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SPEAKERS

Amy, Stump The Chump, Jamie, 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, and welcome to another episode of Two Bees in a Podcast. In this episode, we are joined by Dr. Reed Johnson, who's a faculty member at Ohio State University. He will be talking with us about honey bee toxicology. We will follow that with a Five Minute Management segment on common arthropod pests of honey bee colonies, and we'll finish today's episode with our question and answer segment. Hello, everyone, and welcome to another segment on Two Bees in a Podcast. You know, Amy, we have been talking a lot recently about honey bee toxicology topics. And today, we have someone I consider one of the world's experts on this topic. Joining us. Dr. Reed Johnson, who's an associate professor in the Department of Entomology Ohio State University. Reed, thank you so much for joining us on Two Bees in a Podcast.

Guest 01:44
Thanks. It's good to be here with you.

Jamie 01:46
Reed, I have a confession to make. And it is scary to make this confession. But every time I get toxicology questions I can't answer, I secretly give people your email address. So, I hope you're not getting bombarded by questions that I'm pushing up your direction since I know it's a hot topic, and I'm sure a lot of people are reaching out to you to talk to you about the impacts of pesticides on bees.

Guest 02:08
Well, it's good to know where those emails are coming from. But yeah, people do reach out to me periodically. I mean, it's an interesting topic, but it's a challenging topics as well. So yeah, keep sending them my way.

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Jamie 02:24
Thanks. I feel like you probably feel like you have to say that since we're on the podcast, and maybe behind the scenes you'll chastise me. But Reed, you know, with regard to toxicology, we really could interview you about 1000 different things. Today, we're specifically talking about risk assessment. We're going to get into all of that here shortly. But since you're a first-time guest, we really like our listeners to be able to get a feel for how you fell into bee research in the first place. So, without asking you a single question about tox, first, I simply want to know if you could tell us a little bit about yourself and how you found yourself at the Ohio State University and how you ended up working with honey bees specifically?

Guest 03:03
Man, how did I end up here? Well, so, I'm originally from Missoula, Montana, that's where I grew up. And I was looking, when I was an undergrad in college, I was looking for a summer job back home. And I knocked on the door of Jerry Bromenshenk at the University of Montana, and I was just desperate for any job, you know, related to biology, really. And he was looking for people to work with bees. I figured, "Oh, I don't know anything about bees, but that sounds interesting." And I worked for him for two summers and he was actually doing some toxicology work back then using bees. This was just before we got into using bees to find landmines, he was using bees as Sentinel animals for pollutant. You know, and then I went on to the University of Illinois, worked on a PhD with bees on bee toxicogenomics and the honey bee genome. And then I did a postdoc in Nebraska with Marion Ellis at the University of Nebraska in Lincoln. And then they hired me at Ohio State in 2011. And, yeah, it's really a great place to work. I'm happy to be able to continue working with bees and bee toxicology

Jamie 04:09
Reed, I had no idea that your introduction to bees was through Jerry Bromenshenk. I think that's a really neat story. It's one of those things that you said you go knocking on doors, and then there's that one knock that's going to change your life forever, right?

Guest 04:21
It's really amazing the way that works. Yeah. I mean, if I hadn't, you know, if he had been in that day, my life would have been totally different.

Jamie 04:27
Well, I love the term toxicogenomics, man. That's a good one.

Amy 04:32
It's a difficult word. So, we wanted to discuss a recent document that was published by you and your team. And it was a cross-border approach for assessing the risk of pesticides to bees in Canada and the US. And can you tell us just a little bit about the background of this project and how this research kind of came about?

Guest 04:54
Well, so this document was actually for a lunch and learn that a group of us organized at the Entomological Society of America meeting in 2018 in Vancouver. And it was, I mean, this group of

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people on the regulatory side with EPA and PMRA in Canada, as well as, you know, people that work for industry for the chemical companies, and, you know, a handful of academic researchers, this group has kind of been an amorphous group trying to advance the field of risk assessment for bees. It really started back in 2011, the Society for Environmental Toxicology and Chemistry organized what's called a Pellston workshop, and there was a book published out of that, took a global approach to, you know, bee risk assessment. And then, this document, and this lunch and learn that we hosted at ESA in 2018, was really kind of a follow-up to this work that's been going on in redefining how bee risk assessment is done and the work that's, really, probably near completion now in updating that risk assessment process.

