. So Jamie and I are always talking about the research that needs to happen. It sounds really exciting that you're able to extend the research across the world, and you're finding data to support

your research as well. So I'm excited to see what happens in the future and what this looks like as far as the industry goes. But thank you so much for joining us today, and thanks for all your hard work.

Guest 23:49
Absolutely. My pleasure. Thanks so much for the invitation and for the wonderful work you guys are doing.

Amy 24:06
I say this every time, Jamie, but I always get really excited just speaking to researchers and understanding the background, the methodology, and trying to make sense of everything, of how to bridge that gap between research and beekeepers. Right? We've talked a bit about Varroa resistance, what this looks like, hygienic behavior, and so I wanted to talk just a little bit about, I guess, traditional ways that we look and identify hygienic behavior, and ways that this semiochemical contributes as a tool to look at hygienic behavior and honey bees.

Jamie 24:40
Yeah, so, the more traditional ways of determining how hygienic a colony is, is using either the freeze-kill assay or the pinprick assay. So the freeze-kill assay is you put a piece of PVC pipe over the top of a section of capped brood. So that will then define that section of capped brood, and you pour liquid nitrogen down the PVC pipe onto that section of capped brood, and just like the name implies, freeze-kill assay, liquid nitrogen kills the brood in that little circle of PVC pipe, then you can count the number of cells that had brood in it, put it into a hive, give the bees a set amount of time, say 24 hours, then take it back out and count the empty cells. So you killed the brood, you count how many of those brood cells the bees removed, and then you can assign a hygienic score based on that. So for example, if there were 100 capped cells in that section of brood that you ended up killing, and bees removed 50 of them, then they were 50% hygienic. If there were 100 cells that you froze, and bees removed 90 of them, they're 90% hygienic, so that's the freeze-kill assay. The pinprick assay is similar in that you are the one killing the brood. But it's different in that you're not using anything to freeze the brood, you're using a small pin that you push through the capping of the cell into the developing bee. You're killing the bee in that cell by pricking it with a pin. And you do this for a set number of capped brood cells, you return it to a hive, the bees remove so many of them, and then you can assign a hygienic score based on the way you would do it with the freeze-kill assay, which is the number of cells that you killed and the number of cells that the bees removed as a result of that. All of that would go into that calculation. So Kaira and her team of colleagues, they isolated chemicals that they determined that unhealthy bees or unhealthy brood make, and they created a blend of these chemicals such that you can spray that blend on the brood. You don't have to freeze it, you don't have to pinprick it, you can just spray this blend of semiochemicals on the brood. The bees will remove so much of that brood and you can assign a hygienic score. She was arguing this was more predictive of colony ability to handle Varroa than some of these other hygienic tests that are quicker or easier to perform, etc. So that they were more beneficial. And so she calls this the UBeeO test.

Amy 27:20
Very cool. Yeah, I'm always about adding more tools to the toolbox. Right? So it's always fun to see how things like this develop, especially, I don't know, I'm hung up on the compounds and creating

compounds. I think it's just so fascinating how you can do that in the laboratory, being able to identify, create, mix and work with chemists on that type of stuff.

Jamie 27:39
Yeah, absolutely. What I really appreciate most about this is kind of like what you said earlier where she didn't just do the research. She saw an application on behalf of beekeepers in the beekeeping industry and then took that next step. So many of us, we're just researchers. We'll do a research project and we might see an application, but we can't get over the hump of, oh, how can we get this into the hands of beekeepers? Right? And she and her colleagues have figured that out. And they're branching out and trying to make this a tool beekeepers could use to score their colonies and combat Varroa. And I think if a lot more of us had this kind of entrepreneurial spirit, we could possibly put even better solutions in the hands of beekeepers quicker than we've been able to do historically. Oftentimes, we have to do research and we rely on other companies to pick that up to license the idea. And it's neat to see them taking the next step themselves directly.

Stump The Chump 28:39
It's everybody's favorite game show, Stump the Chump.

Amy 28:49
All right, welcome back to the question and answer segment. Jamie, the first question that we have for you today, the question is related to mating nucs. This person is using mating nucs to rear queens, and they've got these mating boxes. They're essentially letting their bees create emergency cells and they hear that these cells, these emergency cells are not good. So they're wondering, are they getting bad genetics? Is this bad practice, especially if they're doing this repeatedly? What are your thoughts on this?

Jamie 29:17
So, Amy, there's a lot of biology behind that question. And so the questioner is essentially saying, I've got these colonies that happen to be mating nucs, that they are allowing to requeen themselves, and now they're thinking, is this best practice? The reason that they're thinking this is maybe they heard on the podcast or reading some articles that show that queens are now believed to lay larger eggs in cells like swarm cells, as an example, and that these eggs lead to bigger queens and maybe more fit queens, etc. It's not like there's a queen egg and a worker egg, it's still a female egg. But queens, when they're purposely laying eggs that go into a queen cell, can lay bigger eggs, and you couple this with the idea that when a colony loses its queen, it's in an emergency situation where it then has to go to the youngest available female offspring and start rearing its next queen. Well, if the previous queen that was lost was failing before she died or was lost, then you might not have very young female larvae available. You might only have female larvae that are two days old, for example, and these are on the outer edge of being redirected to being quality queens. And so it's this whole idea behind if I allow colonies to requeen themselves, are they making the best queen in an emergency situation? So there's a lot to unpack here, but I'll try to keep this a succinct answer. In short, I've allowed colonies to requeen themselves zillions of times in my lifetime as a beekeeper, and then I don't make a judgment on the process itself. I'll make a judgment on the resulting queen. So, for example, this beekeeper says, I'm allowing emergency queens to be the next queen in these mating nucs. Well, if she turns out good, you keep her. If she turns out bad, you don't. I mean, the fear is that they might be going to a larva that's too

