Episode 105_mixdown PROOFED

Thu, Aug 25, 2022 10:06AM • 48:02

SUMMARY KEYWORDS

bees, varroa, essential oils, foragers, pollen, nectar, honey bee, hive, bee, colony, question, amy, brood, beekeepers, propolis, mites, honey bees, selectivity, frames, deposited

SPEAKERS

Guest 2, Jamie, Guest, Stump The Chump, Amy, Serra Sowers

Jamie 00:10
Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast. Hello, everyone and welcome to another segment of Two Bees in a Podcast. Amy and I really are fortunate to be joined by two guests today. This topic, I think, will be very interesting to beekeepers really around the world, to all of our listeners. We are talking today about a new paper that has been published. The paper is entitled 'Evaluating the Efficacy of 30 Different Essential Oils Against Varroa Destructor and Honey Bee Workers,' and I think this is such a relevant topic, Amy, because every time I speak at a bee meeting, beekeepers will come up to me and talk to me about what essential oil cocktails they're using against Varroa. These two individuals who are our guests today actually studied 30 different essential oils to see how they impacted Varroa, as well as how they impacted honey bee workers. Those two individuals are Marian Hýbl and Petr Mraz, both are PhD students at the Faculty of Agriculture in the University of South Bohemia in the Czech Republic. Thank you both for joining us so much on Two Bees in a Podcast. It's good to have you both here.

Guest 02:01
Thank you.

Guest 2 02:03
Thank you.

Jamie 02:03
So, this is your first time joining our podcast. We're excited about having you, and every time we introduce new guests to our listeners, we like for our guests to spend a little bit of time talking about

how you started researching honey bees. Are you beekeepers, have you kept bees for a long time? Or did you just discover honey bees when you were at university? So could you both tell us a little bit about yourself and your background with honey bees?

Guest 02:33
Hi guys. So my name is Marian Hýbl. I come from Czech Republic, which is a small country in Central Europe. I'm currently finishing my PhD degree in České Budějovice bees department. I got into beekeeping and entomology at the University. I chose bees because they collect all the fields that I find interesting. The honey bee is a farm animal but participates in crop production. It's an environmental bioindicator. And last but not least, it produces bee products that have high nutritional value and great potential. After finishing my master's degree, I wanted to focus more on applied test rush and, therefore, I started studying my PhD degree where I started special techniques of bees. I focused mainly on experiments with live bees from cage experiments to experiments into environment of hives, and bee nutrition or queen breeding.

Jamie 03:52
I love the fact that you said that beekeeping is a topic that connects all the fields that you find interesting, Marian. I really agree with that. That's one of the things that attracts me to bee science, that it really does satisfy so many interests that I have. So that's really cool that you said that. Petr, how about yourself?

Guest 2 04:18
Okay, hello, my name is Petr Mraz, and I'm a PhD student of biotechnology and at the Faculty of Agriculture, University of South Bohemia in the Czech Republic. My interest in nature and ecology led me to beekeeping and it had been a similar course with my grandfather, whom I have helped with beekeeping since my child. This fascinated me so much that I decided to learn more about honey bees in my PhD studies. In my studies, I focused mostly on laboratory work, that is genetics, microbiology and honey bee in vitro experiments. I dealt mainly with alternative methods using essential oils to control honey bee pathogens such as mite Varroa destructor, bacteria, Paenibacillus larvae, or fungal pathogen.

Guest 05:11
After our first year of our PhD studies, Petr and I, together, found out that we had something to offer each other and started cooperating. While Petr is good at lab work, and has access to modern laboratories, I had access to university apiaries. So where they have good beekeeping backgrounds, for Applied Research together, we were able to carry out quite interesting experiments and projects, which would have been impossible with other individuals or places.

Amy 05:51
Yeah, it sounds like you guys make a good team with your strengths and with your background. So that's actually why we brought you on here today because you both together published a paper on essential oils, and how they fought against Varroa destructor. And so we're really excited to discuss your research today. You looked specifically at essential oils and their efficacy against Varroa and

honey bee workers. So can you just discuss a little bit about your methods, what you were looking at, and some of the oils that you chose, and maybe discuss why you chose some of the oils, because as Dr. Ellis mentioned earlier, beekeepers come to us all the time with different oils and different recipes that they have. And so we're interested to know what methods you used, which oils you chose, and why.

