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SPEAKERS

Guest, Jamie, Amy, Guest 3, Guest 2, Stump The Chump

Jamie 00:10

Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast. Hello, everyone and welcome to another episode of Two Bees in a Podcast. In this episode, we're joined by Dr. Jennifer Han, Dr. Nick Naeger, and Dr. Steve Sheppard, all from Washington State University. They'll be with us talking about the use of Metarhizium fungus as a biological control for Varroa. In our Five Minute Management we're going to be talking about making honey, and then we'll finish today's episode with our question and answer segment. Hello, everyone and welcome to another segment of Two Bees in a Podcast. All of you beekeepers out there absolutely hate Varroa. You hate Varroa. I hate Varroa. Amy, do you hate Varroa?

Amy 01:39

I really hate Varroa.

Jamie 01:41

Well, see, we all hate it. We are all trying to find ways to attack Varroa. Well, there's been a lot of interesting research coming out lately about biological control of Varroa, specifically with fungal pathogens. And joining us for this segment of Two Bees in a Podcast are actually three guests all from the Department of Entomology at Washington State University. And they are Dr. Jennifer Han, who's a Research Assistant Professor, Dr. Nick Naeger, who is a Research Assistant Professor, and Dr. Steve Sheppard, a Thurber Professor of Entomology. Jennifer, Steve, and Nick, thank you so much for joining us on Two Bees in a Podcast.

Guest 02:17

Thank you for having us.

Guest 2 02:19
Yep, thanks.

Amy 02:21
Alright, so I get, as the Extension Coordinator, I get a lot of phone calls, we do a lot of programs and workshops, and something that people are always asking is are there biological controls of Varroa? And so before we actually get into the topic of conversation, we always like to introduce our guests and have our guests speak a little bit about themselves. So why don't we go ahead and start with Dr. Han. How did you get into honey bee work?

Guest 02:49
So, unlike Dr. Nick Naegar and Dr. Sheppard, I think my path to this research is a little bit more circuitous. I actually got into this work because of my interest in the fungal side of this project. So my background is in plant breeding and genomics. And so I was brought in to deal with the fungal breeding and genomic side of this project.

Amy 03:12
Very cool. What about you, Dr. Nick?

Guest 2 03:15
So I got into honey bees about 20 years ago now. When I was doing my undergrad work in genetics, I was looking for a lab to work in. I found the honey bee lab almost by accident. And from my first day visiting, I wanted to work there. The animal was just so interesting, and it had so much potential for new genetics and neuroscience and all of this interesting research, in addition to being so economically important. So, since that day of kind of discovering honey bees, I've centered my career around it. Although, I have done different sorts of work, some much more into pure research about how instincts are wired into bee brains and so on. But I'm very happy to be working in applied research right now and trying to do something to make the situation better.

Amy 04:10
Very cool. What about you, Dr. Steve Sheppard?

Guest 3 04:13
I guess we have to go back a little bit farther. When I was a child, my great grandfather had been a beekeeper, he had passed away when I was a year old. I grew up playing with bee equipment that I didn't know really what it was. He had a trailer, he had an extractor, he had hives made from apple crates. And so as an undergraduate a little more than 20 years ago, Nick, I was able to take a beekeeping class at the University of Georgia from Dr. Alfred Dietz and kind of got hooked as an undergraduate and went on from there to go to graduate school and study honey bees in Illinois.

Jamie 04:57

Well, Steve, I think all great things come out of Georgia. So I think going to Georgia is really not a bad thing.

Guest 3 05:04
Yeah, yeah.

Jamie 05:06
I always enjoy listening to folks talk about how they got into bees. It's always interesting. You get a lot of folks get in it from a purely academic standpoint through the universities. And it's just neat to hear how all three of you have a diverse entry into the world of bees and how you ultimately got hooked. So let's focus a little bit on the research we're actually bringing you on to discuss. So you recently published a paper as a team on entomopathogenic fungi and how that impacts Varroa destructor. So first of all, can you tell us what type of organism entomopathogenic fungus actually is? What does that big, fancy name even mean in the first place?

Guest 05:46
And the question is what is an entomopathogenic fungi. And I guess, if you break down the word, you can break it down to entomo and pathogenic. We understand pathogenic can be short for pathogen and entomo for entomology. So these are pathogens to a lot of the insects that we see in our world. If you think about what it looks like, and how maybe people have been introduced to entomopathogenic fungi, some people may have heard of things called like, the zombie ant. Right? So this is a cordycep, it's a fungus that can infect ants, and, as they say, control their brain or something like that. I don't know if you guys have heard recently with the cicada emergence this year, there's an entomopathogenic fungi that attack cicadas, and it's colloquially called the "salt shaker of death." So these are all interesting and diverse fungi that exist.