far down the worker path or a larva that's slightly too old, for example, they redirect to become a queen and you get a pseudo queen or an inferior queen. And while the probability of that may be slightly higher in an emergency queen rearing situation, I still don't think that would keep me from doing that. I still think I would allow that to happen and just make a decision based on the resulting queen. Now, if I did this for a living and needed to do this for thousands and thousands of queens, and I wanted to sell, etc, I definitely would not do it that way. But if we're talking about hobbyist or sideliner operations where you've got some mating nucs in your backyard, and you only want five or six queens, or something like that, I don't think it's a problem to allow the emergency queen that's produced to become the reigning queen in that nest. Again, there's a quality check you can do. If she performs well, you keep her. If not, you replace her.

Amy 32:06
That sounds like a good recommendation.

Jamie 32:09
Yeah, I hope so. But I will say, Amy, the person did ask about genetics. You're not really getting bad genetics. The genetics are unaffected by kind of what larva has chosen, or at least in the context of good or bad genetics, it's not like in emergency situations, they're going to go to genetically inferior individuals. They just may go to individuals that are too far down the worker pipeline. Again, the genetics wouldn't be an issue here, it would be just the age of the larva. And so it's not really a genetics quality issue at all.

Amy 32:37
Got it. Alright. So for the second question that we have, we've talked a lot, Jamie, in the past about Vespa mandarinia, Vespa velutina and trying to keep them out of the United States. We know that we've had specimens that have been confirmed, of course, Vespa mandarinia has not stuck around, hopefully, and then, Vespa velutina, we're still kind of working on right now in Georgia. But something I'm not sure if we've discussed is just generally speaking, yellow jackets in the hive and what that could do to a colony. I guess the question is, can yellow jackets be a problem in the colony? And if so, at what point does it become an issue in a hive?

Jamie 33:17
Yellow jackets absolutely can be a problem in the hive. And I will elaborate on this a little bit. So in Florida -- I'm speaking from experience here in Florida. Yellow jackets are distributed over large parts of the US and they're very similar species to these things elsewhere. For example, Europe has its own type that's very similar and quite related to this one that we struggle with here in Florida, as an example. I see the questioner is from Minnesota. And so this would be up there as well. But, let me just give you a very, very, very brief summary of the typical social wasp lifecycle. Social wasps are carnivores, they collect meat and feed to their offspring. The adult wasps eat sugar for movement purposes. So you will see these wasps at flowers collecting nectar the same way you see bees at flowers collecting nectar and they use this sugar to move. It's their energy source. But they must collect meat for purposes of rearing young, and so the social wasps are really good at doing this. They might go after caterpillars or other soft-bodied insects. And in spring and summer, you get large populations of soft-bodied insects. So there's ample prey available for yellow jackets and other social wasps like paper wasps, bald-faced hornets, things like that. So there's all this prey available during those times of

the year. But as the end of summer starts to approach and you get into fall, you start losing a lot of those prey items in the environment. So the social wasp will often turn their attention to the next available insect that occurs in high densities and that, of course, would be honey bee colonies. So usually, in late summer and early fall is when you tend to get most of your social wasp problems. So the questioner is asking about yellow jackets, so I'll kind of pivot specifically to talking about yellow jackets. We have yellow jackets absolutely everywhere here in Florida. And I would say, in the 18 years I've been at the University of Florida, we have actually had yellow jacket problems to the level we needed to do something about them in our apiaries twice. So out of all the years yellowjackets would show up at our hives, twice they've killed colonies, and we've had to do something about it. So how do they do that? Well, they're transitioning from their preferred prey that's not so available that time of year to honey bees that are very available that time of year. And we routinely see yellow jackets at our colonies throughout the year if we have leaky feeders. So if we're feeding sugar water through the lid of our hives or through jars, we might see yellow jacket adults collecting sugar water, again, for their energy. But they will pivot to collecting bees or brood directly in late summer and fall, and we've had it so bad that yellow jackets were flying in and out of our hives, hauling off whatever they could take with them, adult bees that they would have killed and macerated or brood, etc. And I've seen this to the point that we've actually lost colonies. In fact, one year it was so bad, it took out one of our entire research apiaries. The good news for us here is that's the exception rather than the rule. But the bad news is it does seem to cycle depending on a lot of different factors. So this questioner is saying, hey, I've got yellow jackets at my hive. They don't seem to be doing a lot. That's the typical response. Yellow jackets will often show up at hives and not do so much. But occasionally, seasonally, depending on where you are, it can be a significant problem. So just keep an eye out for it. If you see dozens and dozens, maybe hundreds or more yellow jackets flying into and out of a nest, you've probably got a colony that's so weak that it's succumbing to yellow jacket invasion. And this absolutely happens. Again, I consider Florida a high-risk area for yellow jackets compared to other states. So if it's happened in my old apiaries here for research purposes two out of the 18 years, I still wouldn't consider it a significant problem. But the years that it's a problem, it's a problem. So yes, yellow jackets can be an issue for honey bees.

