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SPEAKERS

Amy, Jamie, Guest, 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. Hello, everyone, and welcome to another episode of Two Bees in a Podcast Today, we have a repeat guest, one of our listeners' favorites, Dr. Tom Seeley, who's an emeritus professor in the Department of Neurobiology and Behavior at Cornell University. Tom, thank you so much for joining us again on Two Bees in a Podcast.

Guest 01:08
It's my pleasure to be here, Jamie and Amy.

Jamie 01:10
Amy, when I saw that we had Tom on today, all I could think about was there's a million things we can bring him on to discuss, and it's hard to whittle down the topics when we have him because he knows so much about so much. Alright, so Tom, we have you on for two main reasons. The first of those is we would like to discuss with you your research on the bee colony as a honey factory. I saw you give a talk about that some years ago, and I know you've got a lot of work on it. And then secondly, you've got a very new book out, "Piping Hot Bees and Boisterous Buzz-Runners" that I've had the privilege to be able to read already. And so we want to ask you some questions about that first. So since you're a repeat guest, you're aware that the first question that we ask is always to tell us just a little bit about yourself and what you're up to these days.

Guest 01:58

Well, a little bit about myself, I've been a beekeeper, I fell in love with honey bees when I was a teenager. I brought a swarm home, had watched a bee tree when I was a young boy. So I've been associated with honey bees for a long time. At one point, I thought he'd become an MD, a medical doctor. But then I realized, no, I'm much more interested in how a honey bee colony works than I am in how human beings' bodies work. I've been working with bees for a long time with a focus on understanding their behavior and how they live in the wild.

Amy 02:29
Dr. Seeley, like Jamie mentioned, as soon as he found out that you were one of our guests, he was like what are we talking about today? I'm like, we're talking about nectar foragers. And so we wanted to chat with you today about how a colony operates as a factory and how a colony produces honey, despite having different resources of supply and nectaries. I know that you do a talk about it. I jokingly told Jamie that we need to have you on, we could do like an entire year of Tom Seeley episodes. I almost feel like we should just do once a month, have Tom Seeley as our guest, because you can talk about so much. But today we are specifically talking about nectar foragers. Before we get started with that, I would love for you to tell us a little bit about the division of labor and what that means as far as where the nectar foragers are in that process.

Jamie 03:19
So Tom, how old are these bees? Because in a division of labor system, we've got foragers, we know they're usually 18-19+ days. The receivers, where do they fall out in the age cohort of bees?

Guest 03:19
Yeah, thank you, Amy. The collection of nectar is very different from the collection of pollen or resin in that when a nectar forger gets back to the hive, she doesn't deposit the nectar in the cells herself. Pollen foragers do that. So instead what they do is they pass it off to middle-aged bees, bees usually in the range of about 10 to 20 days old. I call these the nectar receiver bees, and it's those bees that take the load of nectar and walk up to the top of the nest where the honey storage cells are and smear it on the sides of those cells to start making it into honey. It's a kind of a cool process with a distinct division of labor between the collectors and the processors. They fall out, Jamie, in the middle of the bees' age range, so they're approximately 10 to 18 days old. It's flexible, depending upon the age distribution of the hive and that sort of thing. I like to call them the middle-aged worker bees.

Jamie 04:29
So you've got these forager bees coming in with nectar. You've got nectar receivers meeting them at the entrance to receive that nectar. What's the give and take between those two populations? How do they communicate that there needs to be more nectar receivers or fewer nectar receivers? Can you talk a little bit about that the communication between the foragers and the receivers to control that rate of nectar flow coming in?

