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SPEAKERS

Serra Sowers, 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 00:46
Hello, everyone, welcome to this episode of Two Bees in a Podcast. I'm really excited. And Jamie, you know what's really funny is that we always bring in guest speakers, and we talk about their research, but very rarely do we talk about our own research.

Jamie 01:01
Yeah. I thought about that a lot too because one of the fortunate things that we do here at the University of Florida is we have mixed appointments. We teach, we do extension, and we do research. So, Amy, I think it is a good opportunity every once in a while to highlight some of the research that we do because we really want our research to impact the lives of beekeepers really all around the world. So it's important for us to be able to highlight that for you guys. And I'm excited to be talking about some of that today.

Amy 01:25
Yeah. So for listeners, today, what I'll be doing is Jamie and I are going to discuss one of the publications and research projects that you, Jamie, are involved in. You're one of the authors on it. And so let's talk about this study. So it was called Honey Bee (Apis mellifera) Exposure to Pesticide Residues in Nectar and Pollen in Urban and Suburban Environments from Four Regions of the United States. So it's a super long title. I'm out of breath now.

Jamie 01:53
Typical Jamie title. Way too long.

Amy 01:55
But I'm looking at all the collaborators on this project, and they're all rock stars. They're just all amazing people on this. I'm really excited to just talk to you about this study. I know that a lot of our listeners will be excited too. I'm especially excited because pesticide residues and pesticide calls are something that I receive pretty often from beekeepers. When they have an issue, they want to know, you know, I think I had a pesticide kill. I think in the past, I always thought that if you were going to collect samples for pesticide residues, I always thought that it was just like collecting the bees and then you would capture the pesticide residual from the air or something like that. But, really, what I've learned is that a lot of the pesticide residues could be found in nectar or pollen. So is that the case?

Jamie 01:57
Absolutely. So there's a lot well, I say lots, I guess lots it's a relative term, there are multiple routes of exposure that bees have with regard to pesticides. One of those is topical exposure, where the pesticide just touches the outside of the bee's body. So in that particular case, they could encounter it, a field is recently sprayed, the bee flies through that fog or mist and they get it on their bodies through flight, or a crop is sprayed, the spray has settled on the leaves or the flowers of that crop, and so the bee touches that flower or that leaf and they get the pesticide on them. They can also get exposed through consumption. So they can eat something or bring something into their body that has pesticides, so maybe nectar exposure or pollen exposure, which we're talking about today. But they could also potentially get exposed to pesticide residues even when they collect water for thermoregulation purposes. So topical and consumption, they can even respire it, they can breathe it in if it's present in the air. So there are multiple routes of exposure. And as you point out, the paper that my colleagues and I were able to publish focuses on two routes of exposure, which are through nectar and pollen.

Amy 03:52
Right. So can you tell us a little bit about just the history, maybe motivation behind the study?

Jamie 03:57
Yes. So it's a bit of a story, as most research projects are, but I got hired at the University of Florida in 2006, August of 2006. In November of 2006, just a few months later, is when the events that led to the pronouncement of Colony Collapse Disorder, and then colony losses unfolded, happened. That's like when it happened, just a few months after I got hired. And very quickly, there was a very strong swing toward suspicion of pesticides and pesticide residues, among other things, but pesticides are one of those things that kind of rose to the top. Roughly at the same time, somewhere around 2007, 8, or 9, a team of scientists, led by Chris Mullin at Penn State University, conducted pesticide residue analyses in colonies that were situated in agricultural areas. It kind of makes sense to us and to beekeepers that honey bees kept and managed in agricultural areas might be exposed to the chemicals that growers use to protect their crops, either through these topical applications or topical exposure or oral exposure routes, respiration, etc. So Mullin et al. published a really big seminal piece of work, where they

collected samples of various types from colonies that were kept in agricultural areas around the US, and they published, in that manuscript, the compounds they were found, and the substrates, wax, etc, in which they were found. It's basically a 'gigantinormous' residue paper, where when we do toxicology work, we're able to refer back to it and say, "Hey, these compounds have been found in these residues in these hive components. Therefore, when I do this toxicological study, I'm going to use that level of residue because I know it's a field-realistic exposure scenario. People have actually seen that level in colonies. So it's something that I need to test." That project, really, kind of set alone for years. There were kind of minor residue studies here and there where people were looking at specific compounds, but not necessarily this kind of clean sweep of compounds. And then some colleagues and I got together and talked about doing a similar study but for colonies situated in urban-suburban areas, right? These populated centers where people keep bees. We, essentially, wanted to do a very similar study what Mullin et al. did, instead of looking at bee placement and agriculture, look at bee placement in urban and suburban areas and see the residue levels and the types of compounds to which bees are exposed in these areas through contact with nectar and pollen.

Amy 06:49
So I mean, in your title, it says that you examined four regions. How in the world did you do this, one? And I mean, what were the methods? How do you collect pesticide residues in nectar and pollen? What does that look like?

