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SPEAKERS

Guest, Amy, Jamie, Stump The Chump, Serra Sowers

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 00:43
Hello, everybody, and welcome to this episode of Two Bees in a Podcast. I am extremely excited to introduce our guest speaker for today, Mika Hardison. She is a very good personal friend through the collaborations that we had and have here at the University of Florida with the organization and the business that she runs. And so she is The Herban Bee. And I say herban, h-e-r-b-a-n, so it's kind of a take on the urban beekeeper. Mika, I really enjoy that. She also manages the community garden and the community apiary through White Harvest Farms, that is with the Clara White Mission. And I think Mika is going to talk to us a little bit about that as well. She is located in Jacksonville, Florida, so not too far from here in Gainesville. But I think that her program and her projects are very applicable to beekeepers all over the nation and all over the world. So, Mika, thank you so much for joining us today.

Guest 01:50
Thank you for having me.

Amy 01:51
So, we are going to talk about your community garden, the community apiary that you've started. This apiary is in a very low-income area. And I think you mentioned behind the scenes that it is one of the

poorest areas in our state. But before we get into that topic, I would love to hear about your beekeeping experience.

Guest 02:16
Sure, so I actually started beekeeping from homesteading. So I'm a homesteader. I live in a regular neighborhood with an HOA and a big fence. And so behind that fence, I grow my own food. I have chickens, rabbits, lots of things back there. But initially, I didn't have bees. But what was happening was that I wasn't really getting the pollination rates that I needed in order to preserve food. So it's discouraging to grow food the whole season or trying to grow something the whole season, and then it comes canning time and you've got two cucumbers. Wasn't good. So that's how I got into bees. So instead of going from plant-to-plant, because initially, I was going from flower to flower, flower to flower trying to increase my pollination rates. And I said, you know what? This is a lot. So I got my first hives. I started out with three hives. From there, it was just kind of love at first bee. As soon as I got into beekeeping, I just, like a lot of people I'm sure, became super excited about it. It's really, in my opinion, a whole nother way to see the world, through the lens of bees. And so it stuck. And so from there, I got involved with the farm that's run by White Harvest and the Clara White Mission. I started a community garden there. So just helping people to control their inputs and grow their own food and just kind of be more in control of their finances through that way. And from there that was super successful. I said, you know what? There's a community garden where kind of everybody comes in and everybody participates. Let's extend that concept and do a community apiary. So we do a grant from the Department of Agriculture, the SARE grant. We were able to obtain the funds to start this community apiary about two years ago, but almost three years ago now. So we started the community apiary and so through that, I was able to extend the experience that I had with beekeeping and open that experience up for the community.

Amy 04:47
Yeah, that's amazing. You had already mentioned it but that was actually how I met you, through the grant, through the SARE grant which is the Sustainable Agriculture Research and Education Grant. I know you had a huge part in writing that grant and grant writing is very difficult. So congratulations on that. But that's how we had originally met. You were wanting to provide education and an internship opportunity for individuals in your area. So can you tell us a little bit about that project? You kind of discuss how it started. But what are the goals? What are the missions of the Clara White Mission? Or, what do you all do at White Harvest Farms? And why did you begin the program?

Guest 05:34
Gotcha. So, when we initially wrote that grant, there's a component in the grant where you're looking for community partners. Of course, I knew about UF and the honey bee lab. If you're involved at all in beekeeping, I'm sure in the state of Florida, you know about UF and how they're leaders in that area. But I really thought it was a long shot. We're gonna reach out to UF and yeah, we're probably never going to hear from these guys. So I was pretty surprised when we got a response. Yeah, yeah, we'd love to partner. Yeah, we can help. I was super, super surprised to get that response and super excited to have the University of Florida as an education resource for the community apiary. But the community

apiary, really the concept behind it is self-reliance and self-sustainability. As I mentioned prior, the community apiary is in area 32209 in Jacksonville, and the national median average income there is 62% below the national average. And so it's an area where resources are limited. And because resources are limited, sometimes opportunities are limited as well. And so really, the intention of the community apiary was to provide the opportunity for people, regardless of their income levels, to get involved in beekeeping if they had the desire to. So we started beekeeping. It's been great. Kids come on the farm, and everybody loves bees. So I just think that bees are just one of those things that just everybody kind of gravitates towards, and especially children. When people come and visit the farm, or when kids come and visit the farm, people are super excited to see the honey at the market stand, but then they see the connection because the hives are right there. So I think that the community apiary and then the community garden, and the farm itself really is a way for people to connect to agriculture and connect to their food sources and to control their inputs.

