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SPEAKERS

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

Jamie 00:10
Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast. Hello, everyone, welcome to another segment of Two Bees in a Podcast. Today, we are joined by Dr. Gabriela Quinlan who is an NSF postdoctoral research fellow in the Department of Entomology at Penn State University. And she's here to talk to us today about a recent paper she and her colleagues published. And the paper is entitled "Grassy herbaceous land moderates regional climate effects on honey bee colonies in the North Central US." Gabriela, thank you so much for joining us on this episode of Two Bees in a Podcast.

Guest 01:20
Thanks for having me. I'm excited to be here.

Jamie 01:21
Yeah, our team read your paper and we were immediately interested in talking to you about it. One of the things that I mention a lot in beekeeper meetings is if you read the Bee Informed Partnership surveys, beekeepers routinely point out that weather impacts their bees. But there's so little talk about climate impacts and climate effects on bees. And it just seems like it's one of those things that's just waiting to be done. And you and your colleagues started looking at this, and we can't wait to dive into it. But before we get there, our listeners would love to meet you. So could you spend a little bit of time talking about yourself, how you got where you are, and how you ended up getting interested in bees in the first place?

Guest 02:05
Yeah, absolutely. So I'm from North Carolina, and I grew up just being outside all the time. And when I got to college, I realized that being outside was a job that I could have. I was really interested in biology and those sorts of things. Conservation, my parents really instilled this love for the natural world in me

early. And I just grew up as a Girl Scout and all of that wanting to be able to protect the natural world. And so through all of my classes and research at North Carolina State, I was able to do a lot of really cool things. I worked with Nick Haddad on endangered butterflies. And I worked with Dr. David Tarpy on wild bees and wild bee diseases. And after that I was just hooked, went to grad school to get some more experience with that and got involved with honey bees when I was a technician and grad student and haven't looked back. Really interested right now in honey bee nutrition. So as a postdoc researcher, I study everything about honey nutrition. Everything from the individual bee's physical condition all the way up to the environmental factors that influence landscape level suitability for resources for honey bees, which is really what this paper is about.

Amy 03:43
I always think it's really funny when we interview people because nobody really grows up and says, I'm going to be an entomologist and work with bees, right? You kind of just fall into it some way, somehow,because you were introduced to it in some way. So I think it's always fun to hear everyone's story.

Guest 03:59
Yeah, absolutely. I actually took my first entomology class at NC State because I was scared of bugs. And then after I took the course, I was just like, wow, insects are so cool. There's so much we don't know about them. And that's what really like sparked that love and that interest.

Amy 04:19
Yeah, so let's talk a little bit about your study. Can you discuss just a little bit of the background of this study? I know you've just kind of mentioned how you got into grad school and your interest but what motivated this specific study and a little bit of background on the climate effects of honey bee colonies?

Guest 04:37
Yeah, totally. So, this study was actually born out of this meeting that was organized by one of Christina Grozinger's earlier postdocs, so he's working in Germany right now. But back before the pandemic, right before the pandemic actually, he brought together all of these researchers, all the co-authors you see on this paper from across the Midwest, North Central US, who are all working with hive scale data. So we all had hive scales that we were using in our research, using them to monitor our honey bee colonies. But we're sort of doing it siloed, kind of disparately. And his idea was to bring us all together, sort of this meeting of the minds kind of workshop, where we would swap ideas, talk about our data, talk about our struggles with analyzing the data, and really use that to improve each other's methods, advance the field of colony monitoring through high scale data. And bringing all of these different people together, we sort of realized, we all have these separate data sets that we're using to say something about our local environment, how beekeeping is where we are, so I was at Michigan at the time. But in combining all of those datasets, we could really say something about the broader influence not only of where we were locally but that those climate-level effects that Jamie was talking about in the beginning. So we were really interested in drawing broader conclusions about what's driving floral resource availability for honey bees.

Jamie 06:19

So you guys talk a lot in your paper about land use data. And before we kind of go down this road of what you guys did and how you analyze the data, could you talk a little bit about land use data, how it's collected, and then how it was relevant to your specific project?

Guest 06:36
Yeah, absolutely. So land use data, if you've ever used something like Google Maps, or Apple Maps, and you see when you're passing a body of water, it's like blue on the map, or when you're passing a forest or something, it's green. And then like all of the urban areas are gray. It's essentially the same thing, right? It's satellite images that have been put through some sort of model to classify them as one land use versus another. And so the data that we have is a little bit more specific than what you get from, say, Google Maps. It's not just natural area of water, developed land, but our satellite images, they've been classified down to more specific things. So I used the US Department of Agriculture cropland data layer, and there have been models developed to understand how the reflectance, each plant cover has its own spectral reflectance, so it's a color or a light spectrum that is given off to the satellite. And then smart people go in and use models to classify that as saying, "Oh, the color that this is giving off is more similar to a cornfield versus a soybean field." And so we can tell, based on the satellite images, what is on the ground. So then I use those data to calculate what types of land use are within the foraging range of the hives. So what sorts of different land covers that these bees had access to, was the bee in a super agricultural area, was it in a more urban area, etc.?