Amy 06:38
Those are very intense names.

Guest 06:41
Yes.

Jamie 06:42
I know. I can't imagine a salt shaker. I don't even want to know. There's this joke, Amy, assault with a deadly weapon, bah dum tsss.

Amy 06:49
Oh, my goodness.

Jamie 06:51
Let's move on. Let's move on. Why do they call it the salt shaker of death? I feel like I need to know.

Guest 06:56

Well, so cicadas are underground for most of their life cycles. And when that happens, they can get infected by this fungus. And this happens to the males. And what it does, is it, my understanding is it consumes basically the male cicadas abdomen and so when it emerges, it has no sexual reproduction parts or anything like that. Its abdomen is more or less just fungus. And as it flies around, it is spreading spores of that fungus infecting its other cicada friends.

Jamie 07:27
Salt shaker, I get it, I get it.

Amy 07:29
Ew. That's so gross.

Jamie 07:31
It's disgusting. But I get it.

Guest 07:33
It's so cool.

Amy 07:35
Oh, geez. Okay, well, I'm really glad you explained the pathogenic and entomo because when you look at the word entomopathogenic, it looks like it's a very difficult word to say. And I probably would not be able to say it five times in a row. But breaking it down into the pathogen and entomology, now I feel like I could say it a million times, and I'm good to go. But you all just recently published the paper on entomopathogenic, look, now, I can't say it. So you all recently --

Jamie 08:03
You set yourself up for that one, Amy. We all saw that one coming.

Amy 08:09
So you all published a paper on this fungi and discussed how Varroa destructor is susceptible to it. Can one of you describe your study, and just a little bit about what you looked at, what you were looking for, and some of the findings that you had?

Guest 2 08:26
I'll answer that one. So, as a little bit of background, about 20 to 30 years ago, a few different labs, including some in the USDA, began looking at using entomopathogenic fungi to kill Varroa. There were fungi on the market that were known for killing mites and a few beekeepers have discovered that there was some effect when they treated their hives with these off the shelf fungi that were available to kill other mites and other arthropods. Well, there are these issues with strain variability, consistency of action, and so on. And so these efforts were largely abandoned. So then we came in, we took a look at what had been done previously and decided that the main problem was the strains of fungus that they were using. And indeed some of the work by the USDA has shown that these fungi could infect and kill Varroa, it was relatively safe for bees, but the biggest problem was that the fungi died in the heat of the

hives. So I imagine a lot of listeners will know bee hives are quite hot. They keep it thermo regulated for their brood, and it ends up being 95 degrees Fahrenheit. It's quite hot. And the problem was is that killed the fungus. And so a treatment window of duration would only be a couple of days because fungi that was put into the hive was killed by the conditions in the hive. So we picked up the laborious process of trying to breed a fungus better suited to live in bee hives, and hopefully, kill Varroa better with a longer window of treatment per treatment, and so on in a way that hopefully, we would have developed a Varroa treatment that is extremely bee safe. And I'm very glad to say that after two plus years of work and screening about 30,000 mites for infection and so on, we did succeed in isolating new lines that do survive quite well in the beehive and do seem to control Varroa well.

Guest 3 10:39
Yeah, and I'd like to add to what what Nick said, especially the part about that it kills mites, because one of the difficult tasks that maybe Nick and Jen haven't let you know is the idea of screening the mites that killed, that are killed by the fungus. When we started early on, mites would fall down, and some proportion of those mites, you could grow the fungus out of, meaning they died from the fungus. And one of the innovative things that Nick and Jen did was selected those mites generation after generation through the beehive. So they're selecting the fungus, basically, that has more and more virulence. And so now the fungus, when you put it in the hive, a bunch of mites fall, and they are almost all killed by the fungus itself. So we went from a lab that had, for years had been breeding bees to now, we're basically breeding a fungus to do its job the way that we want it to. And the other thing, one of the reasons that this fungus couldn't withstand high temperatures is because it's naturally a soil dwelling fungus. And it's a little bit out of its element when you put it in a beehive. Both the selection for virulence and the selection for heat tolerance is sort of the innovative part of this.