Guest 04:53
Yeah, that's a really important topic important to the honey bees because all beekeepers know that there are times of nectar dearth when there's little nectar being collected, and then there's other days

when there's a nectar flow on, and a lot of nectar is coming into the hive. And the tricky situation for the honey bee colony is when the nectar intake, the nectar collecting by the foragers, is rising. And this is like suddenly having more and more traffic coming into a toll booth or something like that, or in the checkout lines in a grocery store. Lines can develop. Delays can develop in the unloading process. And one of the cool things about the nectar foragers is when they come home from a good nectar source, but they experienced difficulty finding a bee, a middle-aged nectar receiver bee, they have a special signal to call for more of these nectar receivers. And that signal is called the tremble dance. Its name describes it very well. The bee walks in, the returning nectar forger walks in, she's had a delay, she's experienced difficulty finding somebody. If she doesn't find somebody, she walks around in the unloading area and trembles. And when I say tremble, I mean, her body is trembling back and forth, side to side, a little bit front to back. It's a very distinct behavior. And when it was first observed by Karl von Frisch back in the early, early 1900s, he was very puzzled by it. And he never was able to figure out what it meant. He thought it might have been maybe pesticide disturbance or something like that. He was very puzzled. He never figured it out. And he finally concluded, "I think it tells the other bees nothing." But it does tell the other bees something very important, it turns out.

Amy 06:39
So, Tom, you've written a lot of books on honey bee behavior. And I'm fascinated by how you're able to look at these behaviors and exactly what you said -- kind of decide what it all means. And so I'm wondering if you can kind of describe some of the research projects and some of the things that you've done, some of the observations that you've looked at, looking at that nectar forager, and then bringing it back, doing the trembling, when they tremble, then what happens? A receiver bee comes. What does that whole process look like? And can you describe the research that you've done to look at this?

Guest 07:11
Yeah, the tremble dance, its function and its message became clear to me in the course of doing an experiment. And it was an experiment where I was looking at how the nectar foragers adjust the strength of their waggle dancing. I had seen that if a nectar forager comes into the hive and gets unloaded very quickly, that is very stimulating to her to produce a waggle dance. So I wanted to see, well, what happens if I make it hard for her to get unloaded. Well, that inhibits her from doing the waggle dance. So I did an experiment where I made it hard for the nectar foragers to get unloaded by removing many of the middle-aged bees that were the nectar receivers. I had sat by an observation hive, and for basically a day, I put a dot a paint on the back of every bee that wasn't functioning as a nectar receiver. And then, in the evening, I opened the hive up, the observation hive, and removed those bees. It was about 500 bees from a colony of approximately 4000 bees. And then the next morning, this was now the exciting point, I wanted to see what my nectar foragers would do when they got back to the hive. When they got back to the hive, well, there were very few nectar receiver bees. And the weird thing is -- weird at the time -- that the returning nectar foragers walked around doing this weird trembling motion. I hadn't paid much attention to it. But it suddenly became clear to me that, oh, this might be a signal to call for more bees to function as nectar receivers. And I won't go through the details of how we then followed up on that hunch, but that was the key aha moment or the key moment of insight that this tremble dance is not just a bee malfunctioning, even though it looks like a bee is just acting strangely. It's actually a fully functional signal.

Jamie 07:13
Tom, that's a fascinating description of a give and play between nectar foragers and nectar receivers and how all that's regulated through these dances at the nest entrance. You have summarized this type of work, and a lot of your other research in a brand new book entitled "Piping Hot Bees and Boisterous Buzz-Runners." Can you tell us why you wrote that book?

Guest 09:05
Thank you, Jamie, for asking that question. I wrote this book because I feel strongly that the things that I've learned, the mysteries I've solved about honey bee behavior are too good to be hidden away in the scientific journals. And so I wrote this book with 20 chapters, and each one is written in plain language that anybody can understand about a mystery about the behavior of honey bees. And just as an example, at some point, we were talking about the tremble dance. There's a chapter in here called Chapter 15: Mystery of the Tremble Dance." And then there's other ones like another one I love, like the title is "Groom Me, Please," because the bees have a special grooming invitation behavior. And then there's a chapter on forest homes, home site inspectors, the nest site scouts, choosing home site, things like that. So that's what this book is about, and that's what it's for, and what the target audience is. Thanks for asking.

Amy 10:24
As an extension educator, I am really excited to get your book and read it. I know you that you just kind of went through some of the chapters on it. I'm wondering how you organize the chapters? I mean, how did you decide what behaviors you were going to put into this book? How did you organize the book?