Amy 08:34
So you had mentioned earlier working with your collaborators on high-scale data and how you're all doing high-scale data. So you just mentioned foraging and forage availability to the bees. And so can you just talk about the colony weight and whether that's related to foraging availability? And also just to general colony strength and survival?

Guest 09:01
Yeah, totally. So I think that using hive scales is a really cool way that we can understand not only the condition of the colony but the availability of resources around the colony. And by that, what I mean is, we know that honey bee colonies will hold only about a kilogram of pollen in the colony at a time. They don't store a ton of pollen. But we've bred these honey bees to store a lot of nectar, they'll store as much nectar as the landscape allows and that their hive has space allowed for. So in a way, by seeing how much weight a colony puts on how much nectar a colony puts on, we can see how good that landscape is for the bees, right? So if it's in a really great landscape, they'll put on a ton of honey, versus if it's in a poor landscape, they're not going to reach their full potential. So they're sort of these, honey bee colonies, they're sort of these sentinels, these weather stations of what landscape level condition looks like. So we can use them to question the bees in a way to ask them, is this a good landscape? Or is it not? And more than that, we can start getting into the fine tune. How good of a landscape is it, and how is that related to environmental factors?

Amy 10:31
So I have a really silly question for you about hive scales. Are you ready for it?

Guest 10:36
Absolutely. Yeah. I'm sure it's not silly.

Amy 10:38
When you put out a hive scale, is it you've got one scale? You've got a lot of colonies that each have a scale? How do you charge them? How are you collecting these data? Do you go out and individually just look at each scale? Or is it something that is connected to some sort of technology?

Guest 10:56
No, absolutely. So there are so many different kinds of hive scales, the ones we used in this study were all automated. And so they collect data, anywhere from a 15 minute to an hourly time period. And so they're electronic. You go into the field, you download the data with Bluetooth. So very high-tech, but I know beekeepers use anything from feed scale, bathroom scales, etc. which are obviously not automated so you'd have to go out and look at the weight yourself. But yeah, so we have this really rich data source where we're getting high scale weights, every hour, every 15 minutes. And so that way, you can really see these really interesting things happening to your colony over the course of a day, to weeks, to months.

Jamie 11:51
Are colonies ever embarrassed about their weight gain? Gosh. I'll get back to the real question. So, Gabriela, I've kind of reordered some questions in my mind here. And I just kind of wanted to put it all together and let you tell me if I'm correct. So understanding your paper, you're using colony weight gain as a proxy for understanding how the local landscape supports a given colony. So presumably, if it's more weight gain, which you guys are assuming is coming through nectar and therefore honey storage, that it's better landscape, and then the reverse would be true if it's lower weight gain, or maybe even weight loss. So that's kind of the whole purpose of your project.

Guest 12:39
Perfectly said, yeah.

Jamie 12:41
Alright. So that said, could you talk a little bit about some of your key findings?

Guest 12:46
Well, I think one of the really interesting findings that we found was this really broad regional pattern. So we saw that climate level effects, the typical weather of a region, how where you guys are in Florida, it's a lot warmer and wetter than it is where I am here in Pennsylvania. Those regional climate effects really are setting the stage and underscoring the ability for colonies to put on weight. And so what we think is happening is that climate is setting the stage for the types of floral resources that can grow in a given area, among a lot of other things. So its climate is the reason why the floral communities, say in the Dakotas, are really, really great for bees, and they push nectar in a certain way, as compared to Pennsylvania, which maybe doesn't have a climate that is as conducive for floral rewards. Then once we have that really broad, foundational level of climate, we saw that that is then further constrained by land use, right? So we have this climate. But then what do we do with that climate? What are the land use influences? So within the Dakotas, for example, you have this really great climate, but what sort of land use is there to provide resources for bees? And that brings me to what I thought was the most exciting finding was this interplay between climate and land use. So we found that whether you're in a

really great climate, or a less great climate, the bees having access to really beneficial land use, which in the Midwest is things like open grassy herbaceous land places with lots of flowers, so think prairies, pastures, etc. Whether you're in a good climate or not so good climate, the bees having access to those land types can improve their honey weight gain. So I think it's really cool to see that even if you're not in a great place, climate wise, regionally, or you don't have super great weather one year, the land use can make up for that, in a way.