Jamie 06:07
So, Reed, I think risk assessment is one of those things that many folks don't really think about with regard to pesticides and bees. A lot of people kind of take the stance that well, if it's possible to kill bees with it, then it doesn't need to exist. But that's kind of toxicology, right? But within toxicology, you do get this idea of risk assessment. Products have to be studied before they are released to the masses to be able to use, and so you mentioned the SETAC Pellston workshop. You and I were both there. I remember a lot of good conversations with the folks there at that meeting some years ago. So, for our listeners' sake, can you talk a little bit about risk assessment,and what happens within the risk assessment framework, why it's necessary, all of those types of things?

Guest 06:53
Well, I mean, the fundamental reason we need risk assessment, regardless to bees, is we don't want to be killing bees with the pesticides that we're using. And this really derives from a legal perspective from the Federal Insecticide, Fungicide, and Rodenticide Act, which states that pesticide applications should not have an unreasonable adverse effect on the environment. And it's from that federal statute that bee protections flow and that risk assessment is, therefore, necessary to make sure that unreasonable adverse effects on bees are not occurring with the pesticide application. So, the risk assessment process, I mean, there's a multi-tiered process that has been developed, really kind of growing out of that Pellston workshop and building on work that was done before, where you test honey bees in a, you know, a laboratory setting, individual honey bees, and you do a traditional, LB50 kind of assay. And you just try to characterize, how toxic is this particular pesticide to bees? And as you'd expect, many insecticides are highly toxic to bees, because these are insects. And then the question is, you know, how much are bees actually going to be exposed to this pesticide or insecticide when it's used to control the pest insects for which it was designed? And that's when you move up to more realistic field settings. There's tier two or tier three testing where you would actually spray this candidate pesticide on a crop and look at what bees are actually exposed to when it's sprayed on a blooming crop. And then, you know, look at the effects of application to a blooming crop on a whole colony to see if that exposure actually has any measurable negative effect on the functioning of a honey bee colony. And this risk assessment informs, really, the risk management, which is on the pesticide label that is eventually produced, which crops can this particular pesticide be applied to, and when can it be applied, as well as any other restrictions on pesticide application to protect bees. So, risk assessment is really characterizing how toxic this particular pesticide is to bees, and even if it is highly toxic to bees, that's not necessarily, you know, the end of the road for that particular pesticide. It will then inform how it can be used so that its use pattern will minimize the harm that it does to bees when it's applied out in the real world.

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Amy 09:30
That's really interesting. In previous episodes, we talked about pesticides, we talked a little bit about risk assessment. And, you know, it's really interesting to hear the different tiers of how this process works. I know that you were saying, like, which crops can this pesticide be applied to, when it can be applied? There must be a lot of research that goes behind all of this and so, how long does this process normally take?

Guest 09:52
Well, so, this is all work that is done by the registrants or the, you know, the pesticide companies that are working to develop these products. And my understanding is it can take, you know, 10 to 15 years from the discovery of a new active ingredient, a new pesticide molecule, to actually getting it, you know, all this testing done, and then finally, getting it put on the market, because the, you know, the testing, this bee safety is really just a very small component of that. There's all sorts of -- human safety is obviously a major concern when registering a new pesticide as well, as well as all the other environmental effects that this pesticide application may have on, you know, organisms in the water, birds, other mammals, you know, all the life that's out there, how will this pesticide impact everything?

Amy 10:40
That's crazy, I don't think I expected you to say 10 to 15 years. So, thanks for giving me a number. Now, I can tell everyone that I speak to about, you know, if they're wondering why there hasn't been a new pesticide on the market, or even, you know, especially related to honey bee miticides, that whole process takes so long, so it's not going to happen, you know, tomorrow. And so, that's interesting to hear.