Guest 2 12:12
Steve had mentioned that this is typically a soil borne fungus. And soil is cool, and that's one of the reasons it did not like the temperatures found in beehives. One of the advantages of developing this fungus, Metarhizium, as a product is because it is already found across all of the US and really around the world. It's an extremely common soil fungus, and in fact, is one of the top two most common ones we find here in Pullman, where we do the research. So it's very good to know that as we develop this as a biopesticide, we are not introducing anything new to the environment in that way. It's already here in the soils as it is around the US. And so the chance of any sort of dangerous environmental escape seems quite low.

Jamie 13:02
So I think anytime folks talk about biological control, they're often thinking, well, you know, you guys have done a lot of work, you found a strain, that's really good. You know it kills Varroa but it doesn't kill bees, that's great. You're using a species that's native to your soils, potentially spread around the world, but can it harm mites that we actually want? Have you increased the virulence of something that might impact mites that themselves are native and otherwise not harmful? How do you kind of account for that in your research?

Guest 2 13:33

Well, one of the things that we have found is that when Varroa get infected by Metarhizium, they tend to fall off of the bee and spend the last few hours of life on the bottom board of the hive. At that point, the conditions on the bottom board are not extremely humid, it tends to be quite dry. And Varroa mites are quite small, and they do not hold a lot of water. So one of the things that we see is when we treat the hive with spores, the fungus does not regrow and produce spores out of the mite. The mite's a little too small and a little too dry for the fungus to complete its lifecycle. So that gives us an advantage in that whatever we put into the hive tends not to stay alive for more than several months before it disappears. And the fungus does not appear to produce new spores within the hive. So again, we're hoping that everything being contained in the beehive, the fact that the lifecycle seems truncated by the fact that it can't really reproduce spores out of the mite until we take it into the lab, it seems that those concerns are extremely low for a biological control agent.

Jamie 14:45
Well, how does this Metarhizium kill Varroa? Have you guys worked that out? What makes it capable of being harmful to Varroa if it's already cosmopolitan in distribution, what is it doing to Varroa that allows it to get a foothold in them?

Guest 14:58
So Metarhizium is a fairly well-studied fungi because it's been used for lots of different biological control situations. Metarhizium is a genus of several different species, some of which are more generalist, some of which are more specific. So the Metarhizium that we are looking at is a generalist, and so it is capable of infecting Varroa and the mode of infection has been fairly well-studied. I don't know if people are super interested in this, but I can get into it in brief.

Jamie 15:33
Yeah, let's hear it. I'm interested.

Guest 15:35
All right. It's pretty neat. So what happens is a spore lands on the cuticle of the Varroa and there are different, I guess, different chemical cues and other cues that helps a spore know that it has landed on a suitable surface. So there's different, like, hydrophobic interactions between the spore and the cuticle and then there are different protein and other interactions. And once it lands on the cuticle, it knows that it's in the right spot, it begins to germinate. And this is true of a lot of pathogens where it grows what we call like an infection peg at the end, a technical term, appressorium. Basically, it's a swollen bit of hyphae at the end of the germination tube. And from there, an infection peg grows, which is basically, I guess, what would be most analogous to most people is if you think of the way a seed germinates. It first starts to grow some roots, and so you can think of like the germination tube and the infection peg is almost like roots from the spore burrowing down into the Varroa. And so, it does, it busts through the cuticle of the Varroa, and inside, once it's inside the organism, it proliferates through various means. And then once it kills the insect from the inside out, it busts through the exoskeleton again, where it produces spores, where it can do the lifecycle all over. And one of the interesting things about Metarhizium is it produces this chemical, especially Metarhizium Brunneum, it produces a chemical called destruxins. If you can guess by the name, it's quite destructive, if you will. And so these

destruxins are released once the fungus gets inside the Varroa, and it helps to lower the immune system of the host, in this case, of Varroa, to make it easier for the Metarhizium to grow.

Jamie 17:28
I think I love this idea that Varroa destructor is killed by this fungus' toxin called destruxins. I mean, that's just pretty stinking cool, right? We were fortunate they were similar.

Amy 17:42
They're like, yeah, okay, Jamie.

Guest 2 17:45
And we are also fortunate that the toxins that this fungus produce that act as pesticides are only produced after it infects a suitable host. So it only produces these toxins when it's inside the Varroa, and so once again, even if bees consume the spores directly, lick them off of their body and eat them, that seems to deactivate the spores, and the bees seem no worse for wear having done so.

Amy 18:14
I feel like I have so many questions about this whole process, but I'm going to move on to the next question just to ask, so you say that the spores are already naturally found in the ground. And so would a beekeeper just take a spoonful of soil and go into their colonies and just start sprinkling the soil on it? How does this research apply to the honey bees and the beekeepers? And what does the actual application of this look like?