Jamie 07:57
So Mika, what you're doing is really amazing. And obviously, just listening to you talk about it is very inspiring. I've seen similar programs in other cities around the country. My colleagues have talked about programs like this, maybe even in cities around the world. I know that there are probably challenges unique to managing programs like the one you're discussing and what you manage. So of course, you have the challenge of limited income with program participants, but other challenges as well. So can you discuss some of the challenges associated with managing this really amazing program that you manage?

Guest 08:36
Yes, certainly. As you stated, of course, there is the challenge of limited income for the program participants, but it's limited income for the program itself as well. Our funding is ending at the end of this year. Our SARE grant goes away. And just really trying to come up with ideas and do fundraisers in order to extend the program out for another two years is an immediate challenge that we're facing now. The SARE grant was great in that now we have all of the big-ticket items. So we have our extractor, we have our honey boxes, we have those things, but then there are other costs that are associated with beekeeping. You know, the costs for Varroa treatments or the cost of hive beetle traps and, of course, there's always the cost of gloves that need to be replaced or beekeeping suits. Someone's beekeeping suit may have a hole in it or what have you. So I would say that limited income is definitely a challenge. Also, the availability of the apiary. So currently, I'm there two days a week. So I'm there on Wednesday, and I'm there on Saturdays. But those timeframes don't necessarily fit the schedule of all of the participants and everyone who would like to participate. So ultimately, the goal would be to find some type of funding to extend an opportunity to a part-time beekeeper, so that we could have extended access hours. Oftentimes, I find myself using my own treatments or my own resources in order to plug gaps and plug holes. So, that's a gap.

Amy 10:31
Yeah, so Mika, you just discussed some of the challenges. I'm interested to know what successes you've had with the program. What opportunities have there been? So kind of go through the program

for us, and let us know about participants have been doing, and then what are your favorite parts of the program?

Guest 10:51
I definitely love the program. There are a lot of success stories. It's a very interesting thing to see people's reactions, and how their life changes as they're exposed to different things. So for example, three of the beekeepers that have come through the program are now employed with the farm. So one person is an assistant to me, and then two other individuals are either full-time or part-time farmers now. So really, that's exciting. From the aspect of you have this urban farm in this super urban community, and I often say, if you really want to know the impact of a program, think about if that program were not there what would life be like? So for this community, if this farm is not there, then, really there's no opportunity to be exposed to agriculture, to really be exposed to a farm, to have that connectivity with your food and your input and where your food comes from, etc, etc. So I definitely think that some beekeepers that have come through the program that have gone on to be employed is definitely a success story. People that have gone on to pick up things like value-added, we do some value-added training there, so being able to take the information that you have there and then turn it into, for lack of a better word, a passive income or a side hustle. We have people that now can create elderberry syrup, we do soapmaking, we do candlemaking. So we teach that value-added component. So from there, people are able to really provide for themselves a little bit better. I think that the farm and the community apiary really is a big step in people's journey towards self-reliance and self-sustainability, which is something that I'm super excited about. Like I mentioned, I'm a homesteader. So I get really excited about being able to provide for myself. I think that although there's definitely a time and a place for food giveaways, and things of that nature, when you can give somebody the opportunity to control their own destiny, in that regard, to grow their own food, to really even contribute to their own family budgets, in that way, I think that that's really been huge for children coming to the farm, making the connection with bees, and really understanding not only where their food comes from, but the lessons that we learned from bees, not only from a pollination perspective, but from a hive mentality. So that's something we talk about a lot at the farm. We talk about hive mentality and the lessons that we actually can learn from bees, and from honey bee hives. We communicate that to to kids, and they love it. So we talk about sharing resources, we talk about sharing information, we talk about learning from bees in that they take actions that benefit their entire community, not just themselves. And so being able to make that connection for people and teach lessons in a kind of cool way, and really most importantly, in a way that resonates with the subjects, whether that's the kids or whether that's adults. I think that that is pretty cool. I think another success has been people being able to understand that bees are just a fundamental component to a healthy ecosystem and having them connect with their surroundings in that way. I think bees are a great introduction to that. I heard someone say that there are many ways to see the world but through the lens of a bee is a way that will forever change your life. And I agree with that. I think that people really connect for some reason. Bees are just one of those things, they're just universal in that way. People love bees. And even if people are not interested in necessarily becoming a beekeeper, just having that exposure to being able to see the hive, being able to talk about them, being able to experience honey straight out the hive, I think that those are definitely wins not only for the program, but really for the community.