Guest 11:02
Well, it's quite expensive as well, because all this testing is paid for by the registrant, the chemical company, including the bee testing. And the result of them paying for that testing is that it's never really made publicly available, because the results of this testing are proprietary. And the companies hold that. And that's one way that they, you know, when a pesticide eventually becomes generic and the patent runs out, and other companies can manufacture and sell a particular pesticide, that is how the original company maintains control over it is because they hold all the testing data. And that testing data is required for another company to go and put another product, competing product, on the market. So, they hold this testing data very tightly. And this is the reason that beekeepers and I never even see it because it's this data that's locked up. Only, really, EPA gets to see the bee safety data generated by these companies in order to support the registration and labeling and eventual marketing of these products.

Amy 12:05
So, with the risk assessment, I assume because it is all, you know, there's so much research that goes on behind it, the pesticide regulation does differ throughout the world. So, you know, does the pesticide regulation differ between Canada and the US? I know that's what you were doing research on. But also, I was wondering what that kind of looks like in comparison to the rest of the world.

Guest 12:30

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So it's hard to know exactly what's going on in the rest of the world. It's hard enough for me to know what's going on here in the US. I will say there has really, on the topic of pollinator risk assessment, there's been a really focused effort to harmonize the methods for the testing in the United States and Canada, as well as in California, which has the California Department of Pesticide Regulation. They have their own regulatory framework in the state of California. So, pretty much in US and Canada, they've agreed on a similar set of tests. And I know the regulators in those groups communicate frequently to make sure that everything is consistent, at least in the US and Canada. In Europe, obviously, it's a different story. And that could be because they take a more precautionary approach using the precautionary principle for pesticide risk assessment where if there's -- they're much more conservative in allowing a new product to come to market, and this is the reason that, you know, the neonicotinoid insecticides that have been banned, or one of the reasons that people point to that those products have been banned in Europe, while they have not been banned here in the United States. According to that Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), for environmental issues here in the United States, we do a cost-benefit analysis. So in the United States, it's reasonable to harm pollinators and bees, if that pesticide application, the benefits outweigh the risks. And so, I think in Florida there, in citrus, it's a really good example where they continue to use imidacloprid, despite its, you know, well-publicized negative effects on bees, just because the benefits of that imidacloprid use in controlling citrus greening really outweigh the potential harm to bees because the beekeepers can just keep their bees out of citrus, when it's blooming. Imidacloprid just went through reregistration and that citrus use will not be modified. They made no suggestion to change that because the benefits do outweigh the risks, at least in their view.

Jamie 14:44
Reed, there's a lot of directions we can go from here but I want to circle the wagons kind of back to this toxicity test, and you talked a little bit about the tiers for toxicity testing. If you don't mind, if you can walk people through those tiered levels again, and, specifically, you mentioned things like insecticides will almost always get caught in tier one because through these LD50 -- for the benefit of our listeners, LD50 is the lethal dose that kills 50% of the population, LC50 is lethal concentration that kills 50% of the population. So, Reed, when they get those numbers for insecticides and show that a critical threshold is reached and these insecticides are pushed into tier two and tier three, that's reasonable. Like we would expect an insecticide to kill honey bees, we would expect it to move forward into tier two, these cage study tests, and tier three, these field tests. What about herbicides and fungicides that might be applied in these tier one tests, but might not trigger a jump to tier two and tier three? Can you talk about kind of that threshold? What pushes one to the next tier but not another? And if herbicides and fungicides are caught up in this because a lot of beekeepers want to know about the potential impacts of fungicides and herbicides and how they're screened for in these tier testing systems.