Amy 15:21
So something that you did mention a bit ago was about colonies not gaining as much weight in the warm and wet climates. But also, you said that it really depends on what's available at the time, and I know that there are different seasons that will perform differently. And so as far as, I'm going to ask, as far as Florida goes, if it's super warm and wet, how would those colonies do you think would perform?

Guest 15:21
Well, that's an excellent question. So I think that gets that this idea of extrapolation, right? In science, we can really only draw conclusions within the scope of our study. And that means that if we're doing a study in Michigan, for example, we can't really make conclusions about what's going on in Florida based on what we see in Michigan, which is really getting back to that power of the study of bringing all of these different hive scales together across the Midwest, across the North Central US. So we can draw conclusions across a broader spatial scale, across more area. So we really from the study can't say a whole lot about Florida, right? Because we would expect there just to be totally different processes going on, you know, the climate in the Dakotas and Pennsylvania is affecting the floral communities, the types of plants growing in one way. But there are totally different plant species in Florida than there are in the Midwest. And so there could be something totally different going on. So if we wanted to be able to say something about Florida, we would have to either include Florida in the study, which I think it would be super cool to have even broader scale monitoring, hive scales in Florida. And then we could say something about land use effects and climate effects across the whole US. Another option is to have somewhere that has a similar climate to Florida or an even more extreme climate to Florida. And we could do what's called interpolation. So, if we know something about point A, and we know something about point C, and we draw a line through that, we might have some idea about what's going on in point B, does that makes sense?

Jamie 17:45
Absolutely, it kind of brings me to thinking about this issue. I think the reason we were asking that question is because you guys had made the comment about the warm and wet climate, and here in Florida, that's kind of all we experience, and there'll be a lot of places, for example, in the southeastern US or other places around the world that kind of experience these warm, wet climates. But in my mind, I'm thinking about how locally adapted floral resources could or could not offer nectar or pollen rewards based on, perhaps the reverse where maybe here in Florida warm and wet's advantageous, I don't know, I'm just throwing things in the air. So it's interesting to me, that you guys had noticed that the warm, wet impact on hive weight gain and how that could be exacerbated by climate change. And it kind of could easily make everybody who's kind of in a warm, wet climate really concerned about the future of bee productivity in their areas?

Guest 18:45

No, I think that's an excellent point, things are totally different in Florida. And I don't think you can take these conclusions and apply them to Florida, I think what we're doing is we're sort of, we're not getting the full picture, there's a whole picture out there about like the effects of climate across the whole US, but we're only seeing this little sliver of the Midwest. So there could be all sorts of other patterns going on outside of that little sliver. And I think you bring up an excellent point about these locally adapted species, I think, at least in the Midwest, what we're seeing with our native plant species, our prairie species, is that they're a lot more resilient to climate change in these extreme weather events. And so I'm sure it's similar in Florida, you have these species that are going to be important to think about as we move forward with climate resilience to provide resources for honey bees.

Jamie 19:44
I think that's key. Listener, wherever you are listening to us from around the world, my guess is some of these broader implications are going to be true for you guys out there as well. And so this is such an important topic. And Gabriela, what kind of always leads us to some of the last questions that we ask when we interview folks is, we try to think about it from a more applied scale. And I recognize that a given study can only talk about what it knows, the particular conditions under which it was tested, etc. But what are some of the management recommendations that you think could come out of your project? And I know like, in my particular case, I'm thinking less about beekeepers, management recommendations. I think Amy's going to ask about that next. But I'm thinking about, like broader management recommendations you think your data suggests might need to happen based on what you guys found?

Guest 20:35
Absolutely, of course, I think in an ideal world, at an institutional level, we would have policies that we put in place that we would take actions to sort of ameliorate the effects of climate change. So we saw that climate is super foundational to your baseline honey yields. And we saw that weather as well, is super important to shaping those and fine-tuning those. And so we know that with climate change, there's going to be shifts and changes as to do with precipitation, temperature, regions are going to change, and what their climate looks like. And we also know that there are going to be more extreme weather events, greater heat waves, higher extreme precipitation, etc. And so I think this study really highlights that there are these big foundational aspects that can't be ignored, but at the same time, that's a super big, wicked problem, and not something that the average person or the average beekeeper has a lot of power over. So I think as far as land management, beekeeper management, there's a lot of promise in this study that comes from having long-term monitoring data, and the ability to predict where the best places are to produce honey. That has great implications for the commercial guys, understanding where they might be most likely to put on the most honey. At the same time, we saw that a lot of the effects of climate and extreme weather were happening the season before. So if you had really good weather in autumn and winter, it really sets the stage for your honey flows the following summer, which is something we didn't expect, something really interesting, probably through effects on the plant communities and the flowers. So in that way, this study really highlights how we could forecast what honey flows are going to look like the following season. And for migratory beekeepers, or beekeepers who have the ability to put their hives in different yards, we can forecast months ahead of time, where the best places are going to be to put those honey bee colonies for the other beekeepers, stationary beekeepers. I think it's also really exciting for them to have detailed long-term monitoring data because you get an idea about what your honey yields' potential could be. And if

you're not meeting that potential for your area based on your climate and land use, etc, then I think it helps you take a look at, why am I not reaching those yields? Could I do something differently with my management, or can I put more habitat in, etc.?