Guest 10:42
Great questions, Amy. Thank you for asking those. The organization, or the order of the chapters, is chronological. I started the earliest chapters, or my first very first investigations when I was a boy, basically. And then they go through to when I was a senior scientist type person. Anyhow, it's a chronological, and the reason I do that is because in order to understand any given chapter, often, you'd need to know what was in a previous chapter, because some of the chapters build on each other. So that's the organization. The subtitle is "20 Mysteries of Honey Bee Behavior Solved." And when I started to write this book, I wrote down all the mysteries that I feel about the bees behavior that I solved and I came up with 37. But the editor said, you've only got 80,000 words, Tom, so you better do 20 behaviors, solving 20 mysteries.

Jamie 11:32
Geez, Tom, that makes me feel like there needs to be a book part two. What's among the 17 mysteries that the readers don't get to see?

Guest 11:41
A lot of those mysteries, Jamie, are mysteries about how bees live in the wild, how honey bee colonies live in the wild. This book, the current book, the new book, is about how honey bee colonies live in any

beekeeper's hive or anything like that. So the focus is on behavior in the new book, The other 19 or 17 chapters would have been about the natural ecology or the natural history of honey bee colonies.

Jamie 12:08
So you made a couple of statements as you introduced the book that I thought was interesting. So I did have the great fortune of being able to read the book, and I did see each chapter, how you organized it. But you mentioned the target audience, of course, beekeepers, the general public, because you said, just a little earlier, that you've done a lot and don't want it to just get buried in the scientific literature. You want it to be available to beekeepers and the general public. So my question to you, then, is so what are the take-home messages that you want the readers of this book to leave your book with? What is it that you want them to gain or experience as a result of reading this book?

Guest 12:47
Great question, Jamie. The last part of the book is called "Closing Thoughts," and I address exactly your question. The take-home message or overarching message I'd like a reader to come away with is an admiration for the abilities, behavioral abilities, cognitive abilities of worker honey bees. I think they are the smartest insects on the planet, and that's because they live in very complex societies. That's probably why humans are so smart. We had to develop big brains in order to live the complex social lives that we've been leading for millions of years. I conclude with a closing thought, which I borrowed from an entomologist named Vincent Wigglesworth. And he wrote the following: "The honey bee is as far above the general run of other insects as man is above his fellow mammals. The complexity of the social life of bees, their powers of mutual communication, their diversity and skills and employment, their debates and decisions on policy are so remarkable that they raise the question of the capacity of the bee for thinking." That's the take home message of this book of 20 stories about the behaviors of honey bees.

Jamie 14:06
Jeez, that's very inspiring. I feel like I have to ask you this question because I'm kind of in the middle of my career. I tell people all the time that I will never live long enough to study all the amazing things that I want to study with honey bees. And yeah, so you've retired and I'm curious -- gosh, there's so many questions I want to ask you -- I'll ask you just two, what are the great mysteries that you feel still need to be unraveled? That's number one, and number two, what do you wish you had had time to address?

Guest 14:41
Oh, put me a little bit on the spot there.

Jamie 14:44
The great mysteries that still need to be unraveled and what do you essentially regret not being able to do yourself?

Guest 14:50
There are a lot of mysteries about drones because they're not studied very much. The whole mating arrangement, that's a huge mystery, to me, at least. I haven't seen a really good analysis of what

creates the mating areas, the drone congregation areas where the queens and the drones come together. That's a huge mystery. That's one I wish I had the means to tackle. But it's a tough one because they tend to be far from the hive, up in the sky. I've seen them. I know where there are drone congregation areas, and it's fun to lie there and look at queens zoom in, virgin queens zoom in and then get chased by a bunch of drones. But how did they figure out where to come together? Great Mystery. I wish I could solve that one.

Jamie 15:33
I love that. I was at the British Beekeepers Association meeting a couple of weeks ago, and I continue to get questions about that. How do queens and drones find these places? How do they identify DCAs? And I spend a lot of my time saying, well, you know, we need to study that someday. So yeah, I completely sympathize.