Jamie 07:02
Well, it's funny because Amy, the physical study was a very easy study to do in some ways, but the analysis was very difficult. So let's just kind of start from the top. Our interest was urban and suburban areas. So in Florida, as an example, we highlighted colonies around Tampa and Orlando, as you know, you're familiar with Florida, you know that those are city areas. We also had a colleague in California, a colleague in Texas, and a colleague in Michigan, and all three of those individuals sampled colonies in urban and suburban areas in their respective states. So these four regions of the US are essentially Michigan, California, Texas, and Florida. So the north, the south, the east, and the west. We had some larger cities in the states represented. And all of us, all of the players in this here at the University of Florida, at Michigan State University, at Texas A&M, and then the independent consulting firm in California, all of us worked with beekeepers in the cities and we worked with those beekeepers to sample nectar and pollen from their colonies once a month during production season for two years. What do I mean by all of that? Okay, so in Florida, as an example, our target was 15 beekeepers. Each beekeeper had one colony that we would sample monthly. And remember, we wanted to collect pollen and nectar, specifically incoming pollen and nectar. So to collect pollen, we purchased all of these beekeepers a pollen trap, and we would say, "Hey, we're coming to collect pollen in three days, could you put the pollen trap on the colonies, and we'll collect that pollen in three days?" So three days later, we'd go and sample all of those colonies and collect the pollen. And then for the nectar, it's hard to collect nectar at the colony entrance, right? There's no nectar trap, as it were. So what we would do is we would provide the beekeepers a pooled, empty comb that they would put into their colonies X amount of time before we would show up, so that if there was any incoming nectar, it would be stored in those combs immediately prior to our arrival at those sites. And so when we got there, we'd collect the pollen from the pollen traps, we'd use a pipette to collect the nectar from the combs, and so,

essentially, we had a pollen and a nectar sample collected from each of these 15 beekeepers scattered over Tampa and Orlando. Then, my colleagues in Texas and California and Michigan would do something very similar to their beekeepers. What I mean by production season, in Florida, we were able to collect pollen and even nectar samples almost every month of the year. But in Michigan, they have longer colder winters. So when there was no incoming pollen and nectar, maybe from November through March, they didn't have those samples. So essentially, any month that nectar or pollen was coming in, we collected the samples from these colonies. In all, we ended up with 768 nectar samples across these four areas, and 862 pollen samples, again, from these four states over the span of two years. None of us are residue analysis experts, we don't have the equipment necessary to do that. The USDA has a residue lab in Gastonia, North Carolina. So what we did is we sent the samples, the nectar and pollen samples, to that lab, and then that lab would process the samples for us and tell us the compounds that they were able to find in each of those samples and the residue analysis screened for somewhere in the neighborhood of about 200 compounds. So to make a long story short, over 768 nectar and 862 pollen samples, we were able to screen for about 200 compounds over a period of two years. And so we have mountains of data to comb through.

Amy 11:15
That's awesome. I'm just thinking, when it comes to beekeepers that are in urban areas, those beekeepers are usually not migratory. So it's probably way easier to follow the same colony because you weren't really following them. They were just in the same place. Right?

Jamie 11:30
Amy, that's exactly why we wanted to do it with the stationary beekeepers because we want it to represent the exposure in the area rather than historic exposures, perhaps, elsewhere that we're now capturing in their colonies.

Amy 11:47
Right. So you basically have these nectar sources, you've got the pollen samples you've collected over two years. What did you do with the data? And how do you really use that data to move forward?

Jamie 12:01
Okay, so here's where we can get down in the weeds. And so I'll try to make it as clear as I can understand it myself because it gets complicated fast. So we've got, remember, from the USDA, all of these residue analyses, basically 200 compounds times almost 1600 samples, if you combine the pollen and nectar samples. Just a mess load of data. Then what we did is we weren't just interested in reporting what we found and how much of it we found, what compounds were present and how much of it was present. We were very interested in conducting a risk analysis because risk was the most important thing we could uncover in this study. Let me just give an example. It's very easy to freak people out with pesticide data when you are doing residue analyses. If you collect pollen and nectar or wax or bee adults or immature bees, you're going to find pesticide residues in a lot of those samples. But just because the sample is positive for a pesticide doesn't mean the pesticide is in that sample at a level that's high enough to harm the bees. So what we had to do is we had to use the data we were getting and plug those residue numbers into a risk analysis, because risk is what's most important.

Amy 13:38
So Jamie, if you're talking about how risk is so important, what does that mean, as far as what does that mean in relation to pesticides?

Jamie 13:47
So Amy, I'm about to get on a soapbox here because this issue is incredible.

Amy 13:50
You can get on the soapbox but don't crush it.

Jamie 13:54
Did you just call me heavy?

Amy 13:55
No. Just trying to keep things fun.

Jamie 13:59
All right. All right. All right. So let's talk about risk. So this is definitely one of those things that's important for me to communicate to beekeepers, how crucial it is to understand risk. Okay, so many people are beginning to do pesticide research with honey bees. And it's so tempting to say, "Aha, there was this residue of pesticide A found in nectar. So I'm going to put that amount in sugar water. I will put that amount in a pollen patty. I'm going to feed it to bees or I'm going to drop it on the back of a bee and I'm going to see what their toxic response is." And so a lot of the papers that are being published right now on pesticide impacts of bees are looking at toxicology, how toxic is a compound to honey bees. The reason I slowed down and want to explain this in clear detail is in toxicology and the science of toxicology, there's an old adage that dose makes the poison. In other words, everything is toxic to everything if you get too much of it. Water can be toxic, you can drink too much water that you die.