Guest 06:44
Yes. We selected some essential oils based on our previous research. When some research was already known with certain miticidal effects, some other essential oils were selected on the basis of normal acaracidal effects on other species of mites, or pests or some pathogens, and some oil simply found interesting. We put together 30 different essential oils that we suspected to might have some acaricidal effects, included them in this study, due to the fact that it is a relatively large number of substances refers to screen to them move for versatile activity.

Jamie 07:39
So when we looked at your manuscript as a research team, it was very fascinating to us that you were able to conduct a research project with 30 different essential oils. And I really liked your strategy about looking at the impacts of these essential oils overall, but also on bees because, in order for these things to be useful for beekeepers, they have to be able to kill Varroa but they have to be not so harmful to bees. So could you tell us a little bit about the method you used in your research? And number two, are all the modes of action for each of your essential oils similar? And then I've got this third question. I know this is a lot of questions at one time, but you also determine the LC50 for each essential oil for Varroa and bees, so could you tell us a little bit about that calculation as well?

Guest 2 08:35
Yes, of course. The investigated essential oils were tested by two metals. The screening was carried out by glass vial miticide and all essential oils showing more than 70% mite mortality in the screening test or they're subjected to further testing in the complete exposure methods. In the screening test, we started by diluting individual essential oils in acetone. Afterwards, the glass vials were rolled on their side and the acetone evaporated and essential oils traded as a film. Then, file vital female mites were placed in each glass where the most effective essential oils were included in the complete exposure assay. In this test, each of the essential oils were prepared based on the mortality of previous experiments with honey bees. Selected amount of essential oils was diluted in acetone. This solution was deposited on the bottom of petri dish and subsequently covered with filter paper. After an operation of the solvent, five vital adult honey bee workers were placed in each petri dish together with five vital female adult Varroa mites. Positive colony, thymol, and negative control, acetone, were included. Honey bee and mite mortality were assessed after 4, 24, 48 and 72 hours. The volumes of LC50 and selectivity ratio were calculated. Selectivity ratio is a ratio between the toxicity of given essential oils for mites and its toxicity for the bees. To determine the LC50 value, a two fold dilution series was established using half the amount of essential oils, the state in each experimental group. The volumes were calculated by probate analysis in a statistical program exhausted.

Amy 10:47

All right, so you screened with glass vial bio assays, you used five adult bees, you looked at 4, 24, 48, and 72 hours to look at the LC50. Of course, you did statistical analysis as as all researchers do. And so can you tell us about your results? What were the top five oils that you determined to be the most effective?

Guest 11:14
Yes, peppermint seems to be the best oil along with manuka. If we take, as the main indicator of suitability of essential oil, the highest two possible volume of selectivity ratio, and the end of the experiment and the growing trend of activity ratio value over time, so with this ratio value at the end of the experiment, approached the volume of data, which means the oils show 10 times higher toxicity to the mites than to the bees. Other interesting essential oils were oregano and litsea cubeba. Both essential oils show the value of over five. All these essential oils showed a significant trend in growth of the selected ratio value over time. This means that essential oil toxicity increased significantly with mite exposure time, but not with the bees. If we were to choose another suitable oil, I want to mention cinnamon, which had a selectivity ratio value of over 4.5 at the end of the experiment.

Jamie 12:44
That's really interesting to me that peppermint was really good and cinnamon. These are all things that people like to have in their candy but it's really neat to me that this was impacting bees as well. As you probably know, at least here in the US, and I know many other beekeepers around the world, thymol is an essential oil that is common for beekeepers to use against Varroa. Did you guys test thymol selectivity ratio and how did it compare to other oils?

Guest 2 13:21
Yes, thymol is used to control viruses worldwide. And with the decline of synthetic drugs on which resistance occurs in mite population, the popularity of thymol among beekeepers is growing. In our study, thymol was used as a positive control. So it was tested in the same way as all the essential oils mentioned, so that its effect on mites and bees could be easily compared with the test of essential oils. Logically, the aim of the study was to find essential oils with a better potential than thymol. Thymol root was very favorable at the beginning of the experiment, when it had a higher selectivity ratio than most of the essential oil tested. Thus, its toxicity to mites was high after only a few hours of exposure, and yet quite low for bees. The same trend was also observed for essential oils from thyme, in which thymol is the main component.