Jamie 15:40
This is such an inspiring story. I love listening to you tell it. I've got a scripted question, Mika, that I need to ask you, but before I asked you that scripted question, I'm going to go off script for just a second. I'm just going to ask you a personal question, why do you do this? What inspires you to do this, to lead this program?

Guest 16:02
That's a good question, Jamie. For me, I think that being able to grow your own food and control your inputs, I think that food security is a human right. Honestly, that's what I think. And so I think that people in disadvantaged areas, really, they want the same thing for their children and for their families that people in every other area want. There's nothing unique about them as parents in that regard. So giving people the tools that they need to be self-reliant and to rely on themselves and to be in the driver's seat, in terms of the resources that they're able to provide their community, that's a win for me. I think so many of the diseases and the comorbidities that we see in the 32209 zip code can be directly related to the food that is consumed there. A lot of fried foods, a lot of packaged foods, processed foods. And so by just exposing people to something else, when I think about the impact to a family, I mean, that can you can add another 20 years onto somebody's life. For families that have kids that may be acting up in school because they're, I don't know, bouncing off the walls, by giving them the ability to put green vegetables on the table every day as a part of their meals, produce is expensive. And I often tell people, like, it's clear at this point, that there's not some grocery superhero that's getting ready to come in and save this community, that's not going to happen. So it really is up to us as a community to start looking for and providing some of those solutions. So I think for me, that's my why.

Jamie 18:05
I love that. So that leads me perfectly to the scripted question that I had. When we talk about urban settings, especially about low-income urban settings, this term food desert comes up a lot. So could you talk a little bit about what that is? I mean, everything you're doing is addressing, essentially, this issue. But could you talk a little bit about what it is? And maybe what some of the needs are specifically in low-income areas. You've touched on this throughout all of your answers, but it'd be nice to kind of hear some summary statements on these thoughts. So food deserts first, and then needs in low-income areas second.

Guest 18:45
So food desert is just a term, Jamie, that we hear all the time. It's almost become like some type of a buzzword now. It's just a term that people use all the time, basically, to describe an area of where there's not a lot of access to healthy food. So if you come to Moncrief Road where our community apiary and our community garden is, there's food there, but it's just not healthy food. So you'll see lots of packaged foods, lots of gas stations that sell food, lots of corner stores, lots of chains, like Family Dollar and lots of those types of stores. But what you really won't see is a lot of fresh, healthy options. And so it's a food desert in that way. Not a food desert in the sense that there's not any grocery stores that are accessible because there are grocery stores that are within probably about three or four miles.

Of course, in lower income areas, transportation is an issue, so basically what what we see oftentimes is, a family that may make a monthly trip to the grocery store. So if you're making a monthly trip to the grocery store, of course, you're looking for items that are going to be able to last the whole month. And so unfortunately, that's not fresh produce. You're looking for things that have preservatives in them, canned foods, and cheap food, oftentimes. Fresh produce really has become a luxury and fresh produce is expensive. So really, the intention of the farm is to kind of plug that gap. So not only is the produce in abundance, but it is super inexpensive, and it's organic. So it's just a win in that regard. I think, also, when we're talking about food deserts and food insecurity, we have to also talk about changing the mentality of the community because over a period of time, people get accustomed to fast food, to food that is quick. And of course, that is not, most of the time, that's not the healthier option. So it's also about when we're addressing food insecurity, in my opinion, it's also about addressing a mentality. Getting back to a place where families have an intentional meal together, where we're sitting around the table, and we're eating things that are going to have benefit to our family, nutritionally, not just in terms of filling your stomach. So that's kind of my summary on food deserts. In terms of the needs of the community, I think that there's a need for not only fresh produce, but as I kind of spoke to a little bit, there's a need for a cultural change. We need to get back to food being not just quick, but food filling our nutritional needs, and us kind of looking at food more so as medicine in a sense, and what benefits we're getting from food. So it's bigger than, we're hungry, and we just run and grab something to eat. But it's about plugging food into the households, in our communities that are going to give benefit beyond that initial full feeling, that are going to help with things like high blood pressure and diabetes, diseases that really are the higher rates of all these diseases, from heart disease to high blood pressure, to diabetes. All of those comorbidity rates are highest in the 32209 area code. In these efforts to expose people to agriculture, it's about having a connectivity with your food sources. And bees are, just like I was saying earlier, one of those things that everybody loves, and everybody will talk about. So it's very easy for people to make the connection with their food, the food that is coming on their table. We know those stats, like one out of every three bites of food that's on your plate is made possible by a pollinator. So, to me, bees are really great gateway to open those conversations and start to change those habits that have been formed over, in some cases, many years.