Guest 15:50
I think we don't really even have a clue at this point.

Amy 15:54
So Tom, you've had a very successful career. Everybody loves your books. I'm, again, really excited to read the book. I'm sorry I did not read it even before this interview, but it just came out, so I didn't know. But I think our audience would love to know for you, you're retired, you're emeritus, you've got great titles, everybody loves you. And so we're just wondering, what's next?

Guest 16:17
What's next for me, Amy, is another project that I've been working on for about 40 years. It's the ecological history of a forest that I own outside the small city of Ithaca where I grew up and have lived basically my whole life except when I went away to graduate school. This forest embodies the history of the settling of New York State. It was all covered by forests when it was just inhabited by Native Americans. Settlers came in, cleared the forests, set up their farms, and they even cleared some areas where the soil was quite poor. And that includes my forest. It was one of the first forests to be abandoned in New York State and it's grown back. But there's a lot of history built into this forest, both into the trees, into the cellar holes, the barn foundation, all of that stuff, the barbed wire, old rail fences. That's my next challenge is to write an ecological history of this forest in the context of the settling and the changes in the farming practices in New York State.

Jamie 17:22
Do you still keep bees?

Guest 17:24
Yes, I do. I do, Jaime. One thing, I have three bee trees in the forest. So I keep a close eye on them. I also have an apiary just a mile or so from my house where I like to keep four or five colonies. I do so because there's a lot of people that I know who really appreciate having good fresh honey. I just like messing around with the bees as I'm sure you guys will understand.

Jamie 17:47
So Tom, I'm going to conclude with this question. I'm thinking back at your new book, right? We started this conversation with you talking about how nectar receiver bees have this interplay. Then you talked about your new book, how that interplay, the tremble dance, is described as one chapter in the book. You mentioned, you personally, you and your colleagues, your team have contributed 37-39 solve problems in the honey bee world. Looking back, you can do it from your book, you can do it from your total research career, looking back, what discovery excited you the most? And what do you think your biggest contribution to bee science has been?

Guest 18:30
Oh, well, I feel very fond of many of the discoveries. It's hard for me, it's like being a parent, you don't have a favorite child. You love them all. But I think my biggest primary contributions to the bee world fall into two categories of, one, the analyses of the mysterious behaviors that the bees have, like their shaking signal, their tremble dance, and the process of controlling water collection. So that's one big category of things that I'm very proud of. But the other one is the fostering of an appreciation that the honey bee is still essentially a wild insect. We give it a home, but we haven't changed its behavior. I helped develop that perspective. And I think a lot of beekeepers appreciate that. They know they can get good bees if they put up bait hives, they know, in many places, they can get bees that are Varroa resistant if they're catching swarms from a wild population. So I'm quite proud of the way that, back in the 70s, I think I was the first person to say, well, what's the natural home of a honey bee colony like? That involved looking and dissecting nests in bee trees.

Jamie 19:43
Tom, I just want to thank you for the time you spent with us today on this episode of Two Bees in a Podcast. It's been great to catch up with you specifically about the interplay between nectar forager and receiver bees, also to hear about your new book, and then kind of bring it all home as we talked about the significant contributions you've made to the bee world. Thank you so much for your time. Thank you for what you've done on behalf of bees and beekeepers, and I know this isn't it. I know that I'll see you at meetings still, and we'll continue to read the stuff that you're putting out as your love for bees continues. So, thanks again, Tom.

Guest 20:15
You're welcome, Jamie. I treasure our meeting up in Northern Ireland some years ago.

Jamie 20:20
Well, good. Good, good, good. Thank you again, Tom.

Amy 20:33
Jamie, as you mentioned, Dr. Seeley has contributed so much to the honey bee world. And it's just been great to just sit and listen to him talk about his career and everything that he's done, his contributions to the honey bee world.

