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SPEAKERS

Jamie, Stump The Chump, Guest, Amy

Jamie 00:10
Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast.

Amy 00:49
Hello, everybody, and welcome to this segment of Two Bees in a Podcast. Today, we are joined by Dr. James Fulton, who is a research scientist at the Honey Bee Diagnostic Laboratory. He is here in Florida and works for the Florida Department of Agriculture and Consumer Services. So I'm really excited to be introducing James to our podcast listeners, also to Florida Beekeepers, because I think if you're a Florida beekeeper, you're probably going to get to know James at some point or another in your beekeeping world. But today, we brought him on to talk about a very special hornet that we have been dealing with in the United States recently. But before we get to that, James, why don't you tell us a little bit about yourself and how you got into the beekeeping world before we talk about the yellow-legged hornet.

Guest 01:33
Good morning, Jamie and Amy. Thanks for having me on this podcast to discuss this really important issue. So, a brief description of my background. I graduated with my PhD from the University of Florida in plant pathology. My PhD focused on traditional molecular diagnostics for the identification of emerging plant pathogens. Shortly after that, I started a postdoctoral associate position in Dr. Jeremy Bronner's lab, where I developed a universal enrichment sequencing technology for fungi. And during that time, I saw that the Florida Department of Agriculture and Consumer Services was advertising a position as a research scientist to establish a honey bee diagnostics lab, and I was very, very excited to

be engaged with work supporting honey bees and other pollinators, especially in my new home state of Florida. So in the past two years, we've gone on to establish a full-capacity diagnostics lab open to the public.

Amy 02:33
So, James, I'm really excited for us, as the state, to have this diagnostic laboratory. Can you real quickly tell us what you're thinking as far as diagnostics go? What do you think you're going to be offering to beekeepers here pretty soon?

Guest 02:45
So we're going to be offering a full suite of molecular and traditional microscopy techniques. We'll be able to diagnose for viral fungal bacterial diseases as well as arthropod pests, we do primarily focus on the apiary inspector. Within Florida, however, the public will be able to submit samples directly to us.

Jamie 03:06
So, James, we have brought you on to discuss Vespa velutina, which goes by the common name yellow-legged hornet. And the reason this is a big deal is because, in summer 2023, this wasp was confirmed to be present in Georgia. I know a little bit about its invasive biology around the world, but it may be new to our audiences here in the United States. Of course, we have international audiences so some beekeepers listening to us may be aware of this wasp, but for the purposes of all listeners, could you tell us a little bit about Vespa velutina and why this species is so important?

Guest 03:42
Absolutely. So in the August of 2023, Vespa velutina was first spotted up around Savannah, Georgia. The government seat of Chatham County, this is approximately 100 miles from the northern border of Florida, and from this initial detection, the Georgia Department of Agriculture was very responsive and immediately began with support from the United States Department of Agriculture bee trapping & nest eradication program. Since this first sighting, several nests have since been discovered and eradicated in the county. Furthermore, in early November, Vespa velutina was also detected in Jasper County, South Carolina, which is adjoining Chatham County, just across the Savannah River. So the presence of multiple nests does indicate that the population has been present for at least two years if founded by a single queen, or at a minimum, since the beginning of 2023. The species is of particular concern because of its omnivorous diet. However, it does have a preference for honey bees. So social insects such as Vespa velutina are extremely successful invaders of new areas due to their high reproductive rates, their ability to disperse over vast distances, and their broad diet. To provide just one small example, when Vespa velutina was first detected in Galicia which is Northwest Spain. They went from discovering two nests that year to finding 10,000 nests over the next four years, so they quickly proliferated over the area. The species does pose a significant threat to the agricultural industry and has been reported to cause colony losses up to 30%. In France, colonies are devastated by a direct predation, where hornets will hover in the proximity of honey bee hives, and also what is known as hocking behavior. During hocking behavior, the individual hornet hovers for upwards of 15 minutes searching for lone honey bees leaving or returning their nests. The hornets will then capture and incapacitate the lone honey bee before returning to their nests with the honey bee thorax. The honey