Amy 15:18
I was gonna say I could probably drink too much milk and die.

Jamie 15:22
Well, you could. Everything is toxic at some level. So the dose makes the poison is the saying that they often use. So when you do a toxicology study, you're going to find an impact of a pesticide on bees. If you do a high enough level, you're going to be able to see compound A impacts bees, this is what it does, it kills them, it impairs this, it affects their homing ability or their ability to feed their young. If you look hard enough and use a high enough dose, you can make every pesticide look toxic and be toxic to bees because everything is. The dose makes the poison. So toxicity is great, that information is so important. But Amy, unfortunately, it's driving the discussion of pesticide impacts on bees. Why am I saying all this? Well, toxicity is only a piece of the puzzle. The most important part is to look at the entire puzzle. And the way to look at the entire puzzle is through what we call risk. Risk is the probability, the chances of something happening based on the toxicity of the compound and the

organism's exposure to that compound. So risk is a function of toxicity and exposure. So essentially, all these toxicity papers that are coming out are only half of the equation. The other half of the equation is exposure, what levels are bees encountering in the field. And if you have exposure in your hand, and you have toxicity in the other hand, now you can do a risk assessment because toxicity times exposure equals risk. It's risk that is super important when understanding how likely it is that a compound will impact a bee.

Amy 17:22
So you've given this example before, Jaime, but you have a tiger example of risk and exposure. So can you go through that again with us? Because I just need a reminder.

Jamie 17:33
Yeah, absolutely, Amy. I think it's a useful example, and I cannot take any credit for it at all. A former postdoc of mine, Dr. Dan Schmehl, he's the one who came up with this example. I've heard him use this example before, I really love it, and so I use it to teach this concept of risk. And I've even done it on the podcast before so I apologize to you listeners who've already heard it, but if you're new, maybe this will help you understand risk. Alright, so tigers, lions, we'll use lions, I guess. Lions are 100% "toxic" to humans. If you encounter a lion and it wants to kill you, it's going to kill you. If you're in the Serengeti and you encounter a lion, and it looks at you and says, "I'm going to eat you," there's very little you can do to stop it, assuming you don't have a weapon or you can't hop in a vehicle and drive away. Alright, so I'm going to assign it a toxicity score of one. It's as high a toxicity as it can be. That's just the way it is. Now, imagine that I encounter that lion on the Serengeti. I walk up on it, there are no trees, there's no place for me to go. It's just me and the lion, and that's it. Now imagine I encounter that lion at a zoo and the lion is in a barred cage so the lion can't get to me, but I might could still stick my leg in or my arm in or my head in the bars of the cage and a lion can do some damage and potentially harm me. Now imagine that I encounter that lion at a zoo, a second zoo, and in this case, the lion is behind a glass wall. In all three cases, the toxicity of the lion remained exactly the same. That lion is as toxic to me equally in all three scenarios. What changed was my exposure. So on the Serengeti, I have high exposure, in the barred example, I have medium exposure, and in the glass wall example, I have really minor or small or low exposure. So those exposures are the second half of the equation. Toxicity is the same. The lion is equally toxic to me. But all three of those exposure scenarios produce an entirely different risk. Serengeti, high-risk, bars at the zoo, medium-risk, glass at the zoo, low-risk. And unfortunately, a lot of bee papers are being published using toxicity data, "But lions can kill humans!" But what's not being done is that's not being put into a risk assessment to see how likely that outcome is at happening. So the risk assessment is what's so important. So our study generates exposure data, the second half of that question, and it allowed us to couple those data with toxicity data to generate a risk quotient that tells us how likely something is to happen and do we need more information about this? Right, right. So I didn't realize that Dan Schmehl was the one that came up with that. Great example.

Amy 20:55
That's great. Yeah, that is a great example. So we're about to nerd out here a little bit with the risk assessment stuff. But I'm looking at the abstract right now, and it looks like you used a model called

BeeREX. What the heck is that? Tell us a little bit more about what that is. I mean, it's a model, but explain it.

Jamie 21:16
I absolutely love this model. So essentially, what happened, the United States Environmental Protection Agency, I'm going to say EPA from henceforth, put together a model that allows ordinary folks like me to be able to calculate the risk quotient. And the risk quotient is essentially this magic number, below which there is a very low risk of a compound impacting bees, but above which there is a reasonable risk of a compound impacting bees, so reasonable that it needs to kick into higher tier tests. We'll talk about all that later. But essentially, they created a free-to-use tool called BeeREX. And you can go -- if you just Google EPA BeeREX, you can get to this tool. It's essentially an Excel file that you can download, and there's an instructional guide that accompanies that file, it tells you how to use it. And with BeeREX, you can plug in either toxicity data that you generate or residue data that you generate, and it will calculate for you the risk of that compound. So essentially, remember, we looked across 768 nectar, 862 pollen samples screening for 200 different compounds, so every residue level for every compound we found, we put into BeeREX to allow BeeREX to help us know, is this compound at the levels we found here high enough, or toxic enough to trigger tier two testing?