Amy 14:27
So what are your general recommendations for beekeepers who want to use essential oils in their colonies? I know that you were discussing peppermint being great and thyme, also thymol being great. Is there a general recommendation you have for beekeepers and what they should be using to control Varroa?

Guest 14:47
Yeah, the results of our experiments are based on laboratory conditions. Therefore, experiments in field conditions have yet to be performed. I would recommend to use single thymol or other products with a

proven methodology. The advantage of essential oils over synthetic acaricides, such as amitraz, or tau-fluvalinate, is in the volatility and to therefore rapid degradability from the hive environment. The risk of contamination of the hive environment and bee products and the consequent risk for bees and humans is therefore minimal. Compared to organic acids, essential oil seem to be more gentle towards queen bees or bee brood from our point of view, therefore, they seem to be one of the most suitable alternatives to control the population of the Varroa mite. In general, essential oils can influence the smell of honey. Therefore, I would recommend applying to the oils after honey bee extraction for at least a month before it. With improper application of essential oils, the taste of honey may be affected. However, the components of essential oils that affect the taste of honey are natural substances, and, to some extent, may occur naturally in honey. They should not pose risks to bees or humans.

Jamie 16:37
So I think those comments are good and it makes me believe I know what the next the answer to the next question will be. So you've done a lot of lab based work right now. What types of projects do you foresee with essential oils in the future? What might you guys do next?

Guest 2 16:57
At the beginning of spring, we will continue this research in the next logical step to test selected essential oils in beehives, as well as the effect on mites. We are going to monitor the effects on worker bees, drones, queens, bee brood, and their food intake. In addition, essential oils will also be tested for antibacterial activity against the pathogens. So far, we are planning to focus on Ascosphaera apis as the causative agent of chalkbrood and Paenibacillus larvae, causative agent of American foulbrood. The aim of testing the design the optimal dose and methods of application of essential oil so that the population of Varroa mite is reduced as much as possible, and, at the same time, so that the colony is affected as little as possible. In addition, the risk of honey contamination will also be assessed.

Jamie 17:58
So your research with essential oils is really interesting. What other types of research do you guys do with honey bees?

Guest 18:07
In addition to essential oils, we also deal with the toxicity of various substances, mainly microelements and pesticides to bees, including their developmental stages and possibility of the taxification. We also deal with the possibility of food supplementation of bees. We are in favor to cooperation with other research institutions.

Jamie 18:34
So that's really great. It really sounds like you guys do a lot of research to benefit bees. I was really fascinated by your research with essential oils. Everyone listening to this podcast, I want to make sure and tell you that we are going to link to this manuscript in the show notes so that you can go and read the manuscript yourself and see the types of essential oils that they tested and the impacts they found. Marian, Petr, thank you so much for joining us on Two Bees in a Podcast.

Guest 2 19:04
Thank you for the invitation.

Guest 19:05
Yeah, thank you very much.

Jamie 19:07
Everyone, that was Marian Hýbl and Petr Mráz who both are PhD students in the Faculty of Agriculture at the University of South Bohemia and the Czech Republic. They were joining us talking about different essential oil impacts on Varroa destructor and honey bee workers.

Amy 19:32
Jamie, I love bringing in grad students discussing their research just because it's always fun to see what you know students come up with, especially when they're collaborating with one another. So it was really cool to have both of them on to discuss their project on on essential oils. What a huge topic, right? It's a huge topic for a lot of backyard beekeepers, I would say, and, it's just a really interesting topic that I think a lot of hobbyist beekeepers are interested in. I don't know if commercial beekeepers really look too much into that. But I will say that I think a lot of our listeners are backyard beekeepers, so it could be applied to them.

Jamie 20:07
So, Amy, I'll make two comments on what you said. Number one, their story of collaboration is really how science should work. And I love the fact that in their testimony, they're like, "Well, I realized I had these skills, and I realized he had these skills. And we knew if we put them together, we can attack something that was important." That's great. That's what's supposed to happen. And number two, essential oils. I love the defense they gave of looking at essential oils, that there's more future hope with essential oil control of Varroa from their perspective than maybe adding another chemical because it's safer, in their argument, it was safer from bees, toxic to Varroa, safer from a food safety perspective. And so while your comment's certainly right, you know, right now, it's a lot of stuff that maybe backyard or sideline beekeepers might do. There's a lot of commercial beekeepers who may get into it. And it takes this kind of study to get us there, not where we're looking at one compound or two compounds. I mean, they looked at 30. They screened 30 compounds for efficacy against Varroa and safety to bees. It was just neat and who knows where it'll lead.