Guest 16:01
So yeah, so the tier testing system, it really, I mean, EPA has been requiring tests on honey bees going back to the early 1970s. And this is these classic LB50 tests. And if you go on EPA's website, they have an ECOTOX database, which has LB50s for every single pesticide that is on the market or has been on the market since the 1970s because this testing has been, really, a standard piece of the protocol that has been expanded into this tiered approach. It used to be that was it, you just tested it on bees and got the LB50, and then you could calculate what's known as a hazard quotient based on that. But really starting in 2011, that really progressed to this more formalized tiered approach. And I guess,

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if you think of, like, tiers as like a layer cake, you know, your bottom layer is these individual-level tests like that LB50 test. They also now require tests on larval honey bees and chronic tests over 10 days to see if there's an effect on bees feeding on any pesticide. This could be insecticide, fungicide, herbicide that is up for registration. If it fails, then it goes on to field testing, as you mentioned, and that's with actual spray application to a crop. But if a pesticide doesn't show high toxicity, if it's an herbicide or a fungicide, they'll actually put the numbers from these tier one studies into this Excel spreadsheet, which is called Bee-REX. And anybody can download this risk assessment tool from EPA's website, just look up Bee-REX, I guess like T-Rex, but with b-e-e before it. And you can put in these LB50 numbers and the predicted exposure levels, and, you know, do the risk assessment for yourself. Does this need to go to tier two testing? Is there, you know, likelihood of negative effects? Now, most fungicides and herbicides will not have a problem at tier one because they are not insecticides, they have relatively low levels of toxicity to bees. And they would not ever make it to those higher-level testing where you'd look at colony-level effects. And I agree, I think there's probably an issue with that because it could be that some of these products do have colony-level effects. But with the new revised tier one testing where they're actually testing on larvae and testing on workers over a longer period of time, hopefully, it will catch any of these brood effects from, say, fungicide application, that might potentially show up in, you know, in a field scenario. Hopefully, that's the case. I don't know how many of these fungicides have gone through this revised testing. That's really only been starting to be required in the last five or 10 years. But it will be interesting as products are reregistered under FIFRA, which is a process all pesticides have to do. They have to be reregistered periodically in order to stay on the market. And this new larval testing and chronic testing will be required of these products that have been on the market for many years and hopefully, will pick up whether these fungicides really are causing brood toxicity when they do this reregistration.

Amy 19:21
So, outside of the honey bees, I know that something that has been discussed with surrogate species and so, I'm wondering if you can explain what that is, first of all, and then how are they used in testing for the pesticide registration?

Guest 19:35
So, a surrogate species is, for the sake of pesticide registration testing, is like the model species that you use, and then you use results from that to predict over an entire class of organisms. So, they don't test all species of birds for bird toxicity, they just test a select few species. I think there's a quail, and I don't know. There's a -- because you can't test everything. I mean, it would be ridiculous to be testing every possible bird species. So, they just test it on one or two bird species and then predict that, well, this doesn't show high bird toxicity. They'll put, maybe, a safety factor on there to protect against maybe more sensitive bird species based on research that's been done, and then move forward with the registration based on those results. The same is true, honey bees are really the model pollinator species and actually, a model insect species that they use for regulatory testing. And I guess the criticism is that honey bees are not, maybe, representative of all pollinator species that are out there. But that's just the way that the risk assessment is done is you can't possibly test on all pollinator species. We're going to test on honey bees and maybe another species, possibly bumble bees are looking like a promising alternative species. And then we're going to predict the effects on all the other species of bees based on honey bees. Though there are, you know, differences in how different species of bees would be exposed, and obviously, honey bees are these social organisms with all

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these complex behaviors. And maybe that's not quite so representative of a solitary bee. But that's an area that, I think, of research, what are the differences between honey bees and the solitary species, and whether they really are a good surrogate for them?

Jamie 21:26
Reed, I think that's a really good overview of risk assessment. There's so much to know. Probably the thing I've learned most about since I started my job at UF back in 2006 is toxicology I came in with very little experience and just have learned so much from the regulatory risk assessment side all the way to the research side. And Reed, I know you are an active investigator, you're not just knowledgeable on the risk assessment side, you actually contribute to the refereed literature related to this topic, impacts of pesticides on bees, etc. Can you share with us about some of your current toxicology research? Well, I won't ask you to go into too much detail so we can protect, kind of, some of your new information that might be coming out soon. But can you give us an overview of the type of tox work you do and then some of your recent successes?