Jamie 20:49

It really is great. Beekeepers love listening to Tom talking about his research because he takes these really complex issues that seem like, how in the world would you get to the bottom of how this thing works? And then he shows you how he systematically asked questions and milk research projects to address those questions and how he interpreted the information that he was gaining from his research and then making these proclamations. Mystery solved. Everybody who watches Tom thinks the same thing in that regard. His questions are good. The research is elegant. He comes to these cool answers. In many cases, sometimes it solves mysteries that people didn't know that were there to be solved. I mean, who would notice the tremble dance otherwise, as an example. But he noticed, he observed, he questions, he designs a study, he answers, and moves on to the next question. And it's just a really nice systematic way of addressing things. That's the way science is supposed to be done.

Amy 21:43
Absolutely. He makes it look easy, actually. Actually, it's very difficult to do, you know, to translate science to something that is more digestible. I definitely applaud him for that. I wanted to talk a little bit more about that nectar forager, that behavior between the foragers going to collect nectar and then for a bee to be waiting there and for the whole tremble activity. I know that Dr. Seeley was talking about how he had taken some of the receiver bees, he had taken them out for a bit. And I'm just interested to know, with the division of labor, we know that bees have different jobs as they kind of progress in life, right? But also, we know that bees can switch different jobs, depending on the needs. I guess, I wanted to talk a little bit about that whole thing, the tremble, that behavior, and what are your thoughts on that? Have you ever examined this behavior? I've never seen it, actually. So I don't know.

Jamie 22:38
I have seen it. But I wouldn't have recognized it for what it was until I became aware of Tom's research and was able to see it for what it is. And so kind of a lot to unpack with your question. But the basic idea is that we all learned early on, most of us know that when a worker honey bee is born, she's not born to a task in which she remains her whole life, or emerges as an adult, she's not emerging into a task that she remains in. And as she ages, she progresses through a -- and I'm going to say this as diplomatic as possible -- she progresses through a mostly predictive series of behaviors. If you look at the charts, young bees do what young bees do. The charts say old bees do what old bees do, and all of us kind of get this sense that every worker bee does every task exactly as they age when they're supposed to. Well, the truth is that behaviors are very plastic and worker bees and cohorts of worker bees will do the task that they need to do most. And what do I mean by cohorts? Well, young bees have these plastic sliding scale of behaviors where they will do young bee activities that are needed, middle-age bees, middle-aged activities that are needed, and old-aged bees, old-aged activity. So it's not like they will do this activity, and then move to the next one and never go back to that previous activity. They can, based on need. And so here in this example, he's got nectar foragers returning to the nest full of nectar. They need to offload that nectar to receiver bees so that they can go back out and collect more nectar. Well, let's just say the first round of forager bees go out in the morning, they collect nectar, let's just say it's 100 of them, and they come back to the nest and there's only five receiver bees ready. Well, you've got five receiver bees trying to offload 100 foragers, and these foragers are saying hey, there's a lot of nectar out here, we need to go back out and get more, we need to recruit even more individuals. So the question is, in order to keep up with that incoming supply, there have to be more receiver bees and so

the nectar foragers can ask for, can coerce the creation of, as it were, more receiver bees. It'd be like me coming into the house and saying, guys, I have all these groceries, I need some hands to help me get them out of the car. I do that verbally. I'm recruiting people in my house to come help me verbally. But these forager bees returning can recruit one another through these tremble dances to say, hey, there's something we need to do here, let's go get busy and do it. And so we see this give and take, these feedback loops in bee colonies to ensure that all the tasks are being done as the demand for certain tasks increases or shows up. And likewise, as there's more receivers than there are foragers coming in, the reverse will happen. The receiver bees will start switching to other tasks so there wouldn't be more of them than is necessary for the job. And so it's really remarkable. I mean, Tom made that statement that he was quoting from someone at the end of the book about how intelligent honey bees are. And he mentioned that the worker honey bee is probably the most intelligent insect there is and that's so true. When people look at a honey bee colonies, they get all excited about what queens can do. Well, really, the worker bee is the most fantastic bee in the nest. If you want to make it even more complicated, the worker could have been a queen, the queen could have been a worker. So that same set of DNA produces the most intelligent insect out there, the worker honey bee, and the most robot insect out there, the queen honey bee whose only job is to mate and lay eggs. And so it's remarkable the mysteries that are in the honey bee colony waiting to be discovered. And that's really Tom's contribution is to wake up the scientific community, to make beekeepers aware of these glorious mysteries and how they can be solved and what solving of those mysteries leads to in the future. Everybody listening to this podcast, we truly interact with an amazing organism that's a new mystery, a new present to unwrap everyday.