Amy 21:17
Yeah, so I wanted to, I guess, I wanted to discuss the project and just summarize it real quickly. I mean, they were looking at 30 essential oils, and the efficacy of Varroa and on honey bee workers. So they were looking at Varroa and workers, and whether the essential oils, whatever they were testing, was good or bad, or worked against Varroa and had no harm on honey bee workers. Is that right? I just wanted to make sure I got that right.

Jamie 21:39

That's correct. And one of the things I like about it is they didn't just look at its impact overall, they also looked at its impact on bees, because it's really tempting to screen for a lot of compounds and say, "Oh, gosh, we've got these really hot products we should take straight to the field." But, it could be very toxic to bees. And so they did those laboratory bio assays where they looked at its impact on Varroa, looked at its impact on bees, and made their decisions from there.

Amy 22:07
So this was all lab work, right? So this wasn't in the field yet. They were just looking at it in the lab. And I know that something they were looking at was the LC50. And this is something that we've had in the past that we've discussed pretty often. This is something that's used a lot in pesticide research. And so there was something else that they were discussing that I guess I totally didn't understand. It was the selectivity ratio. And so can you just kind of go through what that is? I'm not sure what it is. So maybe our listeners might be interested to know what it is.

Jamie 22:37
Okay, so there's a lot of information in your question, Amy. It's a perfect question. So I'll deal with the LC50 first. LC stands for lethal concentration, the 50 means the lethal concentration that will kill 50% of the population. I don't want to go into too much detail here. But a lot of beekeepers will see in manuscripts LD50 versus LC50. LD is lethal dose, LC is lethal concentration. The difference is, in this particular study, they were putting the compound on the walls of the vial for Varroa and on the floor of a Petri dish for bees. And so they knew how much chemical they put into the vial. But that doesn't mean Varroa would be exposed to all of it. So that's a concentration. If they had put a known amount of compound directly on the Varroa or the bee, the Varroa or the bee would have gotten exposed to all of it, and that would have been a dose. So a dose is when they get exposed to everything we know is there. A concentration is when we say that this is available in the environment, they're getting exposed to it, but we're not sure how much. So they did LC50, lethal concentration that killed 50% of the population. And for you listeners out there, if you follow tox research at all, we tend to speak nonstop in LC50s, 50, 50, 50. And a lot of people wonder why 50 rather than LC10 or LC90. And that's because, and I'm not going to get bogged down in the weeds, but if you look at it from a statistical perspective, the LC50 on a toxicity curve is where the margin of error is smallest. So on a curve, the LC50, the 50 is the most accurate of all the concentrations that you can calculate. So, Amy, then you asked about selectivity ratio. This is really where kind of the brilliance comes in. So I didn't know about selectivity ratios until a couple years ago when Dr. Cameron Jack and I were screening Varroa for new compounds. And essentially, a selectivity ratio is comparing the LC50 of Varroa to that of the bee. And what you're hoping is that that difference is huge. So you want it to be toxic to Varroa at really small amounts, and toxic to bees at really high amounts. So that would produce a really large selectivity ratio. And so if you take something like thymol, that's their positive control, they talked about that, and generate an LC50 for thymol, basically, you can generate a selectivity ratio for thymol, you can generate selectivity ratios for all the other compounds and compare that to thymol. Thymol is a thing that we know shows up in products in hives to kill Varroa, we know that. So they're comparing all their other essential oils to thymol, using the selectivity ratio as the benchmark final. So they would say, "Hey, look, here's what's thymol selectivity ratio. If we can be at or better than that, then we'll take those compounds further into our test." And I really liked that approach.

Amy 25:47
Okay. So they had their selectivity ratio, and then they chose some of the top five oils that they determined to be the most effective. And I guess, before we even move forward with that, I just want to make sure, especially our beekeepers in the United States, that the label is still the law. So, even though these are effective, don't go out and buy candy canes or grab cinnamon out of your kitchen and just start pouring that into your colonies because that may or may not work. And it may be not so good for your honey bees as well.