Amy 23:34
So I actually have a listserv of commercial beekeepers and I try to send them a weekly, like Ag Weather Report. And so I'm hoping that they're finding it useful, and so for some of the beekeepers, they've commented and said that they thought the information was really cool. But now that you're talking about the seasons and paying attention to what's going on, year after year, I think you're right, I think that it could help predict the forecast for future years. And so with that, you've kind of already mentioned this, but what do you feel like beekeepers could do with the knowledge of weather and land use so that they can increase their colony health? I mean, ultimately, what do you think that they can do? Because weather is out of out of their control.

Guest 24:20
Right, absolutely. I think that, as I said, with this forecasting stuff, you can have some idea about what your yields should look like or have the potential to look like. Weather is a huge factor in determining those yields. But it can also help you understand, when you might need to feed, managing your colonies to keep them disease free, so as they go through the winter, they have access to sufficient food resources and you can make it through the winter well enough.

Jamie 25:00
So Gabriela, this is really fascinating to me. I really am intrigued by this idea of whether one year impacts the quality of the landscape the next year. I often hear beekeepers talk about, we didn't have a good flow of honey this year, it was too wet this year, it was too cold this year, it was too dry this year. But that's usually where the conversation stops: this year, this year, this year. And instead, you're suggesting that it could be the previous year, or maybe even some combinations of the previous years that led to what the beekeepers are seeing. This idea of forecasting, while I know you guys aren't promising you can do that now, it's still intriguing to me as more data are collected. I mean, that's basically what weather men and women do, they forecast the weather. They anticipate based on what we see, what it's going to be. And do you believe that is something we'll be able to do with reasonable accuracy at some point in the future is forecast, honey flows and pollen flows, and the need to feed and stuff like that? I mean, that's intriguing.

Guest 26:09
Yeah, that's absolutely something I think is possible. And that I would love to see. I think that, as you were saying, there are all of these really interesting inner playing factors when it comes to lagged effects on honey production the next year. We have, of course, the within your effects, it was too wet or too hot for the bees to go out and forage, etc. But then, there are also these things that are happening to the plant communities across timescales. So, just the season before, a lot of plants need the weather to be a certain way in order to grow. And it can go back years and years, and maybe with more monitoring data, we'll be able to more and more accurately forecast what honey flows can look like. And so I think, in order to get there, we need to have these networks of maybe hive scales throughout the US so we can really monitor what's going on and capture different events, different weather patterns, etc. So that we can more accurately predict what it's going to be like in the future.

Jamie 27:29
More data, more data, more data.

Guest 27:32
I know.

Jamie 27:33
We scientists always said, I completely agree with you, I just love this idea that someday there could be a data repository large enough, that's allowing us to forecast with some good accuracy. What beekeepers can do, I'd love to be able to tell a beekeeper, don't go to Tupelo this year, it's not going to be a good year. And I think about all the resource and time savings that they could have knowing that information. So it's really exciting that you and your colleagues are taking some of those first initial steps to get us there.

Guest 28:02
Right. I mean, I think that that's a great point that you make is that, even if the plant is there, even if we put the habitat in, if the weather isn't right, that plant is not going to push nectar, it's not going to be a good resource, even if that plant grows and blooms and all of that. So I really think that weather is this missing piece that we need to consider.

Jamie 28:24
I just stay fascinated with this topic, though. Because every year beekeepers in our law surveys reported in the top five. And you go to conferences, and people are talking about Varroa and nutrition, and queens and viruses and things like that. But, I could probably count on my hand the number of climate impacts or weather impact lectures I've seen over my years of going to research meetings, and I really feel like that this is one of those fields is going to explode. So it's really cool that you guys are meeting this head-on.

Guest 28:57
Yeah, I think it's super interesting. And of course, the management stuff is super important. You're not going to see these effects. We managed all of these colonies for Varroa. And so maybe we wouldn't have seen these effects if the colony was just decimated by disease and pests. So I think that's an interesting thing. And an important thing to highlight is, you're not necessarily going to even have really great honey flows if you don't have your management right.