Amy 18:53
All right, Mika, I'm switching gears just a little bit. This is also a little off-script. But, I wanted to talk a little bit about The Herban Bee, and how you started that, and what are your primary -- what do you do with your business?

Guest 24:11
Oh, thank you. So, The Herban Bee. We are definitely honey producers. We do raw honey, but we also do a lot of infusions. So we take honey and we combine it with something to create a culinary experience as it relates to honey. So whether that is ginger or whether that's garlic, we take honey and we pair it with something. We've gotten so good at it that we actually sell way more infusions than we sell raw honey now. So in the fall, how we're going to expand the business in this fall is that we're now introducing candles, we're introducing lip balms, we've have already been doing honey soaps. And so hopefully, by the time the farm table launches on October 20, the plan is to have a table full of honey-

related products. We're really trying to roll out our honey experience. We want you to be able to wash with honey, rub honey on your skin in the form of a lotion, put honey on your lips, and put it on your dinner plate.

Amy 25:25
Very cool. All right, thank you so much for sharing that. I know Jamie has said it a couple of times, Mika, but every time I talk to you, it's so inspirational to just be able to discuss the really great work that you're doing. You and I are friends, we spend a lot of time together, and we've also had you at Bee College, we've had you teaching at Bee College in the Bahamas. There are so many things that we've done together. Every time I talk to you, I get really excited about how we're able to help various communities, not just here in Florida, but just throughout the world. So thank you so much for everything that you've done for that program.

Guest 26:07
Yeah, yeah, absolutely. One of the things I wanted to talk to speak to, as well, Amy, is just how important the UF partnership has been. Really, it's been a fundamental part of the community apiary. Without the opportunity to have that scientific information, you guys do such a great job of being scientists, and taking the information and making it relatable and making it information that is digestible to people from all walks of life. Like I said in the beginning, when we originally reached out to you, I didn't know you then, but when we originally reached out to UF, everywhere you go there's an extension office in the state of Florida that is run by UF. Being a homesteader, I'm very familiar with the extension agent position and the extension offices throughout the state of Florida. I follow different things like the efforts that UF has made in agriculture or when there's an issue like graining or something of that nature, how UF is just all over. So I was very well aware of who UF is in the space of agriculture, and to be able to reach out to UF and get a response, I've been able to meet mentors, and I've been able to get my questions answered. Having access to that type of information, hearing Dr. Jamie Ellis speak and it's actually funny and it's actually engaging and it's actually information that I can digest and take with me and then share to other people in the community has just been awesome. So I definitely want to say you guys do a great job in terms of being relatable, having information that is helpful and having information that's accessible to people in the state of Florida. So I know I speak for many, many, many people not only here in the state of Florida, I'm sure all over the world, but I'm in Florida, in Duval County. And so I just want to say that you guys do an awesome job at doing what you do. So I'm always excited to go to Bee College. It's like a highlight. I like planning. I will drive five hours to get to Bee College. Oh heck, I took a plane to the Bahamas to get to Bee College. So the partnership has just been great. And I want to thank you all for that.

Amy 28:45
Thank you so much, Mika.

Jamie 28:46
Thanks, Mika.

Amy 28:46
Yeah, we didn't even pay her to say that. So thank you. All right. Is there anything you have, anything else you'd like to add? Is there anything else you'd like to share with our audience, Mika?

Guest 29:01
I definitely want to welcome anyone from the beekeeping community who would like to instruct or has some extra resources, in terms of maybe some extra equipment or some equipment that you're no longer using and you're looking for a good use for that. I definitely want to put it out there that we are really looking for other members of the beekeeping community to come in and engage with us and to teach and to jump into this community beekeeping experience. I can be reached on social media and I have a website, TheHerbanBee.com. TheHerbanBee_Official, but anybody can always DM me or contact me. There's a Contact Us button on the website that goes to my personal phone number. I'm always looking for speakers or trainers or really whoever wants to get involved. We'd love to have them.

Amy 30:06
Thank you, again, so, so much Mika for everything that you've done. And thank you so much for being on our podcast today.

Guest 30:12
Thank you for having me.

Amy 30:30
So, as I mentioned, Jamie, I've gotten to know Mika very well through this position and through our collaboration. Again, we've said it so many times, but it's so inspiring to be able to hear what she is doing for her community and in the area that she's in within Jacksonville. So it's always just fun to hear people's experiences and how they've put together very successful programs.