Guest 18:42
Well, I suppose you could spoon some soil over your bees. However, the concentration of Metarhizium that's in the soil is not high enough where I think you would see any sort of effect whatsoever. So what you could do is isolate it from the soil, grow it up in pure culture, grow up a whole bunch of it to treat, but the way that we have been treating our bees, at least for the paper, what we first did was very scientific lab stuff where we grew it up on petri dishes in the lab. But as we move forward, and what we're doing now is we're trying to look at ways that we can make this a real viable product for beekeepers, because growing them on petri dishes is fine for an experiment, but it's not a feasible solution for large scale production. So what we are doing now is looking at different growing mediums, including different types of grain and different amendments to the grain so that we can grow the Metarhizium in bulk. And the idea is that we will then develop a way to treat the hives using the grain that's been colonized by the Metarhizium.

Guest 2 19:55
Yeah, so we have some experiments going right now where we have grown Metarhizium on different grains that it seems happy to grow on. And we are testing them in hives using different methods of bags, strips, grease patties, a lot of things that beekeepers would recognize as ways that they've treated hives in the past. And hopefully, this will develop a very user friendly delivery method, ones that the bees can access in the right way to help spread the spores around, but not in a way that they clean the whole treatment out of the hive too quickly. So that's kind of the current challenge is finding the way

to mass produce it, which definitely seems doable, and then finding a way to get it into the hive in a way that the bees work it in the correct way. And that also seems quite doable. So hopefully just another year or two of work, and we can begin to approach the EPA about a product formulation to get out there to beekeepers.

Amy 20:56
Sure, and also something that could be potentially lower cost, I guess, to beekeepers.

Guest 2 21:03
Yes, absolutely. With the way we ran our initial experiments, the cost per treatment would have been too high. It was laboratory, tightly controlled growth media that we were using. But even from the initial conception of this project, we've always wanted to do this not as a scientific endeavor, but really hoping to get something to help the bee situation. We all know just how deadly Varroa is and the prospect of miticide resistance kind of coming up to the last few chemicals like Amitraz, it seems to be working. We just, we need something else to help the bees out. And so yeah, it's always been our goal to try to push this into a product.

Jamie 21:51
Well, let me ask the all important question here. What level of control are you getting? Are we above 50%, 75%, 90%? And what length of time do you see that control maintained? So is it you treat it, you don't have to try it again for two months, three weeks? What are you seeing kind of through your research?

Guest 2 22:11
Well, in our initial papers, we were comparing the fungus to an untreated control colony. And we learned that that's a bad idea, because untreated Varroa colonies just reinfect everything in the area over and over, and it's hard to keep anything in that apiary alive. So since then, we've transitioned into comparing it to EPA approved existing treatments. And so last year, or two years ago, we did a series of experiments that compared the Metarhizium treatment with our best delivery method that we had going at the time, which was bags of Metarhizium grain. We compared it to oxalic acid, and we actually got comparable control. It was actually trending towards Metarhizium controlling mites a little bit better than the oxalic acid drip. But that was just over one summer. But it was promising enough that we're kind of following it up now with another experiment where we're testing different growth and delivery methods. And because the fungus is so safe for humans, we're pretty sure that we can get it approved for use during the honey flow. So currently, we are comparing it against another product that can be used during the honey flow, which is Hopguard. So we've already shown that it did as well as oxalic acid. We're now hoping that, even though we're tinkering with delivery methods along the way, we're comparing it against Hopguard. So far, I'd say it's pretty -- that the fungus is really good at knocking down mites along the way, but it is going to have the problem where the spores cannot get through the brood cap. So a certain number of the mites are going to be hidden away from the fungus and protected from the treatment. And so some of what I'm saying is I do not think this is going to be one of those treatments that will save a hive that already has bad Varroa in it. But what we can do is knock down the population continuously throughout the months, keep that population low, and hopefully, in

that way, if a hive does reach threshold where a chemical treatment needs made, well, hopefully that's only once a year, instead of three times a year or seven times a year like we've been hearing about. I don't know if this will be an ultimate cure for Varroa in that way, but another tool that beekeepers can use to help keep Varroa levels low without harming the bees any.