Guest 22:16
So, I like to look at specific situations, you know, places where beekeepers have reported problems, and then trying to figure out if pesticides are contributing to those problems, and which pesticides might be the issue. And we've done that in Ohio. There's the corn seed treatment dust problem, you know, that all the corn seeds and many of the soybean seeds are coated with neonicotinoid insecticide. And the problem there is that would chip off, form on insecticidal dust that would cause a noticeable and measurable bee kill when corn is being planted in the Midwest. So that's an area we've been working on and continue to work on. The other area we're working in is almonds, because of course, you know, 80% of the US honey bees go out to almonds each winter to pollinate over a million acres of almonds they've got out there in the Central Valley of California now. And they do apply pesticides during bloom. And the question there is not so much -- we've got a pretty good handle on individual pesticides through the regulatory testing that was done. But regulatory testing does not look at combinations of pesticides. And in practice, in almonds, they actually tank mix, you know, a fungicide and an adjuvant, and potentially, a quote-unquote, bee safe insecticide, together in a tank mix and then apply that during bloom. And the question is, do these tank mixes that are actually applied in almonds during bloom, are those responsible for some of the brood problems and, you know, harm to colonies that some beekeepers have been observing in almonds and coming out of almonds? And so we continue to be very actively working on that. At the moment, I'm particularly interested in the adjuvants. These are not actual pesticides, but products that are added to the pesticide tank to improve the properties, the spreading, the sticking of that pesticide application on the crop. And there's very little testing done of these adjuvants on bees and, particularly, in combination with other pesticides. So that's really what we're working on right now.

Jamie 24:22
So, Reed, that's our last formal question. So, what I'll do is just ask, is there anything else that you would like to cover that we have not covered? I've been scrambling to take notes, but you're answering everything so thoroughly and well, but I can't think of many follow-up questions. Amy, did you have something that you wanted to include?

Amy 24:40

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No, I think this was really great.

Jamie 24:42
Reed, did you have something that you feel that we've missed that we need to ask about?

Guest 24:45
Well, I do just want to say that I am not a pesticide regulator. I'm an academic. So, I'm looking at this, kind of, from the outside, but I guess that gives me some freedom to talk about things here from what I do glean from talking with people in EPA and in industry. There's probably a lot of subtlety and some details that I am not aware of, and it's a complicated topic and a lot of it is obscured from our view from the outside. And I think that's what makes it particularly challenging, but also really interesting. How does risk assessment actually work? It's really interesting.

Jamie 25:25
You know, Reed, when I got into it, I was actually quite surprised at how much work the EPA, or how much information the EPA requires behind the scenes. And I was looking at these tiered assessments, and then I learned about hazard quotients, and all of this stuff, and it really, you know, risk quotients, etc, it really kind of blew my mind the science that had already gone into this topic before I ever thought about it in the first place, right? And the reason we all began thinking about it is when colony losses started becoming the news back in 2006, people very quickly jumped on pesticides as one of the potential contributors. And so, that was my introduction to honey bee toxicology. But it was also my introduction to the risk assessment approach, and it was pretty fascinating to see how all of this works, and I've been intrigued about it ever since.

Guest 26:15
Yeah, I mean, it's amazing. I would say 85% of the toxicology research in bees that happens happens by industry, and none of us ever actually get to see it. And there's this huge effort going on out there between EPA and these companies. And most of us, you know, never get to see that. It maybe will show up in a word on the label at the end of the day.

Jamie 26:38
Yeah, that's what I always tell folks is all of this testing goes to inform the label, Reed, which is what you've said a couple times. And everybody asks me, "What's the best way to protect bees from pesticides?" Well, I suppose an outright ban of all pesticides ever could do that. But I think, secondly, follow the label. Labels, first of all, it's the law. But, even more important than that, I would say, is pesticide labels are developed in a way to minimize the impact on non-target organisms. And so, you're right about it just showing up as a word. A lot of research goes into producing the words that go on those labels. So, those labels are designed to maximize the impact on the target and minimize the impact on the non-targets. So, the best way to protect pollinators, if you have to use pesticides, is to follow the label.