Jamie 26:15
You're right, yeah, we're not sending the message that you need to read this manuscript and then go put all these things in your hive. But what this is, is this is a message of promise, which is, hey, there are folks out there screening lots of different options that they hope someday, might can be made into products that are tested and safe to use in bee colonies. It takes papers like this to start getting us in that direction.

Amy 26:37
Yeah, absolutely. Well, I'm really excited to see where the future goes with research on essential oils and their efficacy against Varroa.

Jamie 26:46
Hey, and if you notice too, Amy, they were talking about, hey, these essential oils might also impact pathogens, and they even listed, they're moving this year in a research project focused on American foulbrood and chalkbrood. So that's one of the beauties of some of these things is maybe they have efficacy against a number of different things. And it's just great that there are research teams out there looking at these types of strategies.

Stump The Chump 27:13
It's everybody's favorite game show, Stump the Chump.

Jamie 27:25
Hello, everyone, and welcome to another question and answer segment. It is my pleasure to actually be asking the first question to Amy. Amy, what do you think about that?

Amy 27:35
I don't know how I feel about this. We'll see. I'll do my best. I'll take my best guess. How about that?

Jamie 27:40
That's good because I'm tired of always being the chump and getting stumped.

Amy 27:44
I'll be the chump this time.

Jamie 27:46
You'll get it right. I'm sure you will. All right. So, Amy, the reason I'm asking you a question is because one of the questions that came in from one of our listeners is actually a question about plants. And you are the lab's resident plant expert. I want to ask this question to you because I really know that you're going to do a much better job of answering than I would be able to. Alright, so the listener said, do you know if honey that bees make from White Aster flower is good for bees? And one of the reasons, incidentally, Amy, I couldn't answer this question is because White Aster flowers, you know, depends on where you are, what you're calling White Aster, etc. I don't even know what this flower is. So Amy, I'm going to lob it over to you. Some folks say that honey from certain flowers are bad. You tell me about this one. What do you have? What do you know about this?

Amy 28:34
So, in the question, that listener actually says that their friend had a colony that stored a lot of White Aster, and so they think that they lost their colonies from it, right? And so like you mentioned, Jamie, we do have plants that are good and bad for bees. And so this person's asking about White Aster in particular, and Aster, actually, is known for having pretty good pollen and nectar for honey bees. And so really, when I look at this question, I'm not quite convinced that it's a White Aster that has caused colony to decline, but maybe something else, like maybe a disease or maybe even starvation, even if they had Aster. And so, there are lots of different things it could be, but I'm not quite convinced that it's from the Aster. When we look at that pollen, and when we look at that nectar, the sugar content and the nectar of Aster ranges from about 24 to 41%. And so I think, I'm not quite convinced that Aster is bad, and depending on who you ask, there are some associations that consider it a great honey bee plant. So that's my answer for you. I don't know if it's Aster. I don't think it's Aster. It may be something else.

Jamie 29:47
That's a good answer. I will tell you what I always do, and I love your answer. I always kind of go through my standard triage and I always start with Varroa. Your bees died, okay, it's easy maybe to blame someone else but what did you do for Varroa, what did you do for this, what'd you do? Okay, now, once we get through all those, I'll start going, okay, now let's explore nectar sources. We do have some plants, in Florida, for example, that do produce toxic nectars for bees. One of the Tatas does, one of the Yellow Jasmine does. Yeah, exactly. And so I know that there's other things in other parts of the US, and for that matter, around the world, that can make toxic nectars for bees, but I don't know about Aster. That's why I had to just have you do this.

Amy 30:27
You know what, Jamie, now that you've said, have you ruled out Varroa? Have you ruled out this and that and that? Maybe we should put together a checklist. That might be something cool.

Jamie 30:37
Triage sheet. I like it. I like it. You heard it here first, folks.