Amy 23:09
And so you ended up finding, again, I'm looking at the abstract and just kind of reading it, but you ended up finding 17 pesticides in nectar and 60 pesticide compounds in pollen in those samples. I guess I had a couple of questions. What drives this risk? And also, why would there have been lower pesticide detections in nectar versus pollen?

Jamie 23:36
I mean, it's tricky, and there are a lot of potential things that go into this, but you're spot on. We found 17 unique compounds in nectar. That's not per nectar sample. We're saying, across the 200 or so compounds for which nectar was screened, 17 different compounds were found in nectar, 60 different ones were in pollen. So how might this happen? Well, remember that there are a lot of things at play here. A lot of compounds, for example, are lipophilic, meaning they are wax, lipo, loving, philic. So they're compounds that gravitate towards things that are lipid kind of in base. So for example, lipophilic compounds would end up in wax a lot, in beeswax. If it's a very lipophilic compound, you could expect to see it in beeswax. If it's a lipophobic compound, which is a lipid-hating one, or a hydrophilic compound, meaning water-loving one, you might see it more in nectar. So it depends on the nature of the compound where you're more likely to find it. It also can depend on the application rate. Not application rate, application method. How is that stuff applied into the field? Is it applied as a systemic? Is it sprayed on? How does it translocate in the plant to end up in the pollen versus the nectar? But there are a lot of factors at play here. And in our study and in other people's studies, we are consistently seeing that pollen seems to have more compounds in it than does nectar.

Amy 25:14
So I also see that 73% did not have any pesticide residues at all. Is that right?

Jamie 25:22
That's a very important thing to bring up. Amy, one of the things that sets our paper apart from other folks' papers, is a lot of other manuscripts that have been published on residue levels will only show you the samples that have had positive detections of pesticides. So let's say, for an example, you screen 100 samples, and you find compounds in 25 of those. Well, the 75 you didn't find compounds in you don't even talk about in your manuscript, you only highlight the 25 compounds. And we felt that that was an erroneous representation of the levels of pesticide available in the environment. So you can look at this statistic in two different ways. You could say, golly, gee, right?Three-quarters of all samples we tested didn't contain pesticide residues at all, right? Or you could look at it, and say, holy cow, a quarter of all samples that we took had pesticide residues in them. But if you look at it, what we were trying to illustrate is that the majority, maybe even the vast majority of samples that you'll collect from honey bee colonies, don't actually have detectable levels of pesticide residues. It's only a fraction. In our study, it was roughly 27%, right? Roughly a quarter of all of our samples had residues in them. And then you've got to take the next logical step as well, not all of those samples had high residues. In fact, the vast majority of them had low residues. So we're talking about a fraction of a fraction that might have some level of impact on bee. So we thought it was very important to highlight the fact that 73% of samples had no detectable pesticide residues at all.

Amy 27:14
Right. That's a lot of fractions for me, honestly. But that's okay. I mean, I know you just said, we can't just say, all right, 27% of the samples had residues, but I do want to focus on that 27% because out of that 27%, there were four compounds that were showed up as something called an acute risk. And so we kind of brought this up in the past, with pesticide research and other researchers that we've interviewed. But can you just quickly remind me the difference between what acute versus chronic risk is?

Jamie 27:49
Sure. So the way that I usually teach this is an acute response to a pesticide is when you take on that pesticide, however you're going to take it on, either by eating or by topical exposure, and it generates a nearly immediate response. You either die or you instantly start twitching, or you instantly lose an ability to do something or another. A chronic risk means -- let's go back to acute to make sure that was fully clear. That means you're getting a level of pesticide that produces a near-immediate effect. And that's almost in like one exposure scenario. Whereas a chronic risk is something that you're getting exposed to a little bit over time. It's so little that you're not having an immediate acute response. But you have this smaller amount of exposure over time. And this exposure accumulates and now, downstream, you're starting to see effects, like maybe it affects my immune function. Maybe I can no longer fight off diseases and pests the way that I would or maybe I can't handle nutrition now. Or maybe as a queen, I'm going to run out of eggs sooner than I would if I wasn't exposed to this compound. So our study, we specifically and exclusively look at acute risk. We're not ruling out any chronic risk associated with the exposures that we found. In other words, the pesticides we found could still have a chronic impact on bees. We're stating that the vast majority of them didn't pose an acute risk. In other words, bees weren't going to take it in and show an immediate response.

Amy 29:24
Right. Okay. So let me clarify so it makes sense in my brain. So I always think, like, when I think of acute I think it's small. So I think it's always a small amount, which is not right in this situation. So the acute risk is something that hits once and it's done, versus chronic is just a little bit that is exposed through time in kind of a longer-term space.