Guest 27:32
Exactly.

Jamie 27:33

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Reed, this is all great information. Thank you so much for spending your time with us on Two Bees in a Podcast. I'm sure our listeners are going to benefit from having heard everything that you shared with them.

Guest 27:44
Well, it was great to talk with you. This was really fun.

Jamie 27:46
Reed, we'll no doubt have to have you back on because this is one of those topics people love to hear about. And I think that beekeepers really can't get enough of this. Everybody, that was Dr. Reed Johnson, an associate professor in the Department of Entomology at Ohio State University speaking with us about honey bee toxicology, but, specifically, risk assessments and how important risk assessments are to maintaining pollinator health and safety.

Amy 28:17
Broadcasting from Gainesville, Florida, this is Two Bees in a Pod. Have questions or comments? Don't forget to like and follow us on Facebook, Instagram and Twitter @UFhoneybeelab. Today, in our Five Minute Management, we are going to be talking about common arthropod pests of honey bee colonies. Jamie, what's an arthropod? I know what it is, but I'm going to have you answer.

Jamie 28:57
I'm scared to answer because if I answer, are you gonna hold this against my five minutes?

Amy 29:01
I mean, no. I won't.

Jamie 29:02
Okay, good.

Amy 29:03
Yeah, so answer that and then I'll start the five minutes.

Jamie 29:06
Arthropod means jointed foot. So, arthropods are critters with jointed feet. I know that's not very helpful. But to give you some examples, those would be insects, spiders, mites, things like that. And so, when you and I were originally thinking about this Five Minute Management, we were thinking we were going to just do insect pests, but then I was like, "Well, that doesn't allow me to do spiders or mites." So, we broadened it to just say arthropod pests. So, arthropod pests would be, at least for purposes of today's Five Minute Management, insects, spiders and mites.

Amy 29:51
Awesome. Okay, so tell us about some common arthropod pests that people would see in their honey bee colonies. And I'm going to start the timer right now.