Amy 30:42

Okay, so I'm done answering questions now. It's my turn to answer questions or my turn to ask the questions from you. I feel more comfortable doing that anyway. So let's get back to normal, shall we? So the second question we have is this individual, they had a donated swarm from last year. Okay, so those bees overwintered, they're currently in a single deep, they are being used by bees. This person wants to cull them out when the weather warms up. They're also in Michigan, but I am not even quite sure what culling means. So Jamie, do you want to talk about culling frames, what that means? Am I even saying it right? Any information would be greatly appreciated.

Jamie 31:25
Well, you are saying it right. So we can start there.

Amy 31:28
I can read. Thank you.

Jamie 31:31
You can read. You said it. Not me. All right. So this questioner is basically saying, I've got a colony established on frames, and I don't want the frames anymore, but I want the bees. How can I switch in new frames for them? All right. Great question. So I have actually experienced this a lot in my lifetime as well, where maybe even here at work, where we buy colonies from folks, and it's really so that we could have the bees, and we wanted to switch out to our frames rather than frames maybe that we've purchased, etc. So what I do, is there's a couple of options. Number one, what I would tend to do is get that colony incredibly strong on those frames. So it's a deep box, I think, the question was asking about, so let's just run off that one. Here's a deep box, make sure that it's wall to wall bees, maybe I feed it, whatever I do to get them as strong as possible, I do that. Alright, then I get a new box with new frames or frames of foundation. I take the box occupied by the bees off of the hive bottom board. I put the new box on the hive bottom bottom board. I then find the queen in the box that has the old frames and put her into that new box. I put on an excluder, and then I put the old box on top of that excluder. And so what you're going to have, by virtue of trapping that queen in the lowermost box with new frames or frames the foundation, the bees are going to migrate down there to her, build comb, she's going to produce brood. Over time, they will increasingly use the frames and the combs that are in the bottommost box. The uppermost box, on the other hand, that has these old frames in it, the brood will all emerge out of it, by 24 days. 21 days if there's only worker brood, but 24 days if there's some drone brood. So 24 days later, all of the brood should be out of all of those combs, those old combs that are in the uppermost box. And so the only thing that can be in those combs that I would want the bees to be able to keep would maybe be any stored honey that they put up there. But the way to handle that is you can take that box, shake all the bees off of all the frames from it into the lowermost box that now has the queen and new combs, etc. And then you sit that uppermost box just out in the apiary and allow it to be robbed. That way the bees can reclaim that honey that they may have stored up there. So usually, the only time I would kind of gradually phase out old frames like this is because they have brood in them and I want to capture that brood into my new box or because they've stored lots of honey. And what I'll do is exactly that. I'll put the queen in a new box in the bottom, put a queen excluder, put the old box on top, and let that old box get used less and less, the new box get used more and more to the point where once the brood is gone, I'll take it off and do everything I said. Now, there is another way.

Another way is you can kind of mark -- let's go back to the original hive configuration. You've got a box full of old frames and you've got the queen and the bees. What you can do is mark the top of all of those old frames maybe with a paint pen or a thumbtack or something, and then you can start taking out those frames that have no brood and cycling in the new frames that you want to keep. And then, slowly, you want to move those brood frames to the edges of the nest so that as they are emptied, as the bees emerge from it, the queen will be less and less likely to produce more brood in those outer frames than she will in the inner frames, and so slowly over time, you're cycling out the brood out of those old frames, and you're removing old frames and putting in new ones and removing some old frames and putting in new ones. But I like the more drastic approach, personally, where I simply move the queen and some bees down into a new box, put the excluder on, throw the old box on top, and once all the brood has emerged from that old box, I just take it away if there's honey in and I'll let bees rob it. But the cycling through is a less drastic way. And it just requires a lot more time and then the queen can double back on you and lay eggs in those old combs right when the brood emerges. You just, you start the process over. It becomes a pain.

Amy 31:32
Alright, so the third question we have for today, I'm pretty excited about this third one. I will tell you, Jamie, that I was talking to someone who listens to our podcast, and they're like, "We can't tell if you actually know the answers or you're just pretending like you don't know the answers." And I'm like, "You'll never know. You will never know whether I actually know the answer or not." But this one I truly do not know the answer to for at least one of the resources but the question is how are resources deposited in the hive? So, we know that foragers bring in nectar pollen, propolis, and water. Okay, so I know how they bring in nectar. I've seen them bring in pollen and water, but do they hand things over to everyone? The one that I don't know of, for sure, is propolis and how propolis gets deposited in to the colonies. So why don't we just go through all four? And you can tell me how they bring them into the colony.