Guest 3 24:45
Yeah. Hey, this is Steve. I'd like to to add, sort of, to Amy's question about registration, which is one of the encouraging things to us is that there are a number of Metarhizium treatments that are or have been approved by EPA, including I believe, Nick and Jen will correct me, in food service. So for, I know for grasshopper control, carpenter ant control and there may be some others. It's basically modified through standard breeding and selection methods, not through some sort of molecular genetic manipulation to strains that are already approved. So, we don't think it'll be a big hurdle to reach registration.

Amy 25:32
Wait, what are you talking about, insects and food service?

Guest 25:38
There are no bug legs in any of the food that I eat.

Guest 3 25:43
Yeah, well, I think Jen knows better. But there is a strain that's approved for use, I believe, in kitchens and inside structures where people are.

Amy 25:54
Alright, that's a topic for -- we'll have to bring you back to discuss that another time. I have one last question. This is going to be the most difficult question you have for today. Is it fungi or fungi?

Guest 26:08
I don't know if there's an approved fungi or fungi? I don't know. It's more fun to say fungi.

Guest 3 26:18
Jennifer teaches a course at Washington State University.

Amy 26:21
That's why I was asking. Well, Jamie thinks he's a fun guy.

Jamie 26:27
Fungus joke. So I've actually heard it "fun-jee" which I think I said earlier, "fun guy." Yeah, I've heard it so many ways. I feel like it's whatever's rolling off the tongue at any moment, right?

Guest 26:39
Yeah, I'm a fun gal. So, you know.

Jamie 26:44
So, guys one of the benefits here is that there can be continuous selection for efficacy. And even though we're all bee people, our listeners are bee people, we want to see Varroa mites die, the research that you've done is also relevant to other pests, other mite pests as an example, because of the strategy that you use to select this specifically for Varroa. Could you guys comment, maybe, on both points, the idea that there's continuous selection, and that it might have some spillover interest for other mite pests or other pests in general?

Guest 3 27:12
Sure, I'll comment on the first part there. That idea of selecting continuously for virulence is one that could be adapted to other sorts of biocontrol organisms. And I think it's really one of the innovative parts here that if there is a chance that the Varroa would be developing, say, some sort of tolerance, or you would be selecting from strains of Varroa that might be able to have thicker cuticles or whatever is going on. The fact that we are continuing to select for virulence, through generations of the host, in this case, the mite, allows us to sort of keep up with whatever defenses the host might be coming up with.

Guest 27:57
I would also like to add in that continual selection for efficacy, there's a lot of research that shows that if you grow some of these fungi, specifically Metarhizium, on artificial medium, it loses its virulence after a few generations. So it is imperative that we reintroduce it to the host, in this case, Varroa periodically, so it maintains its virulence. Because if we just keep doing selections in the lab, we will lose that bit.

Guest 2 28:23
When it comes to entomopathogenic fungi being used in the real world, what's frequently cited as a limitation to these systems is that the fungi are susceptible to heat, UV radiation from the sun, things like that, these different abiotic stressors. And so one of the things that's very exciting about this research is we have shown that we can select for strains that are more resistant to heat and sunlight and so on. And so we hope that not only will this become a new tool to help bees, but we've kind of demonstrated that there's an untapped ability in these fungi to do better than the currently existing strains. So we could begin to select for strains that are better pathogens of other mites. As Steve mentioned, the two spotted spider mite is a prime candidate. But we can also kind of develop biopesticides to just do better in field situations. This sort of selective breeding has a lot of promise to develop these strings beyond what we just find naturally, but to actually domesticate them much like we've domesticated plants and turn them from an okay wild variety to something that is extremely useful for humans and agriculture.

Amy 29:48
So how were you able to demonstrate that this was safe for bees?

Guest 2 29:53
We have done a lot of experiments with bees in cages where we dosed them with a certain levels of Metarhizium. And we followed that up with various tests of health and function. What we find is that

when we give bees a typical or even a somewhat higher dose than what we they get in the hive, the bees do very well. And in fact, sometimes they even live a little bit longer in the cages. So the bees do extremely well until we start giving them mega doses. We have been interested to know like, how much can a bee tolerate before it does get sick? And the answer is a lot, probably 100 times higher than what we apply in the hive. And even then, the bees do not seem susceptible to the fungus in a typical way. Instead, these really high doses seem to begin to give them intestinal issues, and they get dysentery and things like that.

Guest 30:54
So when Nick says a high dose, what we did was the dose that we were giving a typical two deep hive, we gave to a cage of bees. And that is when we start to see dysentery. So that's the scale that you want to think about.