bee thorax is a rich source of protein for developing brood. Once a vulnerable honey bee colony is discovered, the Vespa velutina hornets do return to the same location multiple times per day, and there can be as many as nine hornets hovering, or hocking, around that hive. So, directed predation has also been shown to cause oxidative stress in honey bees, which increases their vulnerability to other diseases, pests, and nutritional deficiencies. So in addition to this direct predation, the honey bees become paralyzed, and you'll see honey bees bearding in front of their entrances, where they are inhibited from going on foraging flights. And so this directly causes a shortage or a deficiency in nectar and pollen uptake that can lead to starvation and vulnerabilities to other concerns, like diseases.

Amy 06:37
James, in 2020, during the COVID lockdown when Jamie and I had to sit in our respective closets at home and podcast, there was the murder hornet, which blew up on the media. This murder hornet was out and we had interviewed Chris Looney, who was with the Department of Agriculture in Washington State. That was the Vespa mandarinia, which, I think, gave me job security for probably two to three months because everybody was panicking that it was here in Florida, but we had not confirmed it. We were trying to share with everybody, it's okay, don't panic, if you think you see it, report it. But they were able to do a really great job locating hive nests and making sure that it was eradicated and we hadn't seen it in a while. Well, fast forward to a couple of years later, all of a sudden, Vespa velutina has been found way closer to our state. So we're way closer to Florida, in Savannah, now in South Carolina. It's really concerning. And so Jamie and I are in the process of sharing this with beekeepers out there to really keep their eye out on looking for this pest. But it's interesting to see the media had kind of taken it with the murder hornet, and now we've got the murder hornet's cousin. So we're talking specifically about Vespa velutina and it being found on the east coast of the United States. So it was recently found. I'm wondering if you could tell us where these wasps even come from. Where are they native? You had mentioned France. I don't know if they're from France, or they're invasive to France. But if you could tell us just a little bit about where these wasps came from, where they have spread, where they're invasive, and if you can discuss a little bit of their biology.

Guest 08:16
So Vespa velutina is native to northern India, as well as China and Southeast Asia, where it co-evolved with Apis cerana, or the Eastern honey bee. The difference between Apis cerana and our Apis mellifera is that, because of this coevolution, Apis cerana developed defensive strategies, including heat balling, where a group of Eastern honey bees will pounce on an individual hornet and cause the temperature and carbon dioxide concentrations to increase. Unfortunately, because Apis mellifera has not had this natural exposure to this threat, they lack this defensiveness. Since this initial origin, they have expanded through many regions of the world, including, in 2003, to Korea, and then, in 2004, they were introduced what was believed a single queen foundress on Bonsai potting material in 2004. And so since 2004, it has spread everywhere from Portugal, and Spain, the Iberian Peninsula, the southern reaches of the United Kingdom, all the way to Northern Germany, and now it's spreading into parts of Italy. It's also been reported, as of 2012, to be in Japan, and now as of 2023, in the western hemisphere. So the basic biology of Vespa velutina is that the species follows an annual cycle. It begins each spring with a hibernating mated queen when she will emerge to establish what they term an embryo nest, typically in tree shrubs, the ground, or, concerningly, human-made structures. These

nests are similar to the nests made by bald-faced hornets. So they're egg-shaped, probably about the size of a grapefruit, and after several generations where the queen is raising a few new generations of workers, the nest will reach a point where there's not an adequate amount of space. And this typically is reached in June-July. So the entire colony, at this point, will abscond to start a secondary nest, which can be located very distantly from that primary location in temperate regions of the world. The secondary nest is found around July when brood production really ramps up. This is the point when beekeepers or members of the public will most likely note or detect the species if it is present. The population can ultimately produce thousands of individuals, and during this time, as the brood is consuming so many resources, this is when the workers will go out to find rich sources of protein, most often including honey bees. So once the hive continues to develop and expand, the season will transition to fall, at which point, reproductive female founders are developed and produced, as well as males a few weeks later. During this fall portion, which occurs around September-October, mating will occur, and successfully inseminated queens will go on to disperse to even further locations, which can be as far as 50 miles distant from that originating nest, at which point they'll hibernate until January or February.