Jamie 37:03
Perfect. Happy to help.

Amy 37:04
Okay. Yeah, so foragers bringing in nectar. Let's start with that. What's the process?

Jamie 37:08
Let's start with nectar. So bees go out and collect necta. We call them nectar foragers. That's how we refer to them. And so they come back to the hive with their crop, which is a special organ in their body, their crop full of nectar. And so when they come into the entrance of a hive, they actually offload their nectar to a cohort of worker bees we call nectar receivers. They meet the foragers at the nest entrance and take from them their crop contents and then walk those crop contents to the open cells where nectar is stored, and then they put that nectar in to start that conversion process into honey. So from the nectar foragers' perspective, they offload it to nectar handlers or nectar receivers right inside the nest entrance when they return from the field.

Amy 38:02
All right, so that's pretty cool. Let's go to pollen. I just recently saw a video of honey bees bringing in pollen, actually, so let's talk about pollen and how bees that have pollen bring it back to the nest.

Jamie 38:16
Well, these girls go out and collect pollen, similar to nectar, they go out, work flowers to collect pollen, they stick it on their hind legs, so while they're working a flower, they're getting pollen on their body, they'll rake that pollen, they'll moisten it with nectar, and they'll stick it in the corbiculae or the pollen basket on their hind legs. They'll fly it back to the hive, and here's where they differ from nectar forages. So nectar foragers will offload it to nectar receiver bees while the pollen foragers actually take their pollen loads directly to cells where pollen is stored. They'll look into that cell, and if they determine it ready to receive the pollen load they have, they back their hind legs up to the opening of that cell, put their hind legs in that cell, and knock off those pollen balls into the cell. Then, they will go out and start the forging process all over again because there's another cohort of bees that will now come in and process that deposited pollen, beginning its conversion to bee bread. So the pollen foragers actually put it directly into the cells, but pollen handlers take over from there for the bee bread conversion process.

Amy 39:24
Okay, but real quick question about the pollen. When they're doing the pollen baskets, are they making one big ball and sticking it to their hind legs or they're slowly just adding pollen so that it builds up on their legs to make that ball?

Jamie 39:39
They're adding to it. I'll tell you, Amy, the name basket, when I was a kid, the name basket just completely threw me off. I thought bees had this flexible, for lack of a better term, like skin layer on their hind leg that they could open up and stuff stuff into, like a pouch. The term basket, I was like imagining this kind of pouch thing on their hind leg. But really, this pollen basket is nothing but a row of hairs on either side of one part of their hind leg. There's one hair in the middle of all of those, kind of on the surface of the leg, and they will moisten the pollen they collect, and start packing it on their hind leg kind of around that one stiff hair. And those hairs that line the hind leg on either side are almost like fingers that just kind of hold that pollen ball in place. So that pollen ball will grow and grow and grow and grow as they visit more and more and more flowers. So they're constantly adding to it. And when they determine their load to be appropriate, they bring it back to the hive and deposit it directly in cells.

Amy 40:41
Pretty cool. Okay, so this is the one I don't know. Propolis. So how do foragers collect propolis? And then what do they do when they get back to the colony?

Jamie 40:51
Well, Amy, you're in good company. This is what I also did not know. I knew how they collect propolis is much similar to kind of how they do pollen. They'll go find this sticky substance, these tree saps or rosins, etc., and they'll work it with their mandibles and they'll take it and put it on to their hind legs the

way that they place pollen on their hind legs. But what I didn't know is what they do once they get back to the hive. I assumed that, before looking up the answer, I assumed that the worker bee actually went and deposited the propolis directly where it needed to be. But then, when we got this question, I go, gosh, that's probably maybe not completely true because that's so much time, right? There's not many propolis foragers in general, but if they have to come back and deposit it where it needs to be, it's got to be some time before they can even take the next trip. Well, I looked up the answer. And there is a really remarkable paper that we're going to make sure and link in the show notes so that you guys can see this. It was published by Simone-Finstrom and Spivak back in 2010, and we'll make sure and link this in the show notes because it really is pretty remarkable. I've highlighted a paragraph that's just cool that I wanted to read from the paper.

Amy 42:09
I'm ready. I'm ready.