Guest 2 31:09
Yes, so we can easily give the bees 10 times or even 100 times higher dose than what we're getting good control of Varroa in the hive with and the bees still seem remarkably well off and unaffected by it. We do not know exactly why bees seem immune to this fungus. But we think it's a combination of intrinsic physiological immune factors and behavioral and external factors. Jennifer mentioned that for this fungus to infect an animal it has to make contact with the cuticle, the exoskeleton of the arthropod. And bees are so hairy that a lot of the spores are kept away from the exoskeleton. And the bees are also excellent groomers where not only are they removing the spores, but if the spores do happen to germinate as they're growing these little infection peg groups, if the bees groom, it breaks it and kills the fungus. So we think that this combination of hairy bees, good grooming behaviors, nice hygenic behaviors in the hive, and then intrinsic immune function, like the combination of all of that makes bees extremely resistant to infection by Metarhizium.

Amy 32:28
I feel like every time we've got new research coming out, I'm just amazed by everything that you all are working on. It's really inspirational to see. I'm sure a lot of the listeners would agree with me. I mean, I guess we wouldn't have even thought about fungus being a biological control for Varroa but it's really neat to hear all the work that you all are doing.

Guest 2 32:49
All right. Well, thank you very much.

Jamie 32:51
So guys, that was fantastic. Our beekeepers are always looking for ways to kill Varroa. It's really neat to see that you guys are working with entomopathogenic fungi. There I said it, instead of fungi or fungi. I'm so grateful that you guys set it straight on how to say it correctly. Nevertheless, I really appreciate the work that you guys are doing. And thank you so much for joining us on this segment of Two Bees in a Podcast.

Guest 33:12

Thank you for having us. It's been a really great time.

Guest 3 33:15
It's been a pleasure.

Guest 2 33:16
Yes, thank you.

Jamie 33:16
Absolutely. Everyone, that was three faculty members in the Department of Entomology at Washington State University, Dr. Jennifer Han, a Research Assistant Professor, Dr. Steve Sheppard, a Thurber Professor of Entomology and Dr. Nick Naeger, who's a Research Assistant Professor all working on the biological control of Varroa with fungal pathogens.

Amy 33:47
You're listening to Two Bees in a Pod brought to you by the University of Florida's Institute of Food and Agricultural Sciences Honey Bee Research and Extension Laboratory. We are at our Five Minute Management. And I'm really excited because we are going to do the next four Five Minute Managements on honey. And I feel like sometimes we forget about the honey part of it, Jamie. I feel like honey bees, of course people think of honey, but then you get into bee research and then you kind of forget about the honey sometimes. So I'm excited for the next couple of Five Minute Managements.

Jamie 34:33
I think it's funny you mentioned that because since we've been doing the podcast, I don't remember doing an episode at all on making honey.

Amy 34:40
On honey. I know.

Jamie 34:41
It seems like that's so important.

Amy 34:42
I know. Alright. Well --

Jamie 34:46
If you're listening, this was all on purpose. It's all by design. We're on top of it.

Amy 34:50
Exactly. Okay, so the first segment we're going to do is on making honey. So I'm going to go ahead and start the five minute timer now. But Jamie, tell us about making honey.

Jamie 35:01

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All right, Amy. So to set the stage here, we're going to talk about making honey, and in future episodes, harvesting, processing and bottling honey. So this is exclusively about a couple of key pointers to remember when you are trying to get your bees to make honey. Key point number one, location, location, location. You cannot make honey in a desert where there are no plants. You've got to have nectarivorous, nectar producing plants in the area. And not just a few plants that produce some nectar, but a lot of plants that produce a lot of nectar. To illustrate this purpose, in Florida, I often get beekeepers who say, oh, I've got one citrus tree in my backyard, I'm going to make so much citrus honey this year. And I'm like, you're not going to even taste that nectar amongst your honey because it's going to be representing such a small part. You've got to have lots and lots of nectar producing plants in your area. So location, location, location. Number two, you've got to have strong colonies. And I know that sounds so stupid and straightforward, but two things go into strong colonies. Number one, queens, number two, disease and pest control. So queens first. You've got to have very productive queens who are laying lots of eggs and whose offspring are good workers, make populous colonies, collect a lot of honey, and store a lot of honey. So it takes good queens. So many beekeepers are satisfied just simply having a queen that they set their threshold for what she needs to do to be a successful queen quite low. So they won't remedy queen problems or failing queens or control swarming, all of these things that are frequent during honey production season. So you have got to be willing and ready to make sure your colonies are headed by good queen whose offspring display good characteristics. So the second part of strong colony is disease and pest control and let's just be honest here. That's principally about Varroa. Are Varroa controling your colonies? There are some other things, viruses small hive beetles, Nosema, other things, but Varroa will always be, at least in the immediate future, will be the principal issue that you've got to worry about from the pests and disease standpoint. Number one, it's a pest, number two, it transmits diseases. So disease and pest control helps produce strong colonies. And there's two more things I want to tell you about quickly. And one that supports a strong colony idea and that's Farr's principle. There's a scientist years ago, I believe in the 40s, if I'm not mistaken, who published a paper that showed bees in stronger colonies make more honey per bee than bees in weaker colonies. So it's not just because there's more bees to produce more honey, but because there's more bees, there are more efficient honey producers per bee. So having strong colonies is super important. And then finally, what might detract from the incoming sugar resources that are going into your hive? And, of course, the answer to that is the production of wax. Wax is a honey sink. So outside of honey production season, if you have wax combs that you use as your honey supers, you need to preserve that wax. All the wax being produced cost you honey. So when you're a new beekeeper, you want to produce that wax that first year to those honey supers that are going to be used year after year after year after year. And when they're not being used to produce honey, you need to protect them from wax moths so that your bees won't have to build it again next year. Location, location, location, strong colonies and protect your wax. Now, there's a lot of other things but those things are things that I think are very important when thinking about how to make as much honey as possible.