Jamie 11:43
James, you've already laid out for us how this particular wasp species can impact beekeepers and their colonies specifically, even from an economic standpoint, but what other impacts might this wasp cause?

Guest 11:57
So, in addition to the direct economical impacts on beekeepers, there are also indirect costs related to detection, eradication, and management activity. For example, nest elimination in France between the years 2006 and 2015 was estimated to cost $25 million US dollars. Additionally, because the species is omnivorous, it poses a direct threat to other pollinators in areas that it has invaded. One study in France showed that a single colony's diet was found to be comprised of up to 159 different species, the primary predominant species being honey bees. However, flies and social wasps are also members of that diet. An additional concern with Vespa velutina is that while honey bees do constitute up to 66% of the diet in urban areas, this does change to 33% in response to the location and habitat where it's found. So, as a result, Vespa velutina could be a direct concern to our native pollinators. Additionally, Vespa velutina could compete our native species of hornets for ecological niches and impact their populations, and they do pose a real concern for human safety as Vespa velutina successfully inhabits developed areas and keeps coming into close contact with human population centers.

Amy 13:19
So what should beekeepers in the United States be doing as far as being on the lookout for the hornet?

Guest 13:26
The importance of beekeepers to combat the threat of this species cannot be overstated. Vespa velutina was first cited in Georgia by a local beekeeper who noticed something unusual about their colonies' behavior. Beekeepers in surrounding states, particularly in South Carolina, Florida, and Alabama, should keep a keen lookout for unfamiliar hornets hocking or hovering near their honey bee

entrances or hives. They should also keep an eye out for bees that are bearding or forming mobs at the entrance that is apparently inhibiting them from engaging in foraging flights, or unusual sudden colony losses in the area. An additional thing to be on the lookout for includes large nests high in trees.

Jamie 14:09
James, I think one of the things that's really important for our beekeepers here in this area that this hornet has been found is to know what they should do if they think they have a sighting of this wasp? Right? Because we're still in an eradication phase. We're trying to get rid of this. We don't want to have it. So what should citizens or beekeepers do if they think they've found it?

Guest 14:29
So there are several resources available to concerned citizens or beekeepers. Foremost is the Apiary Inspectors of America's website, which has a wealth of information about this organism, and they do link to important organizations and institutions that are addressing this concern. Concerned individuals can also contact their State Department's of Agriculture, University Extension offices and the US Department of Agriculture. The Department of Agriculture in states that have reported official sightings, including Georgia and South Carolina, have websites where concerned individuals can report their observations directly. That information will then be passed to inspectors, scientists, extension agents that can follow up.

Amy 14:30
So James, as you mentioned, we have a lot of colleagues, other researchers around the world who have had to deal with the invasion of Vespa velutina. I'm interested to know if you can tell us about whether any of our colleagues out there have been able to have a successful eradication program. And also, for those who the invasion has really taken over, what are they doing right now and how are they handling the situation?

Guest 15:34
So, a region's appropriate response depends largely on the stage and extent of the invasion, the local geography, and the resources available. Initially, in an area where Vespa velutina has yet to establish, prevention is essential and it is feasible. The European Union passed Resolution 1141-2016, and Japan listed the hornet under this Invasive Alien Species Act as a means to officially declare that the organism is a species of concern and to support efforts to restrict its movement to areas where it's free of the pest. However, in areas where Vespa velutina has been detected in a localized restricted zone, surveillance becomes key. This can prepare provinces or states' neighboring regions with detections to be on the lookout. Methods of surveillance include citizen outreach and direct communication to relevant stakeholders, including beekeeper clubs, conservation groups, academic institutions, and governmental entities. The next step in prevention or management includes monitoring Sentinel traps in apiaries, which can provide information regarding the geographic spread of the species, followed up with prompt and thorough eradication efforts. This has shown to be successful, so in Majorca Island, off of Spain, in 2015, Vespa velutina was first detected; however, they implemented a strict thorough eradication effort, which, as of 2019, has been successful. They have not reported or detected a colony since this time. So eradication efforts are performed by first identifying a local area of invasion through