Amy 29:28
So Gabriela, you mentioned something about networks of hives, and you know, using that to monitor weather patterns. And I was just wondering, has there been other research or other projects ongoing, or that have been done?

Guest 29:41
Yeah, so there was this really great long-term monitoring project headed by Wayne Esaias. It was a NASA project called "Honey Bee Net". And he collected data from hive scales from people for years and years and years. But unfortunately, that project stopped in 2011. But he was able to get these

really cool data about how the spring flows have shifted over the course of 50 years to be almost a month earlier. And so that just shows the power of long-term monitoring, using these unbiased methods like hive scale data, and that's something that I think would be really valuable to continue because, especially in the face of climate change, there's so much that we don't know. And we just need that data in order to continue to make predictions and forecast into the future.

Amy 30:37
We were just talking about it, Jamie, this morning, about if you're working on a project for 50 years, I mean, you must have started that, what, when you were like 10 years old, right?

Jamie 30:48
Well, Gabriela, thank you so much for joining us on this episode. It was really neat to see your research. It's really cool to see how collaborative it was. So many folks involved. We look forward to seeing where it goes. And just for all of our listeners out there, we'll make sure and link this manuscript on our show notes so that you can have a look. But again, Gabriela, thank you so much.

Guest 31:07
Thank you. It was a pleasure.

Amy 31:28
So, Jamie, something that you mentioned, when we were interviewing Gabriela was how, normally, we talk about Varroa, we talk about nutrition, and queens. And this segment touched on nutrition and some of the nectar resources coming in, but also, it touched on weather. And so we talked about weather. And it's interesting because I feel like every time I give a talk, I always share the Bee Informed Partnership's information. And I say, "Weather is there, there's nothing we can do about it, and let's just move on from it." And I feel like, in this case, there actually is a lot to be said about weather and climate.

Jamie 32:04
Yeah, I really feel that Gabriela brought up some interesting points. And I think I just want to make this comment. Again, if I haven't already said a couple of times when interviewing, weather it comes up every year in beekeepers' surveys as a chief stressor of colonies. And, so we as beekeepers, we recognize that weather plays an incredible role in the survival of our hives, but we don't think about it much. And we don't talk about it much. And plus, Amy, as you know, and of course, you've got a lot of listeners here, there's this huge public debate over climate impacts, whether they're real or not, whether they're manmade or not. But it's funny that beekeepers still say weather is a bad thing. So let's think a little bit about weather versus climate. What I'm looking at, I'm sitting here as we record this podcast, I look out of my office window, and the sky is blue, there are a few clouds. I did check the weather this morning. And it said, this afternoon, we have a reasonable chance of rain. So weather is what's happening right now, today's weather, the temperature, the rainfall, the light intensity, all that is part of today's weather. But climate is really kind of averaging out one's weather over a large period of time. So a lot of people will debate climate impacts, and they'll say, "Well, it's supposed to be warming, why's it so cold today?", or, "If it's supposed to be so bad, we didn't have a hurricane yet this year." And in reality, you're looking at snapshots when you're making those statements rather than looking out as an averaged period of time. And so what Gabriela and her colleagues are doing is they were looking, over

this landscape, how were weather events impacting colony weight gain? And if the climate's warming and this thing continues to go that direction, then what might that say about colony use of flowering plants in the future or the rewards that flowering plants offer bees? And I think this is an incredibly important topic. Number one, because beekeepers say it's a big stressor on their hives, but number two, there's so little work being done on it. If you're a graduate student out there listening right now, this field is wide open and needed, but just what you said, Amy, so what do we do with the information if we get it? Okay, warm and wet temperatures in certain areas of the US might impact floral resources, but what does that say about me in England, or Australia, or South Africa, or Germany, or wherever I am? And in reality, this is going to be an issue that gets increasingly pushed to the forefront, and so I feel like it's something we need to address sooner rather than later.

Amy 34:45
Yeah, I think like most of the time, I'm just thinking, "Oh, it's raining today. I'm not going to go to my colonies," or, "It's cold. It's wintertime, and it's snowing, so I'm not going to go into my colonies."

Jamie 34:55
You won't say that here though.

Amy 34:58
Because it doesn't snow. So the other thing I wanted to talk about was just about the hive scale data. So as she's starting to talk about how they collect these data, I'm just wondering, like, is it applicable for beekeepers to go? And is that enough for beekeepers to weigh their colonies, get all these scales, and then, look at what's happening in the weight every 15 minutes or an hour? Is there a potential for beekeepers to use this as part of their management scheme moving forward?