Jamie 30:57
When I listen to someone like Mika, who clearly has a passion for what she's doing, and is really making a difference, I keep thinking, given we have an international podcast, how does that expand to our listeners everywhere? Well, frankly, there, there are low-income communities in cities around the world. Mika emphasizes how she used gardening and beekeeping to reach those communities. I think that's an inspirational story that can be duplicated, elsewhere, globally. I hope, if you're listening to this, that you can think of ways that you might be able to reach out to low-income communities, or if you already live in a low-income community, how you might be inspired to do something similar to make that connection and improve the lives of those folks who are living there.

Amy 31:46
Yeah, absolutely. When I was doing my master's, I've always wanted to focus on food deserts. That was always something that was at the top of my mind, teaching people where their food came from. And it started, I've mentioned this before, but it started during my time abroad in Ecuador. There was a

lot of poverty where I was living in the country. And then it made me realize there's a lot of poverty, but there was also a lot of farmland. And so I kind of, connected the two, and I'm very passionate about international work. But then, when I was starting to do my master's, I realized that there was poverty all around me. So I decided not to do international work for a master's, but did work with a nonprofit organization in a low-income area. And so I think, we have a lot of people in this world who are wanting to work in low-income areas and hold programming. I think it is a really great reminder that even just small programs, just simple programs that teach people, expose them to honey bees, teach them about value-added products can make a very big difference.

Jamie 32:57
There are a couple of things worth thinking about and saying here on that point, Amy. So the idea of food desert, and, well, I'll even start further back than that. Most of us think about low-income as over there, somewhere else. But honestly, most of us don't have to go very far outside of our circles, potentially, to find areas that have this low-income situation where we could possibly make a difference, right? So that's one. Number two, this idea of food desert, it's really interesting to me because Mika was making the point, it's not the absence of food, it's just the absence of quality food, right? It's just prepackaged, high calorie, perhaps sugar-laden type foods that a lot of folks in these areas might have access to. And so then the third point, which is why this is on a beekeeping podcast at all, which is the honey bee as the great unifier. You go into these areas, you start a garden, a community garden, things like that, folks can learn a lot about where their food comes from, but beyond that, how important honey bees are. Mika even said this and it's a passing comment that I did not miss. I hung on to when she said, these honey bees, just everybody loves honey bees. It's a great way to quickly meet someone where they are, to introduce them to a new topic, and to give them some hope, some education, some inspiration, some motivation, some knowledge about how they can thrive, even in these settings. I really appreciate that that's what honey bees do. They really speak across all types of boundaries. They speak across all types of situations and in all types of areas. Beekeepers have an amazing gift with honey bees that we can pay forward, give outward, and change the lives of other people through something that we got interested in individually for any number of reasons, but it can be a powerful tool to lift people out of difficult situations. And I really think that that's the beauty of Mika's story.

Amy 35:05
Yeah, I absolutely agree.

Stump The Chump 35:11
It's everybody's favorite game show, Stump The Chump.

Amy 35:20
Welcome back to the question and answer segment. Jamie, we've got a couple of different questions here. I'm going to try to Stump The Chump. And we'll see how you do.

Jamie 35:30
Duly noted, I'm ready.

Amy 35:31
Alright. So the first question we have, this person, there are a couple of questions here, a couple of thoughts, but I'll just go ahead and read it. And we'll kind of just dissect each piece of it. So the question is a laying worker's lifespan different from a standard worker? At what age does a bee become a laying worker? So if a worker is laying, is it the younger nurse bees? Or is it the wing, tattered forger? Which one of those becomes a laying worker if necessary? The last part of it is that this person said it makes him think a young laying worker's life could be increased if she began laying. I mean, in my mind, now that I'm saying it out loud, it kind of makes sense because queens live longer, and they're laying eggs. So would that be the same with the worker bee? So what are your thoughts on all of these questions?