Jamie 30:00

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Yeah, so when I saw this one, and in preparation for it, I got nervous because there's so many. So, I'm worried that I can't do it in five minutes, which means I should stop rambling and get right to it, right? So, we'll start with common insect pests that you might see in your honey bee colonies or around your honey bee colonies. Those would include wax moths, righ? There's two species of wax moth, greater and lesser wax moths. Both of them inhabit honey bee colonies and eat the wax. We all know about those. There's beetle pests. There's a small hive beetle that most beekeepers around the world know about these days. And the reason it is called a small hive beetle is because there first was a larger beetle that shows up in colonies that, now, it carries the name large hive beetle. And a large hive beetle is a fancy term that we give for any scarab beetle that shows up in honey bee colonies. So, very quickly, some scarab beetles can show up in bee colonies around the world. They usually go in after pollen and nectar. And because they were discovered first, we gave the smaller beetle the name small hive beetle, and it is the bigger of the two problems. The smaller of the two beetles but the bigger of the two problems. No, it's not complicated at all, right? So, small hive beetles can lay eggs, the females can lay eggs in our hives, their larvae go through our hives and eat pollen, nectar, bee brood and just can cause complete colony collapse. So, there's two beetles, small hive beetles and large hive beetle. And just to make it even more confusing, large hive beetle is not a single species of scarab that causes problems but multiple species depending on where you live. Now, that's moths, that's beetles. There are also wasps that show up at our colonies in the US. That can be bald-faced hornets or yellow jackets around the world. There are other types of yellow jackets that do as well. There's also, of course, everybody's favorite topic these days, Asian Hornets, as well as Asian giant hornets, both species of which can attack honey bees. There are also fly problems. In fact, I just got a question from a reader of a column that I write for American Bee Journal who was asking about a fly that shows up at their colony. This particular fly is a robber fly. If you listeners out there Google "robber fly honey bee" you're going to see a fly that looks a lot like a bumble bee but that consumes honey bees. This is one species of a member of a family of flies called robber flies, they capture their prey while they're flying. They've got legs with these spikes on them, they'll fly and capture their prey, land on something, pierce their prey with a beak-like mouth parts that they have and then eat the soft tissues from the inside of those bees. And there's a robber fly that does this specifically to honey bees. There are types of bugs that feed on honey bees. And I'm not using bug in the general sense as any type of insect. I mean the actual group of insects that we call bugs. There's one type of assassin bug that will feed on honey bees. There's lots of species, for that matter, of assassin bugs that will feed on honey bees. Where we live in Florida, there's a wheel bug assassin bug that you'll see commonly around your colonies feeding on honey bees, and I haven't even spoken about ants. Lots of different species of ants that can attack honey bee colonies. And that's just insects. I'm not even including other honey bees as arthropod pests of your honey bee colonies. Now, we have to consider spiders, lots of spiders that might build webs around your honey bee colonies. There are jumping spiders that will live in your honey bee colonies. There's ambush spiders that will live in and around your honey bee colonies, spiders, spiders, spiders, spiders that can eat your bees. And the worst group of arthropods that can impact your bees would be the mites. Tracheal mites that live in the breeding tubes of bees, Tropilaelaps mites, which currently exclusively occur in Asian species of honey bees. And then, of course, everyone's favorite arthropod pest of honey bee colonies, the mite Varroa destructor, which really needs no introduction. So, there's lots and lots of arthropods that are trying to take advantage of our honey bees, and I've only scratched the surface. I haven't even talked about some types of flies that can lay eggs on bees whose larvae go into the bee and eat the bees from the inside out and just more and more and more octopods. Amy, we

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could go over days, but I just wanted to hit some of the highlights and make folks aware of some of the types of arthropods that are going after their bees.

Amy 35:03
Wow. I don't know if you've ever hit five minutes exactly. But if anyone timed that segment, they would have gotten five minutes.

Jamie 35:11
Oh man, I should do like a celebratory dance or something.

Amy 35:16
We should get like a clap, you know, some sort of clap sound so that we can add it to the podcast. Thank you so much for joining us on the Five Minute Management discussing common arthropod pests of honey bee colonies.

Stump The Chump 35:39
It's everybody's favorite game show, Stump the Chump.

Amy 35:56
Welcome to the question and answer segment. The first question for today, this listener was asking about peak season and how a queen can lay over 3000 eggs a day, and that's more than her own body weight in eggs a day. So, does anyone know the daily caloric use for queen laying? And what is that? I don't even know what that means.

Jamie 36:18
You know, I think our segment opening jingle is called Stump the Chump, you know the guy. So, what I'm going to say is off of the top of my head, I do not know what the caloric intake of a queen honey bee is because the listener is correct. If a queen is cranking out 2000 to 3000 eggs a day, she is cranking out so many eggs in weight relative to her own weight. So, that's why queens get so much attendance by their workers, because the workers are around her feeding that queen nonstop so that she can keep up the egg output. So, the questioner is specifically asking, like, what's the caloric intake of a queen relative to being able to produce 2000 to 3000 eggs? So, I don't know off the top of my head. So, what I wanted to do with our listeners is I would like our listeners out there to try to see if you can find some sort of refereed manuscript that references the caloric intake of a queen, how much energy does she need to take in relative to the weight of eggs that she puts out? So, basically, Amy, this is crowdsourcing. We are crowdsourcing this question. We're going to ask you listeners out there to see if you can find an answer. If you find an article, submit the link to the article, either in our social media account or through our lab email address, and we'll do our best to revisit this if we find a conclusive answer. If we don't find a conclusive answer, there's two things I can say. Number one, it would make a great research project, and number two, you stumped the chump. So, let's crowdsource and see if we can find the answer.