the use of traps or monitoring apiaries. Afterward, several bait traps are established in the area, and through triangulation of flight direction, the proximal location of a nest can be identified. Once the location is established, surveys are conducted on foot or by more advanced technology including drones to pinpoint the nest location. Now, I do want to emphasize at this point, even when the general location is known, it can still be very difficult to pinpoint the exact location due to the nature of these nests. As they can occur high up in treetops or under foliage, they can be very difficult to detect visually. As a result, other technologies such as trapping individual hornets, and then tagging them with radio beacons, these tracked individuals are then traced back to their origin, and there are other technologies that are in the process of being developed. Unfortunately, in areas where the species cannot be prevented or eradicated, control becomes necessary. Although control measures are limited, there are some promising strategies including continual nest destruction, hive muzzles, or electric tarps that can be employed. So a hive muzzle is an exclusion device that is a wired mesh that allows the passage of individual honey bees but is too fine to allow the movement of the Vespa velutina hornet. Additionally, the electric traps are two electrified wires that the honey bee can pass without touching. However, because of the greater size of Vespa velutina, they do come into contact with these wires and are electrocuted.

Jamie 18:57
So, James, how are the departments of agriculture, specifically in the US, working together to address this concern?

Guest 19:05
So, our intent is to engage all relevant and concerned agricultural stakeholders in the region. In this initial stage, we are working directly with the Georgia Department of Agriculture to support and assist as requested. We are providing diagnostic support, including identification of reproductive females and males and investigating new methods to detect novel incursions and bait individuals for Sentinel detection. At this moment, we're in the process of submitting a proposal for the investigation of a pheromone which may provide the capacity to attract males and thereby pull them out of the breeding population so that they cannot successfully inseminate females.

Amy 19:45
So James, as I mentioned earlier, with the Vespa mandarinia in Washington State, have the Department of Agricultures in Georgia and South Carolina and Florida, have you all been working with the Department of Ag in Washington to see what they've been doing with the Vespa mandarinia?

Guest 20:04
So, first of all, velutina has yet to be detected in Florida, and therefore, the work that has been done has been done directly by the Georgia Department of Agriculture. They have reached out directly to researchers and government staff and Washington. I do know that they receive some equipment for the tracking of individual hornets to their nests. However, at this stage, that's ongoing work to see how successful that will be.

Amy 20:32

Yeah, definitely. I think it's really good for everyone to work together for the common cause and to eliminate and eradicate as best as possible. Is there anything else that you wanted to add? I'll make sure that we have additional resources, so links to the Florida Department of Ag, that page for Florida beekeepers, if they think that they found the wasp, of course, the information for the Department of Ag in Georgia and South Carolina. But James, is there anything else that you wanted to add to share with our audience?

Guest 20:58
Yeah. As a result of globalization and global trade, invasive species are a continual concern for the public. Eradication efforts are generally more expensive and intensive for continual surveillance and inspection. Consequently, supporting efforts to monitor for the introduction of exotic species is cost-effective and merits continued public support. Prevention is often the only way to prevent establishment as control strategies may be limited. However, prevention oftentimes gets the least recognition.

Amy 21:25
Yeah, I completely agree. So, beekeepers that are out there and those who listen to our podcasts who are not beekeepers, if you think you see this hornet, it is very important that you let us know. Thank you so much, James, for joining us today. I'm excited to share resources. And hopefully, no one in Florida ever sees a Vespa velutina in their apiary. So, Jamie, as I mentioned during the podcast, when Vespa mandarinia came around, everybody was coming to me, all these media people, everyone was asking, oh my gosh, the murder hornet is here. It bombarded my life for a while. It was really intense. And then a couple years later, Vespa velutina shows up even closer to where we are, and I've not really heard much about it, except from our French colleagues. It'll be interesting to see. I'm hoping, one, that Georgia does a really great job with their eradication and that we never see it in Florida. But I do think it is a possibility that it can expand and have potential invasion here. I mean, I don't know. What are your thoughts about Vespa velutina and its spread or invasiveness here in the southeast United States?