Jamie 36:24
Yeah, these are great questions, Amy. I'll tell you, what they really do is they serve as a really good prelude to how amazing honey bee colonies really are. I think if anybody listens to this podcast, they'll appreciate that honey bees are remarkably complex animals, and these questions really illustrate that point. Why do I say that? Well, when a queen lays a fertilized egg, that fertilized egg can become a worker or a queen. And maybe our listeners don't know this, but we meet once a week for breakfast, the whole team does. And we were discussing just this morning, this idea about queens and workers both having the capability of being the other well. Queens can live multiple years, workers in summer live three to six weeks, workers can live 100 to 120 days in winter. As they overwinter those colonies, queens lay the eggs, workers don't, workers do all the tasks queens don't. But there's this weird thing that happens when a colony goes queenless, and it becomes hopelessly queenless. They try to requeen, they fail to requeen, all of this stuff. And when that happens, some workers ovaries can develop and those workers begin to lay eggs. We call those workers laying workers because we couldn't come up with a better name. And so these workers cannot mate. Even though they can lay eggs, they can only lay on fertilized eggs. And in most of the subspecies of Apis mellifera, the honey bee we keep, these unfertilized eggs result in drone honey bees. And so the questioner is saying, well, when these workers start laying eggs, who are these workers that do this? Does the ability to lay extend their life? Well, the first question first, who are these workers, the average laying worker becomes a laying worker somewhere, roughly speaking, 10 days to three weeks after the colony becomes queenless. Usually closer to two to three weeks. That means by the time laying workers develop, the youngest workers in the nest are actually quite old, potentially. So it's usually those middle-aged to slightly older workers that are starting to become laying workers. They engage in this behavior. So then the questioner said, well, does that extend the lifespan of these laying workers? If workers, normally, in spring and summer only live three, four, or five, six weeks, if they become laying workers, is it longer? In fact, the literature that I found for this suggests that it is in fact longer, that they can live 100 days or longer. So becoming a laying worker can extend the life of a regular worker three to four times. It doesn't mean that the colony is going to live very long, right? Bunch of workers producing exclusively drones is ultimately doomed. Drones can't do stuff. But it does extend the life, apparently, of the individual workers that are engaged in this behavior.

Amy 39:22

I can't remember, but I think we had a previous episode where one of our listeners did ask us about laying workers and whether it would it be possible or whether it'd be practical to keep laying worker colonies for drones, as a drone source. So I have a feeling that this was maybe the same person, but I can't quite remember.

Jamie 39:42
Maybe so. Keeping us on our toes.

Amy 39:43
Yes, absolutely. Okay, so the second question that we have, you're gonna have to go into basic biology with me here, Jamie. So the question is, how many sperm cells does a queen release when fertilizing an egg? Talk me through this?

Jamie 40:02
Well, the reason I giggle when you ask is I've actually been asked this maybe twice, maybe three times in public when I just finished a lecture on mating biology and honey bees. And again, our listeners aren't privy to all the behind-the-scenes discussions that you and I have. But we just had our South Florida Bee College last weekend and I gave a talk on mating biology of the honey bees and someone raised their hand and said, "Jamie, when a queen fertilizes an egg, how many sperm cells is she releasing?" And I kind of mumbled through the answer. I'm like, well, it's got to be at least one, maybe no more than 10, I don't know. And I kind of said it with confidence. But then, someone in our lab, Devan, who works for us, who's a research technician at our lab actually read a paper. He's like Jamie, he came up to me behind the scenes, like Jamie, I actually read a paper. John Harbo had done some work on this. And so let me set the stage and explain the background and then I'll tell you guys what I found to be the answer because apparently, Amy, someone actually has calculated this. All right. So when a queen lays an egg, she can determine whether or not that egg is fertilized. She has a special organ in her body called a spermatheca where she stores the semen from all of the males with which she mated. So when she mates, she pumps this stuff into that spermatheca. And then as she lays an egg, she has a special valve and a muscular system at the base of the spermathecal duct where she can release semen or withhold semen. So if she's withholding semen, it's unfertilized, it becomes a male honey bee, a drone. If she allows semen to touch it, it becomes fertilized, and it becomes a female. So that would be either a worker or queen. And so then the question is when she passes that egg down the chute, is she releasing one sperm cell, two sperm cells, three sperm cells? And if so, how can she count? How can she control this? Well, I did look up some paper by John Harbo, who was once a research scientist at the USDA Bee Lab, the genetics physiology laboratory there in Baton Rouge, Louisiana. And what he found is he looked at sperm numbers and volume in the spermatheca over the life of queens. So at the beginning of the life of a queen, at the end of a life of a queen, and then he could use that to make rough calculations. And what he determined at the time is that queens aren't releasing a number of sperm cells, they are releasing a volume of semen. So when they lay an egg, they're releasing that kind of set volume of semen in anticipation. So as it were, that there's going to be at least a sperm cell or two or more in that volume of semen. Well, I happened to find a paper in 2016 by Boris Bar and colleagues, where they actually found this. It's in the journal Ecology and