Amy 38:00
That's fair. Yeah, it really is truly amazing that she can lay that many eggs. And she's so tiny. It's crazy. All right. Well, so the second question that we have, this person's a new beekeeper, and they don't

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have any extra drawn frames. Is it worth their time and money to melt down a pound of wax in their crock pot and paint the frames to help them use the foundation? Is this common?

Jamie 38:24
Yeah, so I'm going to answer your question, first, your question and then the one they asked. So, yeah, it is actually common. So, Amy, there's a lot of foundation types today. There's this, basically, this hard plastic foundation with hexagonal imprints molded into the plastic that if you purchase from an equipment supplier, comes with a thin coating of beeswax already on it. And some commercial beekeepers discovered years ago that if you coat it with more beeswax, the bees are able to pull it out quicker, potentially, or accept it more readily. And I will tell you that I have never added an extra coating of beeswax to the already beeswax-coated hard plastic foundation because anytime I'm getting bees new foundation, it is during the major nectar flow and the bees are already hardwired to pull out that foundation anyway. I don't see any delay in their acceptance of that foundation. Now, a lot of folks would say, "Jamie that works well during a major nectar flow, but outside of a major nectar flow, bees aren't going to want to pull it really well unless you add that extra beeswax." So, the questioner is specifically saying, "Is it worth my time and money to do this?" I would argue that it's not if you are trying to get them to pull that outside of a major nectar flow. So, you know, we happen to be recording this in August of 2021. And I would argue that it's going to be hard to get bees to pull comb this time of year, even if you add that extra coating of beeswax. That said, you know, there may be a little bit of benefit to adding wax to get them to give more attention to it during the honey flow, but I've just never had to do it. I've never experienced this problem. But a lot of commercial beekeepers swear by it. I've also never seen a research project on it either. So, it's just one of those things that a lot of people feel like they get a benefit from doing. I just would say, on the small scale, that it's probably not worth doing. I just try to time the pulling of my foundation, either when I'm starting new colonies and they want to pull anyway, or when the major nectar flow is cranking up and they want to pull it anyway as well.

Amy 40:42
Alright, that's fair. Okay, so, for the third question that we have, this person was looking at -- they were reading on the different colors that bees could see and painted nucs, this person painted their nucs those colors. Is there anything that shows that this prevents drifting? Or, you know, what's up with bees? And what's the deal with the colors they can see, and how do we paint our equipment so that they know how to get home?

Jamie 41:11
Yes, so bees can see certain colors better than they can see other colors. For example, bees cannot see the color red. You know, they don't see very far to the red spectrum. Humans see far into the red spectrum. So, we see red as red but bees see red as black. On the other hand, bees see further into the ultraviolet spectrum than we do. So, they're able to see things in color palettes, as it were, that we cannot see. So, as a result, if you paint hives different colors, but colors that are within the bees' spectrum, it can help reduce drifting. Bees can also determine certain patterns, or sorry, distinguish between certain patterns, but not other patterns. So, if you know what those patterns are, you can paint different color pattern combinations on the outside of your hives, and then again, further reduce drift. I will tell you, this is just kind of from experience in our own research apiaries when you're keeping, you know, a handful of colonies or more in the same apiary, you're going to have a reasonable amount of drift, regardless of the color or patterns that you put on those hives. But when we do our research

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projects, and we need to minimize drift between groups, notice I use the word minimize and not eliminate, but when we need to minimize drift between treatment groups of colonies, we will often use pattern and color strategies to try to make, at least, colonies within a treatment look different from colonies within another treatment, again, in an effort to keep bees from moving back and forth between the treatments. It doesn't eliminate drifting, but it can reduce it.

Amy 43:01
Alright, well thank you so much. And everyone, those were our question and answers. Keep those questions coming. We've got a long list that we're still getting to but we always love receiving more. Hi, everyone. Thanks for listening today. We'd like to give an extra special thank you to our podcast coordinator, Chelsea Baca, and to our audio engineer James Weaver. Without their hard work, Two Bees in a Podcast would not be possible.

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