Jamie 29:45
Yeah, Amy, that's perfect summary, but it's even a little trickier because in theory, remember the risk is driven by exposure and toxicity, so you can have a highly toxic compound and only need a little bit of it to get an acute response. Or you can have a not-so-toxic compound, but still get exposed to a ton of it at one time and generate an acute response. So in both cases, you're getting an acute response, a nearly immediate response. It just all depended on the exposure and toxicity of the compound in question. And same thing chronically. If something has a really high toxicity, but you're only getting teeny tiny amounts of it over a long period of time, you can still get a chronic impact or the other way around. So that's why we use the word risk rather than looking solely at toxicity or exposure. It's really the two of them together that's the most informative.

Amy 30:46
Alright. I'm, again, reading from the abstract. I see that there were four insecticides showing a potential acute risk. And so what compounds showed up?

Jamie 31:01
Okay, very important. So, remember, we were talking 17 different compounds in nectar, 16 different unique compounds in pollen. But of all of those, of all 1600 samples we collected, of all 200 compounds we screened for, across all of those samples over most of those years, only four compounds, in a few exposure scenarios, were high enough to exceed that risk quotient, that magic number below which it poses a very low risk to bees, above which you need to know more information. Remember, I want to make the point, I'm going to state these four compounds. But that doesn't mean every time they showed up as a residue in nectar or pollen, they crossed that line. A compound can show up in nectar 100 times, but only one of those times the exposure being high enough to actually cause it to cross that risk quotient line. So I don't want you to feel like when I say these four compounds, every one of them always exceeded the risk quotient. They didn't, they still only exceeded the risk quotient a fraction of the time that they were present. Okay, with that background, they were imidacloprid, which is a compound a lot of people talk about with honey bees and toxicology, chlorpyrifos, which is an organophosphate insecticide, and esfenvalerate, and deltamethrin, both of which are insecticides as well. So to say those again, imidacloprid, chlorpyrifos, esfenvalerate, and deltamethrin. All four of those compounds, at least once, showed up in levels in nectar and/or pollen that would have exceeded the risk quotient. That simply means they pose a potential acute risk to honey bees in those particular exposure scenarios.

Amy 32:52
And those exposure scenarios, that came out of the BeeREX risk assessment.

Jamie 32:57
Right, exactly. So Amy, the key is, and BeeREX says, if you cross this number for acute or this number for chronic, then you would need to know more about those compounds to understand. The EPA has set those numbers very low, they're quite conservative. So essentially, if a compound poses really any risk at all, it will exceed. So that's one of the highlights of this study is that despite the fact we found four compounds in a couple of exposure scenarios crossed that line, a bigger finding is the vast majority of the time, it didn't, and that line is set so conservatively that crossing that line doesn't mean your bees are going to die. It just means we need to know more.

Amy 33:40
We always have to know more. Right? So what needs to happen next?

Jamie 33:44
Bingo. It's that we need to know more.

Amy 33:46
What next? Now what?

Jamie 33:47
Exactly. Exactly. Exactly, exactly. So if you remember earlier in our interview in our conversation, I kept talking about tiered tests, tiered tests, tiered tests. Okay, so the EPA has a system for finding out that "more." There are three tiers in a toxicity test screen. Tier one, we call them lab studies. Tier two, we call semi-field studies, tier three, we call field studies. So tier one is when you expose adult or immature bees, acutely or chronically, topically or orally, to compounds again, in the laboratory. Those exposure and toxicity level scenarios allow you to do the risk assessment that we did. And any score that comes out over the risk quotient would kick that compound into a tier two test. So before we go any further, the vast majority of our exposure scenarios would have never been kicked into tier two because they didn't exceed the level of risk that was reasonable. Those four compounds that did, again it doesn't mean those compounds are killing bees every day out there in the field, it just means that now they've exceeded the risk quotient, they will be kicked into tier two studies. And in those tier two studies, people would expose bees in flight cages. So they would put a colony in a cage, expose that colony to those residues in a cage, and measure their impact on adult bees and brood. Then, it would kick to a tier three field study where the compounds would be administered to whatever the bees would be exposed to it ordinarily. Maybe you're treating a crop that bees are attracted to, so you treat that crop, you'd put bee colonies on that crop, and then you'd look at the bee colony responses to those exposures. So long story short, those four compounds, imidacloprid, chlorpyrifos, esfenvalerate, and deltamethrin, would trigger, based on the residue levels we found, additional tier two testing to see what risks they pose to bees in semi-field and field studies. So the next million-dollar question I have is, what does this mean for beekeepers? I mean, I think just from a management perspective, but also could beekeepers collect their own nectar and pollen, send it off to get the data, and then put it into BeeREX themselves? Oh, they absolutely can. Technically, Amy, they can collect nectar and pollen and send it off to the same USDA laboratory that we used to analyze our samples. They can do it, it's just there's a cost per sample. At the day that we're recording this, it's somewhere in the neighborhood of $400 to $450 a