Jamie 35:32
So the short answer is yes. In theory, beekeepers can collect weight data for their hives and gain some valuable information. I mean, there are a lot of companies that are marketing that idea. If you put hive scales underneath your hives and you can measure your colony weight gain, then you're able to receive some valuable information that you can then use to make management decisions or things like that. But what I would say, in addition to that, there is a great value of those data being part of a larger effort or a public repository to where scientists can look at trends just like what Gabriela and her colleagues were doing. So let's just think about it kind of from a hobbyist's perspective. You got three colonies in the backyard, one of them has a scale under it. Well, if you chose the wrong colony, and it's naturally weak or underperforming, then you're going to get some erroneous data. So it'd be hard to make a management decision based on one colony. So do you get three weight scales if you've got three colonies? What about commercial beekeepers? You've got 10,000 colonies. Do you have scales on a half or a third or a quarter or a fifth? At what point is it enough to make management decisions? I would argue on top of that, though, if all of that information were part of a public repository, then the scientists can look at trends over time and start to make some of these predictive forecasting that Gabriela was talking about. "Hey, based on years of data that we've collected from beekeepers who have one to 100 hive scales, here's what we're able to say about your nectar flow next year or colony health that's likely to occur next year based on the weather patterns that we see this year." So it's interesting because our team, and me specifically, we just haven't relied on colony weight data a lot in the past. We don't have active hive scales that are placed underneath hives. But every time I see

studies like this, it makes me feel like we should have a few scales out in our research apiary just to make sure that we're able to contribute data to the greater good.

Amy 36:55
Well, I'm really excited to see the network of hives. And hopefully, Gabriela can make that happen with her collaborations around the nation. It would be really cool to be involved with that. But for our listeners, we will be sure to add her publication to our website and our additional resources. So if you wanted to read more on her research that should be available to you on our website.

Stump The Chump 37:59
It's everybody's favorite game show, Stump The Chump.

Amy 38:10
Welcome back to the Q&A segment of our podcast. Jamie, we've got three questions today. And I've pulled these questions from emails from kids who have been on tours with us and from an email. So the first question we have is, this individual works in an auto salvage yard and they're wanting to acquire some colonies on this property. And they're wondering if being on an auto salvage yard would be safe for the bees feeding from some of the flowers in the salvage yard? Do you think that they'd be safe? Or do you think that there could be potential chemical runoff in the oil or gas that would ultimately go back to the colony?

Jamie 38:50
So I mean, the safest answer for me is just to put out there, it's really hard to answer this question with absolute certainty. Let me explain why that's the case. There are certainly some compounds that can get taken up in flowers and be expressed in the nectar and the pollen that the bees are collecting. So, for example, probably the most famous group of compounds that people know about in this regard will be the neonicotinoid class of insecticides. People have all been talking about that. That's what a lot of beekeepers have discussed. So it is certainly possible for plants to take up compounds. Now, the question is, is the salvage yard have the type of compounds that would likely be taken up into flowers and therefore be a problem for bees? My gut tells me is that it's not going to be a problem for you at all. I've not read anything that plants can take up fossil fuels or any of this stuff and it be translocated to the nectar or the pollen, in which case it's unlikely that bees are going to pick it up from the flowers in these scenarios. But also, I don't know what else is in the salvage yard. I don't know if there's chemicals being used and things like that. Also, my guess is that the volume of plants that are being grown in and around the salvage yard is going to be so small that the bees are going to be getting the vast majority of what they need from plants outside the salvage yard. So the exposure would be pretty minimal. With that said, there are other ways besides picking stuff up through plants that bees can be exposed to these things. If it can run off in water, for example, maybe there are water sources nearby the salvage yard that's an accumulation pond for a lot of these things that are in the salvage yard, and it's going there and the bees are going to collect water there for thermoregulation purposes. So I'm going to tell you my gut feeling and then my overall recommendation. My gut feeling is the potential impact would be negligible. But the truth is you're not going to know until you try it. And so this leads me to my recommendation, which is, when in doubt, don't do it. Or if you've got a number of colonies, you could always move one colony there and see if you know if it is being negatively impacted compared to some of the other colonies that you have elsewhere. And even that's just a small sample size. So it'd be hard

to derive a lot of truth from it. But it sounds like you're a little bit anxious. I would argue that it's hard to know with certainty, and even though my gut tells me it would be okay, when in doubt, don't do it. Try to find another place that's got a lot of floral resources. Again, I really don't think you'll have a problem. But since we can't know with certainty, there are two options, try it out and see what happens, or don't do it at all and look for another alternative. And just based on the concern that I'm reading into this question, I would probably just try to look for another area to locate bees.

Amy 41:46
Sounds good. And I have to clarify. When I said that a kid asked a question that wasn't that question.

Jamie 41:50
Thank you. Thank you for letting us know.

Amy 41:56
You're welcome. So, that leads me to the second question, which actually came from one of the kids who was coming and touring the lab here. And they asked a really great question. Do bees have teeth?