Amy 26:53
Absolutely. I mean, speaking of mysteries, I'm really excited to read Dr. Seeley's new book that just came out. I feel like we had interviewed him right in time because the book is out, we'll make sure to link it in our additional resources. But Jamie, you had the opportunity to read it and review it and I'm excited for myself, personally, but also for beekeepers to be able to take this book and see what Dr. Seeley has really found as far as his career goes and as far as being able to identify some of those mysteries that are in the colony.

Jamie 27:24
Yeah, I agree. I'll just even broaden that a little bit more. As beekeepers, we tend to look at the how to keep bees books, and there's a lot of those out there. But really, if you want an enriched experience with honey bees, go to some of those books. Of course, Tom has published some, but there are other authors who have published books where research is communicated about honey bees. And if you go to those books, you'll gain this real deep appreciation for how remarkable honey bees are. It shows you all the science necessary to uncover those mysteries and tell us more about this creature that we keep in boxes for the purpose of pollinating crops or producing honey. They really are a fun organism, and books just like those that Tom writes and others write really go along great lengths to introduce us to those worlds.

Stump The Chump 28:19
It's everybody's favorite game show, Stump the Chump.

Amy 28:28
Welcome back to the question and answer segment. Jamie, the first question that we have today, this person is wondering about beekeeping byproducts. And they're not asking about the obvious things like wax cappings or propolis. But they're wondering, let's say they do a mite wash and they've got these bee bodies. They've got these dead bees, or they've got slum gum from wax filtering. What should they do with these alcohol washed bees? They're wondering if slum gum would be good as a side dressing to their jalapenos. All great questions.

Jamie 29:01
This is something I've really never considered. It's kind of like the zero waste strategy. And if you think about it, in beekeeping, I guess there are things that we do that generates real waste, real waste being wasted. There's really nothing else we can do with it. I think bees from an alcohol wash are probably one of those things that there's no backup, right? They were washed in alcohol, so I wouldn't necessarily feed them to chickens like the questioners ask or things like that. So if it's a true alcohol wash, I would probably just discard the bees without thinking twice about it. On the other hand, if you elect to do powdered sugar shakes or something like that, that gives you roughly the same data but the bees stay alive and then the bees benefit. But if you're doing a true alcohol wash actually using alcohol, unfortunately, I can't think of anything you could do with pickled bees. But the other question was slum gum, which is an interesting question. For those of you who are out there, slum gum is kind of the leftover, I don't know, garbage or trash associated with wax rendering. When you melt wax, it's kind of the goopy stuff that separates out. It might have a little bit of honey and bee parts and propolis and just other stuff.

Amy 30:13
It's usually just clumpy and you just usually take and wrap it away and throw it away. Right?

Jamie 30:18
Yeah, exactly. But the reason I'm giggling is that the questioner asked, can it be a side dressing to my jalapenos? Well, maybe. I don't know. You could try and see. But I will say that I have seen one person, and I can't remember where or even who, but I did see one person make slum gum candles. Like there's just enough wax leftover in it that they took that goopy mess and fashioned it around a wick and was selling slum gum candles, which is what it sounds like. These kind of propolis-y kind of bee part-y, waxish.

Amy 30:52
That is so gross.