Amy 39:09
Wow. You got it done in less than five minutes. And you make it sound so easy, making honey, that's all you need.

Jamie 39:15
Strong colonies, Amy. You just put some bees in the right spot and keep strong colonies, you'll be okay.

Amy 39:20
Gosh, beekeeping is so easy. All right, well, I'm really excited. The next three Five Minute Managements will focus on honey harvesting, processing and bottling so stay tuned for our future episodes.

Stump The Chump 39:41
It's everybody's favorite game show, Stump the Chump.

Amy 39:58
Welcome to Stump the Chump. Jamie, number one, the first question, do honey bees respond to the release of CO_2 from people breathing?

Jamie 40:09
Absolutely. In fact, I've been told many, many, many times, so many times that I'm beginning to believe it's true, that when honey bee colonies become defensive, the defensive bees will actually cue into carbon dioxide and often try to attack the intruder there.

Amy 40:30
Oh, good.

Jamie 40:31
Yeah, exactly. And so here's a couple of things. I've always heard that bees, let's just say a colony that's getting very riled up and wants to attack someone because you're intruding in the hive, you're working the hive, the colony's upset about it. So I've always heard that there's two principal things, or maybe three, that they go after in these circumstances. Number one, dark colors. Number two, carbon dioxide emissions. And number three, movement. Movement shows them where you are, right? Dark colors, I've always been told, it doesn't matter what the color of the attacker is, they're almost always dark at their sensitive areas. Their nose, their eyes, their mouth, and their ears, right? There's almost always dark holes into the ears and up the nose and up in the mouth and dark eyes. And back to that very first one, CO_2. That's just concentrating the impact of the attack in an area where it will hurt us the worst, right? If we get stung on our arm, our stomach, our leg, we might decide to continue scraping all the honey out of the hive. But if we start getting stung around the nose and mouth, we're going to quit very quickly, right? And so, I've always been told and always read they are predisposed to attack areas where humans and other would be intruders emit CO_2. Again, just to maximize the impact and try to get that that invader, intruder away as quickly as possible.

Amy 42:01

Yeah, that makes sense. I actually had a bee sting my face and then crawl into my ear. And it was really gross and the sound and the vibration was so loud, I was wondering how far the bee burrowed into my ear.

Jamie 42:15
That's what I was wondering. How far did it go?

Amy 42:17
I don't know. I had one of my friends, it was a very bonding experience that we had, she had to stick her finger in my ear to pull this honey bee out. It felt like it was like close to my brain. I don't know. I don't really know how far it went. But anyway, that was an experience.

Jamie 42:31
I will tell you of all the places that I've been stung, and I've been stung, essentially everywhere at this point, of all the places I get stung, when I'm stung in that kind of like face circle from the chin to above the eyes, from one ear to the other, that circle of a face, that's where I hate being stung. And it almost always makes me stop doing what I'm doing and say I'll save this for another day.

Amy 42:56
Yep, me too. Okay, so for the second question that we have, I feel like I know the answer to this. But is there a correlation between the age of a queen and a hive and then the hive's general temperament?