Evolution. We'll try to make sure and link to this open-access article in the show notes to this particular episode. And I'm just going to read verbatim the second half of the abstract of this paper. Again, I want to make sure and recognize that it's Boris Bar, et al. in Ecology and Evolution. The title of the article is "Sperm use economy of honey bee queens," because I really think it says it better than I can. Essentially, they say, we found that queens are remarkably efficient, and only use a median of two sperm cells per egg fertilization, with that number always decreasing in older queens. So in other words, when an egg passes the chute, they're releasing a median of two sperm cells per egg. That's not a mean, that's not the average. Median means just the most common number. So when they're releasing a volume of sperm or semen, two is the most common number that is released, and they're not releasing it based on a count. They're not going one, two, okay, we can stop. It says the number of sperm in storage, in other words, how much is left in the spermatheca, is always a predictor of the number of sperm used per fertilization. In other words, when queens have full spermathecas, more sperm cells get released per egg than when a queen has a depleted spermatheca. And so they say, then, that queens use a constant ratio of spermathecal fluid relative to the total spermathecal volume. In other words, the amount of liquid in the spermatheca dictates the volume of seminal fluid, or spermathecal fluid they release when they lay an egg. So basically, queens are releasing a volume of the contents from their spermatheca, which has a median number of sperm cells of about two. And so they use this to calculate the lifetime fecundity of honey bee queens and suggested that queens can lay about 1.5 million fertilized eggs over their life. They also make this point, which, I think, is incredibly critical, Amy, that their data provide the first empirical evidence that honey bee queens don't manipulate sperm use. And fertilization failures, this is the quote that I want everybody to hear, and fertilization failures in worker-destined eggs are therefore honest signals that worker bees used to time queen replacement. So what does that last statement mean? A queen may not know that she's running out of sperm because she's continuing to deliver the same volume of fluid for every egg. She doesn't know if her sperm is alive or not or if she's releasing one or two, she's just releasing the volume. So in her later life, even though she's running out of sperm, she's not running out of fluid. So she is laying, still, into worker cells. But an increasing proportion of those eggs that she lays into worker cells are unfertilized. She doesn't know that, because again, she's releasing fluid. But the workers can detect that. They use that as a gauge to initiate queen replacement. So think about, Amy.

Amy 46:13
That's so crazy.

Jamie 46:15
Think about all the folks we've interviewed in our podcast about sperm quality in the spermatheca. Dave Tarpy, folks from Washington State, shipping queens, having bad drones, all of these things, you can have an amazing queen laying an amazing number of eggs, but as she loses the number of active sperm in her spermatheca, more and more eggs that she determines to be fertilized are not. And then the workers say, aha, it's time to replace her.

Amy 46:49

You kind of have to feel bad for the queen. Right? I mean, she's like, I'm just doing my job. I don't know. I thought I went on a mating flight. I thought I was totally fine. Also, I mean, there's just so much to unpack with what you just said. I've got so many different thoughts, and so many different questions. And I think, one of the questions that I do have is you've said that, on average, she releases two sperm cells for each egg. So that is just a standard -- well, I guess you said that's not an average.

Jamie 47:21
That's just the median, the most common number.

Amy 47:23
The most common, so, then you kind of wonder if queens that will have more sperm per egg, do they not last as long? Right? I mean, I guess in my mind, that would make sense.

Jamie 47:38
Absolutely. Amy, think about it this way. They calculated an average volume of spermathecal fluid they were releasing, and that's some ridiculous number. Like 2.364 times 10 to the -6. But that's a bit -- but obviously, as most of our listeners know, one of my favorite sayings is biology is messy. So you're going to have queens that release a large volume every egg and queens that released a smaller volume. So it's an average, right? This bell curve. So you can imagine a situation where queens that are over-releasing volume are more likely to "burnout first." Yeah, so that could just be a biological issue that the queen herself is facing. Maybe she had received more than enough sperm to fertilize more than enough eggs for a typical lifespan, but for some reason, she's releasing too much volume, and that could lead to her early replacement by the workers.

Amy 48:35
Very cool. Well, the other question I have, and this is a question I receive pretty often is just the question of does she actively decide whether she's going to fertilize or withhold sperm versus lay a fertilized egg?

Jamie 48:52
So yes, I mean, what happens is when queens are deciding whether or not to lay a fertilized egg or not, they stick their head and their front legs into a cell to determine is it clean and ready to receive an egg? She uses all of that information, also, to gauge the size of the cell. And with that information, she elects to lay a fertilized egg or unfertilized egg. So when she turns around and puts her abdomen into that cell, she's going okay, this was a larger cell, it's clean, it's ready to receive an unfertilized egg, and things like that. It's pretty remarkable to think about all of this happening. Again, we know humans so well, and obviously, there's so much more number of sperm cells released per individual egg. The males and females and humans can't control that. But queens have this stored sperm and when they lay an egg, they're like, release, quick volume, quick volume, quick volume, quick volume, nothing at all, nothing at all, quick volume. It's just remarkable. I mean, the other half of this story is that workers can know this. They can say, hey, this is an unfertilized egg in a worker cell, she's failing, we need to replace her. Remarkable.