Jamie 30:53
Stuff with a wick in it. That's pretty, pretty neat. And then another thing they mentioned is what about that last half gallon of syrup that's tipped over the edge? Well, there's really nothing you can do with it. You just pour that out and kind of just cut your losses. The syrup thing is a tricky question because, personally, I try not to make any more syrup than the bees are going to consume in real time. Like you

feed it and it's gone. But I do know for commercial beekeepers, there are just plenty of situations that you got to make more syrup than you might end up needing at the end of the day, because you might be feeding 5000 colonies and have 200 colonies left of syrup leftover. I don't know. There's just not good answers for that. The best thing to do is use it as quickly as possible to keep it from going bad. You could refrigerate the syrup. But the questioner was really asking, once it goes bad, what do I do with it? If you've really got some off syrup, in other words it's fermenting, there's really no other option for it except dump it down the drain. This question has showed me the sadness about gosh, there are things that we do to generate real waste that we really have no other options for. So if you guys are out there listening and have alternatives to slum gum and pickled bees and fermented sugar syrup, let us know because I'd be curious to hear what your strategy for dealing with it is. I mean, I think you basically just told everybody the answer. So alcohol bees, trash. Slum gum side dressing to jalapenos, try it and let us know. Slum gum turned into candles, sure, try it. Maybe toss the rest of your bad syrup.

Amy 32:11
But I won't be held responsible for anything that happens if you guys all try this stuff. Just FYI. Now I'm just waiting for mason jars of slum gum sent over to us. Oh my goodness. Okay, so that was a fun question. Thank you. The second question that we have, so this person was traveling through Central Florida, and for those who are unfamiliar, Florida is known for our citrus industry. The citrus industry has changed, and there's just a huge history of citrus here and citrus growers and beekeepers in Florida. There's history, there are relationships with that., and, of course, with citrus greening, which is essentially like our Varroa problem that we have here in beekeeping. What do you think the future is for citrus and bees and citrus honey and what that is for beekeepers?

Jamie 33:22
Yeah, what a really hard question. It's kind of a sad question to have to answer. So, again, I think you hit the nail on the head for the listeners. Florida has historically been a very big citrus state. It's huge citrus industry. But there is a bacterial infection of citrus plants that produces a condition called citrus greening. Plants that get citrus greening are doomed. That's just the way it is. And there is an insect called a citrus psyllid. It's called the Asian citrus psyllid. So, it's from Asia. It carries and transmits citrus greening. So essentially, the citrus growers have to treat a lot to control the citrus psyllid because the citrus psyllid, in turn, transmits the bacterial infection citrus greening. This is the Varroa deformed wing virus honey bee conundrum. Honey bees, in this case, the citrus tree, have a terrible pest. In our case, Varroa, their case, the psyllid that transmits terrible pathogen. In the case of citrus, the citrus greening. In the case of Varroa, deforming virus and other pathogens. So citrus growers have to treat a lot for the psyllid. That's their best strategy at the moment for controlling this disease. You can't control the disease well, so they control the vector. University of Florida has a lot of researchers who are looking at controlling citrus greening through nutrition, through age of plant, through antibiotics, through all kinds of things. And if you drive to Central and South Florida, historically, you would see citrus groves absolutely everywhere. I've been in Florida for 18 years, and when I go to Central and South Florida, I see what everybody else sees, which is abandoned citrus grove, dead citrus plants, those folks who are trying to kind of stick it out and grow citrus trees. They're doing so successfully, but with tremendous input, similar to how you control Varroa. It can be successful, but it takes tremendous input of time, energy, resources, treatments, etc. And so the questioner is basically saying, hey, look, will Florida ever