Amy 37:25
You know, Jamie, I think I'm just realizing that I do not treat all stinging insects the same. I don't mind working honey bees, but when it comes to yellow jackets, I am not a fan.

Jamie 37:37
Yes. They can be cantankerous. Actually, when we talk about African honey bees, the killer bees of the Americas that they always talk about, their behavior is not altogether very different from a yellow jacket nest. So people who've encountered a yellow jacket nest accidentally and had hundreds, maybe, of yellow jackets chase them, that's similar to the response that you will see from African honey bees, in fact.

Amy 37:57
Very interesting. All right, so for the third question that we have, this person saw on social media an individual that put a microphone on a hive frame. So they said the sound was super interesting, and then it made them wonder, do bees communicate by sound and vibration that's transmitted through

comb? I'll let you answer that there. Do we know anything about bees and whether they transmit or they communicate through vibrations on comb?

Jamie 38:24
So they do, and it's interesting because I'll tell you how I found out about this. When I was in graduate school at Rhodes University years ago, I read a handful of books on this super organism concept and absolutely fell in love with the super organism concept. The idea that the colony functions a lot like a beast itself. You can look at a colony almost as an animal. It has a lot of animal level attributes that you see in higher organized organisms. So when I got back to the States shortly thereafter, Juergen Tautz, who's a famous European bee biologist, wrote a book about superorganisms called "The Buzz About Bees, Biology of a Superorganism." In that book, I very vividly remember him talking about, during the dances of bees, we know they waggle their abdomens, and they repeat these circuits either in circular patterns or figure eight patterns, but they also will stop in their straight run and send buzzes through their bodies into the comb that can be picked up by bees that are watching the dance. And so he had said that this buzzing is an important communication, as well as the physical dance. And of course, bees don't have ears. So it's not like they're hearing in the sense that you and I would hear these audible buzzes, but they are presumably receiving information through the combs, through this wax, and in fact, after reading that, I jokingly said, I think others have said too who study this phenomenon, this is kind of the original cell phone, right? There are cells there. Anyway, I tried. But the idea is that they are, in fact, buzzing, wild dancing and sending signals through those buzzes. And he made the argument, if I remember correctly, that as long as bees have multiple legs touching the surface of the comb, they're able to pick up that information that's being communicated. They might use it, for example, to find a dance floor where the other bees are dancing or other purposes. We also know that outside of the honey bee dances, they will buzz communicate one another. There's a lot of bees in the hive that, at any given time, aren't doing anything. And when there are other bees that want those bees to do something, they might approach them and buzz them to get an activity. And of course, the bee may be perceiving it exclusively as a vibration, more of a shaking signal than a sound signal. It, nevertheless, is communication through this buzzing. So my guess is that bees are even more complex than that. I mean, you and I were both in Thailand recently, me two weeks, and then you two weeks after that, and I was watching a lecture given by a colleague at a Thai University. And that individual was mentioning about how Apis florea, which is one of the dwarf honey bees, has multiple audible sounds for different things. They have an audible sound for ants, an audible sound for birds and things like that. So while we pick it up audibly, the other bees would pick it up vibrationally. So long story short, we do believe that they are able to send information through vibrations that can travel through comb that other bees might be able to pick up and decipher.

Amy 41:43
Yeah, definitely. I was gonna ask just as a follow-up of that with the queens, and, you know, when they do their piping and their tooting and their quacking. Haven't there been studies that have shown that that is also kind of like the vibration and how they communicate?

Jamie 41:59
That's absolutely right, Amy. I guess the trick is, and this is the point I'd also like to know about myself, I'll go back to the whole, we've got ears, they don't kind of thing. So we are hearing audible piping from queens. We can distinguish it, we know what it sounds like, but the bees don't have that same luxury of

having ears. And so they are receiving what we have as audible information principally through vibrations, and we know they can receive it if they're touching the same comb that the queen, for example, would be on. But I am curious to know as well if they are picking up these vibrations through the air, not just through standing on the same substrate. So I think there's a lot still to be done in this arena. But it is fascinating to think about.

Amy 42:46
Yeah, I appreciate that. And also, now, I have to think about a honey bee with ears, and I've not ever thought that. I've never considered or thought about the fact that they don't have any ears.

Jamie 42:56
You're welcome.

Amy 42:56
So thanks for that. All right, for our listeners, you know what to do. If you have a question, feel free to send us an email or feel free to send us a social media message. Thanks for listening to today's episode. This episode was edited and produced by our podcast coordinator Mitra Hamzavi. Thanks, Mitra.

Jamie 43:25
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.