Jamie 42:11
Alright, so I'm going to read it and make sure and give all the credit. We'll make sure, again, reference this in the show notes so that you're knowing that the right thing is getting credited. It says, "Once the bee has a full load, she returns to her colony to unload the resin from her corbiculae (pollen basket). The unloading process typically takes approximately 15 minutes," but it says here that it can actually extend from one to seven hours or even overnight. And what they said, it's just remarkable. A resin-forager cannot unload it herself, but rather must rely on her nestmates to offload the resins off of her. Once the resin-forager returns with a full load, she goes to a site within the hive where propolis is needed, then she waits there until other bees, which they call cementing bees, will bite chunks of this rosin off of her corbiculae, and the cementing bees immediately attach it to where it needs to be. They'll smooth the resin, now, they officially call this propolis, with their mandibles in a manner that similar to the way they handle wax. It gets even crazier, Amy. It says the resins may be placed in a storage area where bees can grab chunks of propolis later to put it where they want it. So they even have storage sites that they keep it and when they're ready for use later. It says many of the few resin forager bees and colony can perform and will perform the cementing behavior but not all cementing bees will forage for resins. So long story short, they bring it back, go where it is needed, wait for other bees to offload it who might offload it directly to where it is used or offload it to a little storage site so they can come back and grab it later. And these bees are called cementing bees. So what do you think about that?

Amy 43:59
That is so cool.

Jamie 44:01
It's crazy stuff. That's what it is.

Amy 44:03
That's my favorite new fun fact. Just what they do with the propolis. How do they know where it needs to be?

Jamie 44:09
Who knows? It's so much. I'm sure there's so much that needs to be learned about this process. But hey, read this paper. It's got a lot of great answers about this.

Amy 44:18
That's pretty neat. Okay, so for the last resource, water. So how do they collect water? And then what do they do when they get to the colony?

Jamie 44:27
So Amy, just like propolis is amazing, water collection is also amazing. There's a really good paper for that one as well that we'll make sure and link in the show notes too. But to make a long story short with water collection and deposition in the hive, essentially, there's a group of bees that will go out and collect water. Those are the water foragers, and at that point, it's a lot like nectar. Instead of going to flowers to collect it, they're just going to some water source, they're sucking it up, and they're transporting it back to the hive in their crop, the same way they would do as if they were flying nectar back to the hive. And similar to how they handle nectar offloading, when they get to a hive, the water foragers go into the hive and they will offload their water to bees that will collect it from them, and then go deposit it around the nest, which we know, when they deposit it around the nest, the bees stand at the nest entrance and fan their wings will circulate air through the nest. That evaporates off the water that's deposited on the combs throughout the nest and you get that cooling effect. But to answer the listener's question directly, the water foragers go into the hive and offload their water to water receivers. So there you go. There you have it. The pollen foragers go directly to the combs to offload it, but everybody else offloads it to someone else to do the work for them.

Amy 45:50
Super cool. Okay, so one one last question that I have about foragers. So you were talking about nectar foragers, pollen foragers, propolis foragers, and water foragers. So do these foragers go and do different things? Like can a nectar forager be a pollen forager?

Jamie 46:07
Yeah. So everything that I've read about research on this topic is that bees end up being kind of one thing. It's still under the foraging umbrella. But what they do is when they're a pollen forager, that's kind of what they do. And when they're a nectar forager, that's what they're doing. So it's not like they get to the foraging age, and they read a resume and say, "Oh, gosh, I'd much rather, I'd think I'd be a better pollen forager or nectar forager."

Amy 46:31
They interview.

Jamie 46:31
"You go, you're off to the water for you." I think their decision has a lot to do with what is the greatest need at the time they are transitioning into the foraging behavior, and then that need kind of cements itself in them. And then that's just what they do. Now, we know that nectar foragers will collect nectar

over multiple species of plants, or pollen from multiple species of plants. But, when they're a pollen forger, that tends to be what they do. When they're a nectar forager, that tends to be what they do. The same is true for propolis foraging or water foraging.

Amy 47:07
Very cool. Well, that was a really fun Q&A, and we will be sure to link the resources to our additional resources on our website. So keep those questions coming, and hopefully you enjoyed this Q&A segment.

Serra Sowers 47:25
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.