Jamie 42:09
Yes. And they have to wear braces too. No, I'm just kidding. Okay, they do have structures that we call teeth. But it's a little tricky. So when we think of mouths, I'm going to use humans as an example, we have this hole that we can open our lips and expose our mouth and our throat. And at the forefront of that, right behind the lips are these teeth. Kind of what we think of as teeth.

Amy 42:34
That's a very strange description.

Jamie 42:36
You know what? We got there. Okay, so we got these teeth kind of at the front of our mouths, and we use them to bite things and to chew things and things like that. They're kind of the gateway into our mouth and our digestive tract. Well, honey bees, they have mandibles. Let me start this thought over. Honey bees have two mouth part sets. One of those is the proboscis, which is made up of a lot of different parts. They can put them all together and basically make a tube that's a lot like a drinking straw. Alright, the proboscis. They call it the honey bee tongue, but it's more of a straw-type apparatus when all these things fold together. So that's their sucking mouthparts, we would say in entomology, but they also have biting/chewing mouthparts and we would call that the mandibles. So worker bees have mandibles, drones have mandibles, and queens have mandibles, and at the edge of these mandibles are these little ridges that we often refer to as teeth. And they're not teeth in the sense like what we have that kind of goes straight to the digestive tract. They are teeth, instead, that they use only in their mandibles for biting, grasping, or chewing. I know we use our teeth for chewing so it'd be tempting to think that it's very similar, but they're not necessarily chewing it for the purpose of taking it in through their proboscis, as an example. But if you look closely at the edges of a mandible, you will see these little ridges and we call these teeth. Yes.

Amy 44:08
We do call them teeth?

Jamie 44:09
We do call them teeth.

Amy 44:10
Okay, I did not know that. Learned something new. Learn something new by hosting the podcast and listening to the podcast. Very cool. Okay, so for our third question, so this person has read this and I've also read this, that there are miticides that are something called lipophilic. And so first I want to ask you, what does it mean to be lipophilic? And if miticides are lipophilic, is that a problem in the colonies?

Jamie 44:39
So lipophilic, like the name implies, is broken down kind of into two parts. Lipo meaning wax and/or fat and philic is loving, so wax-loving or fat-loving, right? So a compound that is lipophilic is likely, or not likely, it's chemically attracted to fats or waxes. So there are some Varroa treatments that are available that are lipophilic, which means they are more likely to show up in wax than somewhere else for that matter. A lot of compounds that are used to control a lot of different things are lipophilic. That's why we find a lot of pesticide residues in wax because they're lipophilic and they get in the wax. Hydrophilic means they prefer water, and so they would be in other substances, maybe, for example, such as honey. Honey is soluble in water. So that would be an example of something that's water-loving. So a compound that is lipophilic would preferentially go to wax over something else. Now, the jury's still out on what does this mean for bees? And why do I say that? Well, when you do pesticide residue analyses on wax, and we've seen some of those ourselves, you can find a lot of compounds in wax. So when you see a lot of compounds in wax, you say to yourself, "Well, bees rear their babies, the larvae and the eggs and the pupae in wax, and they store their honey and their pollen in wax and they walk all over the wax and they develop in wax," just, you can think of all the things that they do with wax. So it makes logical sense that if there are lots of compounds in wax, that honey bees can be exposed to a lot of these compounds either while developing or while consuming foodstuffs that are stored in those wax cells. But on the other hand, you could make the argument that given something is lipophilic means it is likely to go to and remain in the wax rather than being accessible to the bees. In fact, you could make the argument that one of the benefits of wax is that it's a natural buffer mechanism between bees and compounds in the environment. A lot of people like to give this idea that humans created insecticides or pesticides. We didn't. Plants and other things have been using compounds well before we knew to create them ourselves for pest control. So honey bees have been exposed to compounds since there were honey bees around to be exposed to compounds. And so you could make the argument, rationally, that part of the function of beeswax is to remove from honey bees access to compounds that otherwise could cause problems for them. So it kind of pulls it away from circulation. So this is actually something, Amy, our team here has been looking at in recent years to try to say, "Okay, look, we know we've got compounds in wax. But is that a bad thing? Or does the wax keep those compounds inaccessible to the bees?" And we're just not sure yet. So that's why I'm trying to waffle with this answer rather than going straight to the point. But I would argue that it's a very interesting point, scientifically. And it's very possible that the buildup of compounds in wax is exactly the way nature is trying to handle keeping this stuff away from bees. Now, I'll add one more thing to that. We tend to keep wax in our colonies, into perpetuity, but I remember years and years and years ago, and if I were asked to find this paper, I'd be unable to do it. So I almost hesitate to say it out loud. But I remember years and years and years ago reading the average comb in the average wild beehive only survives a couple of years. I