sample. So if you want to know just the nectar and just the pollen and just the adult bees and just the brood, that's four samples from a colony, it might take you $1,600 to know that. But you can and with those residue data that you get back, you can go to the BeeREX site and use the User Guide to calculate risk quotients and see all of that. But that's really the reason that we have scientists in these analytical labs to try to perform that service for beekeepers. So what are some take-home messages for beekeepers? Well, our study suggests that the risk of pesticide exposure to bees in urban and suburban areas, it's actually quite low. Yes, they do encounter pesticide residues, they do bring them back. Sorry, they do encounter pesticides, they do bring back residues to their colonies, at least through nectar and pollen, we see that. But the vast majority of the time, those levels are below what would trigger a tier two or tier three study. In other words, the risk that they pose to bees in those exposure scenarios are very low. And that's kind of contrary to some of the popular beliefs about urban and suburban beekeeping. "Oh gosh, these bees are getting exposed to all these pesticides in these urban/suburban areas and is potentially impacting them." The dataset we have, at least under the conditions that we tested it, at the sites where we tested it and the years that we tested it, suggest actually that that risk is quite low. And those four compounds that we did see, these compounds have shown up in other studies as potentially posing a risk to bees, which is why folks are studying these as well already. So I think it should, in the very least, help beekeepers rest a little bit more easily in these situations. But it doesn't mean we need to let our guard down. They're still exposure scenarios. And that's assuming, of course, people putting out the pesticides are following the label to a tee, which we know doesn't always happen. So, as a scientist, I can't make these broad universal claims. But I will, at least, say in our study, the residues that we saw coming in over the two years in these four suburban/urban areas across the United States didn't pose a level of risk that was overwhelmingly harmful to bees. But we certainly need to know a bit more about those four compounds and make sure that even though they might exceed the risk quotient that there aren't necessarily real impacts at the colony level when you start doing these tier two and three studies.

Amy 38:59
So I think that was really interesting. You and I have been sitting here talking about this publication, but we'll definitely be sure to link this publication in the show notes and the additional notes, which is on our main website, UFhoneybee.com. And so for our listeners out there that are interested in this study, you can go to our show notes, click on the link, read it for yourself, and go through and read the methods for this project. But, Jamie, we're recording this right now in fall of 2022. I'm hoping that in 2023, you and I will be able to discuss a lot more of the publications and the research that we've done and have published here at the lab. So I'm excited for that. And in 2023, that'll be one of our goals.

Jamie 39:42
Absolutely, Amy. I think that like this study here that we're talking about, it may seem limited in scope to the areas that we have, but now we've generated the residue data necessarily for other folks to do full-blown risk assessments as they generate toxicity data on these compounds and other compounds. So we want to show, here at University of Florida, we're trying to do things to address beekeepers' needs as well. We put out a lot of good research and this is obviously a huge collaboration amongst multiple institutions, and I want to give all of my co-authors a shoutout. But I'm grateful, Amy, for the opportunity

to highlight one of many studies that we were able to publish this year and one of many that we've been able to publish over the last 15 years here at the University of Florida.

Amy 40:24
All right, well thanks for listening to this episode of Two Bees in a Podcast.

Stump The Chump 40:34
it's everybody's favorite game show, Stump The Chump.

Amy 40:45
Welcome back to the Stump The Chump question and answer time. Jamie, the first question we have is what happens to laying workers when you requeen their colony using a nuc? That's your favorite way of requeening, right?

Jamie 40:58
Yes. I put this question in here myself. This is me asking this question of myself. And let me tell you why that's the case. So I give, Amy, a presentation called queen events or recognizing and mitigating queen events or problems. And in that presentation, the first half of the presentation is what goes wrong related to queens and the second half of that presentation is how to fix it. One of the things that I say in the what goes wrong with queens is the development of laying workers. When you have laying workers, your colony loses its queen, they fail to make a new queen, so some of the workers in that hive, their ovaries will develop and they will begin laying eggs. All of you know the storing workers cannot mate so they can only lay unfertilized eggs, and in the vast majority of honey bee subspecies that we keep, unfertilized eggs become drones. So when your colony becomes laying workers, it's doomed because only drones are produced. You also know it's very hard to requeen laying worker colonies because not only do they lay eggs as if they're queens, but their pheromonal bouquet changes a bit. They start smelling like queens to the other workers in the nest. So if you put a caged queen in a laying worker colony, when the bees release her, they'll kill her. They think they already have a queen. So you'll feed them a new queen and a new queen and a new queen, and they'll kill her and kill her and kill her in favor of their laying workers. Now, in that presentation, I talk about laying workers, and then I talk about the most foolproof way to address that problem, which is requeening laying worker colonies using a nuc. You take five frames out of the laying worker colony, you take all five frames of the nuc, bees, queen, brood, honey, pollen, all and drop it right into that full-size colony that had the laying workers. Wa-la! Your problem is solved. Somehow, the laying workers stop, and the queens that you put in there take over the colony with their bees and brood, etc. So I say this and say this and say this and always get questions about well, what happens to the laying workers in this scenario? And then recently, so we're recording this kind of mid-September 2022, recently, I got four emails within one week from four different beekeepers around the US because someone had posted online about how they deal with laying worker colonies, which is similar to kind of how I deal with it. And all four of those beekeepers emailed me and said, what happens to the laying workers when you requeen a colony with a nuc? So the reason they're asking this question is most people are taught to deal with laying worker colonies by shaking all the bees from that colony 20, 30, 40, 50 feet away from that colony and then putting the combs back in the hive. The idea is that the laying workers, probably since they've started laying eggs,

become too heavy to fly and they won't fly back to the nest. I think that's just one of those management things that's just never been proven, but it's how a lot of people deal with it. So when I tell people, all you have to do is drop a nucleus colony that's got a queen straight into that hive and the laying workers will be requeened, they're like, well, how does that work? I put caged queens in there and it doesn't work. Why would it work with a nuc? And so Amy, all that background, here's the answer. The answer is, I don't know. I don't have -- I seriously don't know.