return to the glory days of citrus? Will we have copious amounts of citrus honey? The short answer is, Amy, I really don't know. I think I'm an eternal optimist saying that I do believe that this is a problem that will be conquered someday. I just don't know if it's a problem that will be conquered soon. In my working lifetime, it may continue to get worse, and we may have less than less citrus, and therefore, less and less citrus honey and things like that. There are other states in the US that produce citrus. Texas, California, for example. There are other countries in the world that produce citrus. Brazil, South Africa, others. Not every place has this terrible disease. But when this disease gets into an area, it pretty much kills the trees, it kills every tree it encounters, and it's sad. So I don't know what the future holds. I'm optimistic that it will be solved. But I am realistic about this and know that it's going to take a lot of effort and things are going to change in the immediate future, I think, before a solution is ultimately found. Yeah, absolutely. And I also think that the other part of it, and this is just from what I hear talking to beekeepers, is that sometimes the citrus growers can't keep their operations alive. And what they'll do is, especially here in Florida, is that we've got so much urbanization happening and a lot of development, we've got a lot of people moving here to Florida, and so many of those citrus growers are selling their properties to developers. That directly impacts some of our beekeepers and where they have their holding yards or where they do pull citrus honey. So I think that that is something that is an immediate impact on our industry here specifically in Florida. Yeah, exactly. And I do feel really bad for the growers. There is an intimate link between citrus and beekeepers. I don't know. It's been tough to watch. So hopefully, there'll be a good solution soon. But in the meantime, it's really hard to know what direction this is headed.

Amy 37:28
Absolutely. So for our third question, we've done episodes and we've discussed pollen substitutes. Something that Emily Nordyke, one of our grad students here at the University of Florida, found was that the larva were not getting fed pollen substitutes. And so this individual was asking, if the colonies, if the bees are short on pollen, they don't have any pollen. How does the pollen substitute help with that brood rearing and helping build that colony?

Jamie 37:56
Well, I think we have more question here than I have time to answer. But I will say Emily and I were able to co-author a manuscript, in which we basically summarize, at least at the time, everything that was known about the impacts of pollen subs and honey bee colonies. And clearly this questioner has listened to us and read our stuff because they're asking a very pertinent question, which is, hey, Jamie, you guys show that when honey bees consume a pollen sub, that it doesn't necessarily get added to the brood diet, which we know is where bees put pollen. Young bees eat pollen, they also feed it to immature bees to grow them. So the questioner is saying, hey, look, if they're not feeding it directly to brood, how can brood benefit by virtue of feeding pollen subs? And the way that it is most commonly believed is that, first of all, pollen subs probably work best in the complete absence of other available pollen in the environment. If there's anything available in the environment at all, then you'd be better off, in many cases, maybe not even feeding pollen subs. I won't say that's universally true. I'll just say in our research, that seems to be the case. So that suggests, then, in the complete absence of pollen, maybe pollen subs can help. There have been papers that have been published, through which the authors have shown that when you feed pollen subs, you can get more brood in certain circumstances. So the

question is, well, if it's not being fed to brood, how do you get more brood? The most common response, the most commonly believed idea is that we all know young adult bees consume pollen. So when a bee is newly emerged, for the first five days to 10 days of its life, it consumes pollen, and it consumes pollen for other reasons, but among those reasons, to develop the glands in its head that it uses to produce brood foods. So bees have hypopharyngeal glands and mandibular glands in their heads that are responsible for producing the food that they feed the young, and they consume pollen to mature those glands. Once those glands are mature, they're able to feed brood food to the young. So in theory, if the larvae aren't being fed pollen subs, it's still possible they're benefiting from pollen subs if the adult bees eat the pollen sub, and are able to mature their glands appropriately, and, therefore, then, produce brood food for the immature bees. So it's an indirect benefit of pollen subs on larvae, because pollen subs then potentially could help adult bees develop their food glands, and then, therefore, be able to feed larvae that they are producing. So in that scenario, they would still be able to use pollen subs to the benefit of immature bees in the absence of a pollen flow.

Amy 40:50
Very cool. Gosh, there's so many questions, right? I mean, there are just so many different research questions. There are so many applied basic research questions. It's just amazing.

Jamie 41:00
That's good. We'll never run out of something to do.

Amy 41:04
Job security, I suppose, for the researchers out there.

Jamie 41:06
That's right.

Amy 41:07
Sounds good. All right, listeners. If you have questions, feel free to ask us questions on our social media pages or by sending us an email Thanks for listening to today's episode. This episode was edited and produced by our podcast coordinator Mitra Hamzavi. Thanks Mitra.

Jamie 41:34
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.