mean, think about it. A colony is migrating up and down and left or right in the nest cavity over the course of a year. So the unprotected combs would be taken out by wax moths. So wax is not really a long-lived product. In wild honey bee colonies, it gets cycled out pretty quickly. So maybe in the normal realm of things, the wax will pick up these compounds, and then things like wax moths would take out the wax and bees would build more wax, and it's a constant recycling. But in our colonies, we tend to use wax forever and you can get these buildup of compounds that you can't help but feel reach damaging levels to bees. But, at the end of the day, we just don't know for sure. Maybe it's not coming out of wax. So, Amy, I'm going to pause naturally here because you need to ask a follow-up question because I chased a rabbit and I didn't answer the, if it's present in wax, could Varroa develop resistance to it since it's these low levels over time. So I'm going to pause and let you say well, "Jamie, as a follow-up."

Amy 49:38
Yeah, so I have a follow-up question. And that's really about the exposure to mites. And so is that an issue? And also, actually, I have a question before that. With the term lipophilic and how it is wax or fat-loving, does that mean that it's just kind of on the edges or more that it's in fused into the wax or fat or whatever it is that it's holding on to?

Jamie 50:05
So I'll answer your second question first, which is it migrates into the wax. We don't believe that it's just on the edges of the wax. So we believe it moves into and is incorporated in the wax. All right. But I think the reason that the questioner asked this question in the first place was all the way back to acaricides, right? If we're using acaricides, these miticides in hives, even when you take out the strips, let's just pick on --well, I won't pick on anyone. Let's just say you put in a strip, it's got this active ingredient in it, this active ingredient, if it's lipophilic, it's going to move into the wax, you take out the strip, but the compound's still present in the wax. In fact, we can see this with some compounds using honey bee colonies. Does that expose mites, the low levels on this compound over time such that they can develop resistance to it? Well, maybe, maybe not. The maybe is the same thing from the bee perspective. Maybe there is this low chronic exposure to pesticides, or in the mites' case, these miticides. And since it's not killing them, they can develop resistance to it. But on the other hand, if it's truly lipophilic, maybe it's inaccessible to the mite altogether, so even though it's there, it's not something that the mite truly gets exposed to because of the lipophilic nature. I will add, though, that the best way, people get tired of hearing me say stuff like this, but the best way to manage resistance development is to rotate chemicals and follow the label, rotate chemicals, follow the label, rotate chemicals, follow the label, and that way mites aren't getting exposed to things longer than they should be, or more often than they should.

Amy 51:47
You also wonder if there's anything that you could do with wax moths. So if they are going in and they are eating it, wouldn't there be something that you could put into the wax to get rid of the ones that are eating it?

Jamie 51:59
Yeah, so I've actually thought about this. Some of the levels of compounds that we actually find in wax, well, I don't want to overgeneralize, I was going to say astronomical, but you could find some things in

really high levels, like I remember seeing fluvalinate or amitraz. Both of these, of course, being products that are compounds used against Varroa and different trade names, those tend to occur in wax at really high levels. But I know, for example, amitraz, it's hard to find amitraz, but it's much easier to find its metabolite. It breaks down very fast. And so you can find its secondary metabolites in it. So then I think, okay, you got all this wax, you've got this kind of buildup of compounds over time in this wax, just naturally, stuff we're putting in the hives versus stuff bees are bringing in from the outside. Is wax just inherently toxic to wax moths now because you get these tiny wax balls, feeding on wax that's got fluvalinate or amitraz or whatever from the outside of the hive in it. And the answer to that question is, we don't know. I still see wax moth damage in combs so I know that they're not entirely susceptible to whatever's in wax. But specifically to your question, there are potentially things that you could incorporate into wax that can be toxic to wax moths, but I think a lot of people are just concerned about that because it can also be toxic to bees. And since wax moths and bees are at least similar enough in size, you'd have to dose them pretty high to get maybe wax moth control. There is one product that's based on Bacillus thuringiensis, the BT product that you can spray on combs that's essentially innocuous to honey bees. But when wax moths eat the combs, it kills them, but it's not a traditional miticide that would be like lipophilic, which is kind of the theme of this question. It does get sprayed on the combs. And when wax moths eat it, it does kill them. But it's a slightly different application. It's slightly different chemistry.

Amy 53:53
Very cool. All right. So in this Q&A, we talked about auto salvage yards, we talked about whether bees have teeth, and we talked about what it means to be lipophilic. I think we've exhausted ourselves for the Q&A for today. But beekeepers, if you've got other questions, any question is fair game, so send it our way, contact us on social media, or send us an email.

Serra Sowers 54:19
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.