Amy 44:33
I was like sitting on the edge of my seat waiting for the answer.

Jamie 44:36
I know. Here's the deal. It's one of those things that has always worked for me. I learned it from commercial beekeepers when I worked with some and talked with some years and years ago. Commercial beekeepers often just combine laying worker colonies with something else and move on or things like that. And so all I know is that it does work. I don't know how it works. So there are lots of potential questions on the table. Does the new queen kill the laying workers? I don't know. Do the workers from the new queen kill the laying workers? I don't know. Do the workers that are laying workers simply detect the presence of a queen and revert back to being ordinary workers? I don't know.

Amy 45:25
That's crazy.

Jamie 45:25
So there's an amazing research project waiting to be done. In fact, I've already come up with a few ways to test this myself. And I'm kind of getting hungry to study it. But it's one of those things that I don't know why it works, only that it works. And so it's waiting to be discovered. But there are a lot of hypotheses on the table. And maybe someday in the Stump The Chump section, I'll be able to say, "Hey, we did it, and this is what we found. They kill them."

Amy 45:53
You just -- you stumped yourself.

Jamie 45:54
That's right. I set myself up for failure. But I wanted to give an example of like, we don't know how everything works, but, gosh, like, this is a really good way to deal with laying worker colonies. The problem is, I just don't know how it works. It just works.

Amy 46:08
I mean, that's the thing, right? So when you go into your colony, I mean, how do I identify which ones are the laying workers? And how many are there actually that are there? Right? Well, how are we going to figure that out?

Jamie 46:20

What great comments, Amy. So the reason those are such great comments is when I think about -- I've even discussed this with some students -- when I think about doing this project, it all hinges on your ability to identify the laying workers so that you can watch, in an observation hive, what happens to them when you combine it with a nuc or a queenright group of bees. And I don't know how. I mean, you've got to catch the workers with their rear ends in the cell and then quickly mark them. It's possible, because when I was a PhD student in South Africa, my PhD student colleague of mine, Dr. Christian Pirk, he's now a professor at the University of Pretoria in South Africa, he studied laying workers in Cape honey bees, so you can find them. I know it's possible. It's just difficult and so you'd have to find them, mark them, and then combine them again in an observation hive, so you can observe it with a functioning queenright frame of bees, and then watch what happens. I'm kind of figuring out ways to do this. But in the meantime, it's still a good management practice, even if we don't know why.

Amy 47:27
Right. And something I learned, I mean, just right now, something I learned was that I didn't realize, I guess it makes sense, but when there are laying workers that they do emit that pheromone to suppress any of the other workers allowing a queen to come in. So I guess I could have come to that conclusion if I had thought more about it. But just looking at the pheromones between what the workers are emitting, the laying workers, and then a queen in a nuc. And so what would that look like?

Jamie 47:54
Yeah, exactly. It's really a marvelous topic. It's really crazy that workers can do this in the first place. So what's even crazier, Amy, is if workers have the ability to lay eggs, why would they ever forfeit? There's a potential reason for that, but maybe we'll save that for another day.

Amy 48:11
So I'd be interested to hear if any of our listeners have ever seen a laying worker in the process of laying eggs. And if you can get a video or picture, send it on over to me because I want to see it happening. Okay, so for our second question for today, this listener was wondering if you could discuss open-feeding pros and cons. They've been told that open-feeding keeps the bees active, gets them out of their boxes and promotes grooming. They're a little skeptical about it. So let's talk about just the pros and cons of open-feeding.

Jamie 48:44
So what is open-feeding in the first place? Open-feeding is simply, and by this they usually mean sugar syrup, but I'll also give pollen subs as as an example, open-feeding is basically putting the food out in the apiary rather than administering it directly to a hive so that the bees are able to come out of their hives and go to that source and collect it. Now, there are pros and cons. The chief pro that I can think of is it's a major time saver. You don't have to go and fill feeders for 100 colonies in an apiary, you only have to go fill one feeder in the center of the apiary and then let the bees do the rest. So principally, it's a time saver, and time is money in the commercial beekeeping world. Okay, so that's the major pro that I can think of and what usually is stated. The drawback, and there are a few that I can think of, is number one, it's a potential way to spread diseases and pests. Number two, it has been known to incite robbing, these feeding frenzies that might spill over to colonies. And number three, one could imagine

that it is often giving food to colonies that need it less over those that need it more. You would feed because a particular colony might be weakening and need that extra food. Well, if you open-feed, those who take it are going to be the strongest of the colonies who take most of it, on down to the weakest of the colonies who probably get the least amount of that food. The particular questioner was saying they were told that it keeps the bees active, it gets them out of the box, it promotes grooming. My guess is all those are just things that people have layered on top of here's why I open feed and that we can't really know that this is the case or not. So the principal pro is just time. It's just easier for a beekeeper to go out and dump it all in one place and allow the bees to go get it themselves. But like I said with the cons, robbing, it kind of benefits the rich and not the poor, in this case, potentially, disease and pest and pathogen spread. But again, if you're a commercial beekeeper, and you have lots of apiaries and thousands of colonies, sometimes the pro of being quick outweighs the cons of these other things. But I would argue that a lot of this other stuff, grooming, keeping them active, all of that it is just kind of anecdotal at the moment, and I would say it's probably not known experimentally.