Jamie 43:08
This is interesting, Amy, because in a recent Q&A, we also dealt with is there a correlation between the size of the hive, right, and the temperament? So now we're looking at it from a queen's perspective. So I did some literature searches. And again, my literature searches are not always perfect. There's other ways that you can find literature. But in my quick literature search, I didn't find anyone who studied the age of the queen related to the temperament of the hive. However, I will say, well, my gut tells me that there's no impact at all. First of all, the queen is always contributing her DNA to the worker, so the workers are half the queen. So if you think about the queen as a whole, the workers get half of that queen. Now, it might be random what half they get and what combination of the two halves they get, but they get half of the queen, and that's from the beginning of the queen laying an egg all the way until the queen dies, months or maybe years later. So her contributions shouldn't change the overall demeanor of a colony as she ages because it should be randomly distributed across her eggling. Now, the other half of temperament, then, would be the drones with which she mates. And let's just say for the sake of easy math that a queen mates with 10 drones. In theory, there could be, let's just say, two drones who are from colonies that are otherwise very defensive, and the other eight drones are from colonies that are very docile. So then 20% of your workers should be workers that are predisposed to be defensive and 80% not. So in theory, it should be pretty random what drone's sperm is fertilizing any given egg while the queen lays the egg.

Amy 44:47
It like rotates.

Jamie 44:48
Exactly, but early in the life, early in the queen's life, drone or semen in her spermatheca is not evenly mixed. It takes a while, maybe months before the semen gets even mixed. So she's not laying eggs, sorry, the drones fertilizing her eggs aren't so random at the very beginning of her egg laying, right? You might get detectable patterns, but about four or five, six months in, it's considerably more random because the semen is mixed. So under that scenario, you could envision an instance where she's fertilizing more often than not eggs from the more docile drones early in her life or later in her life, which would lead to a temperament change of the colony over her life. Again, it has nothing to do with the genetic potential in there, it just has to do with what semen's being used at a given time. But as she ages and that's thoroughly mixed, it would be completely random. And basically, the true colors of the colony would manifest at that point. Now, like I said, the last time I answered a question related to temperament, as queens age, brand new queens early in spring, they tend to head small colonies, and then the colonies tend to grow, grow, grow. So now you get these multiple competing variables. Is it the aging of the queen that's making the colony defensive? Or is it the fact that the colony is just simply bigger, right? But to make a long story short is I don't think there's any correlation between the queen and the temperament, the queen's age and the temperament of the hive. But I could certainly envision a few scenarios that might set that up based on the example that I gave of unequal fertilization of eggs, at least early in her life of the drones with which she mated.

Amy 46:36
Alright, so the third question we have, this is like the ultimate question. What do our bees need, what do they really need to stay healthy? That's like, that's the one question we all have, right?

Jamie 46:48
Yeah. So it's funny because the answer to that is exactly the same that I would say for humans and all critters, right? They need a good shelter. Right? Number one, they have to have a good place to live. And we could go on for days about this. But a good place to live mean the right size cavity, the right distance from the ground so it's protected from invaders, in the right location, close proximity to water forage, all the stuff. They need a good, secure, appropriate home, number one. Number two, once they're in that home, they need quality and abundant food resources, so quality and abundant nectar and pollen. So they can't live in an area that don't have lots of that, because if they don't have lots of that, they are not going to thrive, and they're going to die out during winter. They've got to be able to store enough to survive winter. And when it's not winter, they have to have enough incoming nectar and pollen to flourish when they have adequate food reserves at the right time of the year, they can overcome a lot of stress in their life. So shelter, abundant and high quality food, and then third, freedom from stress or minimized stress. So from the beekeepers --

Amy 48:16
Are you talking about bees or me?

Jamie 48:19

I was gonna say shelter, food and freedom from stress will make us all happy, right? But from a beekeeper's perspective, we are almost always talking about Varroa, right? And when I was going to answer this question, I was very tempted to make the third thing just freedom from Varroa. But I would argue that there are other significant stressors in the pathogen and pest world that honey bees can face. Varroa, viruses, beetles. I'm not saying that these things can't be in colonies, but they have to be in colonies at incredibly low levels or levels that the bees can manage because they're in a good shelter and have good food resources. So shelter, good shelter, good and large amounts of high quality food, and freedom from significant stressors such as Varroa, or significant climate threats, such as too much rain, too little rain, wildfire, things like that. So shelter, food and freedom from significant stress.

Amy 49:22
Alright, well, I think that's a pretty good answer. So I appreciate that. And listeners, I hope you continue to send in your questions to us whether on social media, send us an email, we'd love to hear from you. 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.