Amy 50:06
I know. So cool. All right. So for the third question that we have, the question is someone told me that you could train a bee with positive reinforcement. Is this true? And why would we want to do this? It's like training my dogs at home, hand them a treat.

Jamie 50:23
That's exactly the same. I mean, the most classic example of this is something called the proboscis extension response, PER. And so the proboscis extension response is kind of an experimental manipulation of worker bees, where you can put worker bees in something like a straw, that's roughly the same diameter that they are so that only their head is poking out the end of the straw. And then you can expose the bee to something, let's just say a smell, a particular smell. And when you expose them to that smell, you touch a little bit of sugar water on their tongue, proboscis. So then you do that again, and you do it again, and you do it again, and you are training the bee to associate that smell with sugar water. So after conditioning the bee, at some point, you can just expose it to that smell, and it will extend its proboscis anticipating to get a sugar water reward. So, proboscis extension response, and it's not something -- your question is why would anybody want to do this?

Amy 51:47
What purpose does that serve? Good for you, great. And?

Jamie 51:50
I like that because the general public would ask that kind of question. But scientists actually use this technique all the time because it is a way to look at how things, among other ways, to look at how things affect memory in bees. So for example, let's say I condition bees to smell a certain smell, and therefore, they extend their proboscis in anticipation of sugar water. Now, let's say they've learned, they've created this memory smell equals sugar, water, smell equals sugar water. They've got this in their mind. Now, I treat that bee with a pesticide and then I give them that smell. I can use their response to say, hey, this pesticide affects short-term memory. I gave them this chemical exposure, and then I puffed that air across their antenna, and they failed to put out their proboscis. Or they put it out in 10 seconds, rather than in two seconds when they weren't treated. So it's not just causing them to forget, maybe it's delaying their response. So that's an example of why this is such an important technique in the honey bee research world because we use it to look at the impacts of things on bee memory and all of those kinds of things. Another good example that came out of Jerry Bromenshank's lab at University of Montana or Montana State, I forget which of the two, my apologies which of the two universities he was at, but nevertheless, he was able to train bees to associate sugar water reward with the smell of landmines so that when you release bees into the environment, they could find the landmines because they anticipated receiving sugar water when they got to them. Another good example is someone before has trained bees to extend their proboscis when they smell bomb residues. There's been some dry runs of that, for example, in airports before. We've got dogs, oftentimes, that will come and sniff our bags after we come from an overseas trip, they're looking for drugs or whatever. You can do, essentially, the same thing with bees. When bees have this smell associated with a

reward, when they smell that smell, they anticipate the reward and stick out their tongue and you can use that to kind of hone in. Now, I would argue it's not used a lot in these contexts. It's been mainly shown to be experimental. Something that is shown with regularity or done with regularity is this proboscis extension response in this kind of experimental setting, looking especially at things like pesticides. So yes, you can train them with positive reinforcement. And it has a lot of experimental and even applied application, which is why folks do it.

Amy 52:07
Very cool. So I could definitely see how it could be a little tricky. It's so cool to say, oh, we can condition bees to go find bombs, right? But I can only imagine what it's like if it's maybe an invasive species that we want the bees to go and find. I know, this is totally random, and I'm just saying this out loud. But we have the giant African land snail here in Florida. And how cool would it be to get bees to be able to be conditioned to find these land snails? The problem is, we don't know where they're going. Right? And we can't put a tracker on them.

Jamie 55:20
Amy, that's exactly what I was thinking while you were talking. You could train bees to associate the smell of nearly anything with a reward. The problem is finding the bees once they're released to go to those things. And you really need complex technologies to be able to do that, which I think is why they don't use it in the field as much. But, for sure, these kinds of experimental manipulations to learn more about bees, that's very common.

Amy 55:49
Yeah, I'm also just cracking up thinking about the dogs in the airports. Everyone looks at them, and they're like, oh, look at them, they're so cute and they're so fuzzy and so great. And if you release bees, people probably wouldn't be as happy.

Jamie 56:01
Yeah, for sure.

Amy 56:02
Anyway, all right. So those are our three questions for our Q&A today. Do not forget to send us a message, send us an email, send us a message on our social media pages. We'd be happy to answer your questions on air.

Serra Sowers 56:17
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.