Amy 51:14
Yeah. And I'm just thinking about, I mean, if you are open-feeding, think about all the other vermin that are coming around to try to collect this.

Jamie 51:22
Hey, Amy, that's perfect.

Amy 51:23
I hate ants. People love ants.

Jamie 51:27
Yeah, if you're open-feeding, you're not just feeding your bees. You're feeding your neighbor's bees and the feral bees and the Yellowjackets that are trying to get nectar and the ants that you met. It's a perfect example. That's another con I hadn't even thought of. So good. Yeah, good.

Amy 51:40
Well, thanks.

Jamie 51:42
You're not a chump. I'm the chump!

Amy 51:47
Okay, so for the third question we have, so Jamie, it is pretty well-known, I think, by now and I don't know, I say this, but it's because I hear you say it often that when we're going into winter, the bees need at least one deep super and then a medium of honey, just to even survive the wintertime, right? So at least that is what you like to use. And so this person is wondering about using a queen excluder in between those two boxes. So between a single and a medium super. Do you recommend pulling the queen excluder out during the wintertime?

Jamie 52:23
Yes, absolutely. So let me explain what I mean. I know not every beekeeper out there listening to us right now is a proponent of queen excluders. And that's a whole nother segment for another day. But for those of you who use them, you use them to separate the brood nests from the honey supers, you use them so that you can manage your queens more actively. I happen to use queen excluders, but I would never tell someone they have to. I would just say, this is what I do and I give all of my reasons for doing it when I talk about it, I'm just a fan of using them. That doesn't mean you have to. It's just that I like them. Okay. So my standard configuration is a deep brood box, queen excluder and a medium super. That's my standard configuration. I like that medium super to be full of honey. That's kind of what I like to see year-round. And all the other honey that I can make on top of that medium super is what I like. And that's just kind of how I manage bees. Okay. With that background, the question is, do you take off the queen excluder in winter? Yes, yes, yes, yes, yes. Let me tell you my experience with this. I've read that in books for years. Take them off during winter, take them off during winter. And for years, I did not do it myself. And the principal reason for taking them off is that, in winter, colonies tend to migrate up as they're chasing those food stores in the hive. So they'll start late fall down in the lowermost brood box and then they migrate up as they eat all that food that's stored over their heads. And the books would always say that if you leave a queen excluder on, the queen can get left behind, because as that colony migrates up into the uppermost boxes, they're going through the excluder but the queen herself can't. So she'll get trapped below and freeze to death or die of exposure or whatever. When I first started keeping bees, I took off my excluders over winter because I was told to, but then I'm like, "Ah, this isn't necessary." So for years, I kept them on my colonies. And then one year, it happened to me. I had colonies move up in those hive boxes, and they left queens behind and my queens died. And so I created queenless colonies when they didn't have to be queenless. And so here's my pattern, Amy, and this wouldn't necessarily work across the US or the world. You have to kind of know what your season is but where we live in Florida, Thanksgiving, you know that fourth Thursday of every November is the week that Thanksgiving week is. It's the week that I like to take off my I excluders, and instead of taking them back to my shed or my house or wherever, I actually just take the lid off the hive, put the excluder down and then put the lid back on the hive. That way my excluder is stored at my hive so that when late February, early March rolls around, my excluder is at that hive, I take off the lid, find the queen, put her in the lowermost box, have that excluder ready to put back between the deep brood box and the medium super. So yes. If you use excluders and you get any appreciable amount of winter, any freezing temperatures at all, I would definitely take off the excluders from your late fall until winter is virtually over and colonies are starting to brood up.

Amy 55:48
It's kind of crazy that you're talking about them leaving the queen behind. Because isn't that normally why they cluster? To kind of keep the queen in the middle and make sure she's okay, make sure she's happy. But it seems like everyone just becomes every bee on their own.

Jamie 56:06
Well, what they're doing when they cluster, they're keeping the colony alive, not necessarily the queen alive. So she benefits by being in the center of the cluster, but she's not necessarily the reason that they cluster. I hate to anthropomorphize this, but they're probably not quote, aware, that they leave her

behind. They just move up and expect her to move up with them. And so yeah, I really think it's principally done on accident. Most of the time, that won't happen. It's just when it happens, you've created a queenless colony at a time of the year that's very difficult to address it.

Amy 56:41
Oh, definitely. All right. So those were our questions for today. If you have questions, be sure to email us and/or send us a message on our social media pages.

Serra Sowers 56:53
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.