Jamie 22:34
I'll tell you, Amy, there is so much to unpack on this topic. I'll kind of start a little bit from the top. If I get rambly, feel free to stop me. But I've traveled to Europe a fair amount talking to beekeepers there and going to research meetings. And for years and years when I would go over there, I would hear them give talks about Vespa velutina. And I didn't pay much attention to it, except that they had this hornet problem, it was a big deal, this is what's going on. So fast forward that a few years ago, when Vespa mandarinia showed up in Washington, like you mentioned, I thought that it was the same species that they were seeing in Europe because that's the one that we have problems with. Well, it turns out it wasn't. That one's now called the northern giant hornet. Just like you said, it got so much press. The press put the moniker "murder hornet" on it, which amplified the amount of press we got. But Washington officials, again, as you noted, were quick to respond and haven't found it in a year or two. So that's great news. Okay, fast forward, just like what you said. Now, we've got Vespa velutina, in Georgia, at least. The Georgia Department of Ag has been trying to eradicate it. We're recording this in winter, we won't know if that eradication effort was successful or not until spring 2024. But I will tell you, if this thing is anything like they report in Europe, this potentially could be a very, very big deal. I'm quite surprised that folks aren't talking about it a lot at beekeeper meetings. Georgia has tried to educate

beekeepers in the area, but it's not getting a ton of attention. We know this is an international podcast and beekeepers from all around the world are listening to us. Europeans are struggling with this issue. Now, we may be struggling with this issue more in the future. This hornet has the potential to spread to other places, not only in the US, but around the world. And it's a really, really big deal. It concerns me that gets so little attention. Here in the US, for example, tropilaelaps gets a lot of attention, but we don't even have tropilaelaps in the US. But we do have Vespa velutina, and just like James was discussing, it can do a lot of damage to bee colonies. So we are both hopeful that it's been eradicated. We simply won't know until spring rolls around. If it ends up establishing, it could radically change beekeeping practices in areas where it goes, just like what we've seen in France and Portugal and Spain and other places where it's shown up in Europe.

Amy 25:05
Definitely. I know that we've got European listeners. I would love for you all to send us an email or a message about whether you have Vespa velutina in your apiaries and how you manage them. I'm all ears, as far as that goes. I guess, eyes, since I'll be reading the email. But yeah, I would love to hear what beekeepers are doing and how they're managing it because, if it does happen to be a problem here, we're gonna have to be ready for it.

Jamie 25:27
I mean, absolutely, Amy. We've got this issue with Vespa mandarinia. Fortunately, we think, we hope it's been eradicated. We've got, now, this issue of Vespa velutina. I know our listeners are going to want to know more, and of course, we're going to link some information in our show notes. But there's a lot of information online about this. I just want to spend a quick second telling folks how to find it. Vespa mandarinia originally went by the common name, Asian giant hornet, but there's a big movement in entomology and other things around the world to remove place names out of common names for lots of reasons. So now that hornet goes by the northern giant hornet, but you would probably find information about it looking up both of those ways. Likewise, Vespa velutina, the hornet we now have, had gone originally by Asian hornet, now it goes by the yellow-legged hornet. So looking up information related to that, you'll find a lot online. There's a lot of videos, there's a lot of information. Of course, we've produced some information here, our FDAGs colleagues, Florida Department of Ag colleagues, who produced information. There's the Apiary Inspectors of America site that James mentioned and a lot of sites coming out of Europe. So we can make a point to link to some of these so that you guys will be able to go read some extra notes about this very important topic.

Amy 26:44
There are also really great resources out there that are comparing the Vespa velutina with lots of other hornets that are out there that people may mistake for it. And so I think it's great to take a look at the resources, we're happy to share as much as we can.

Stump The Chump 27:06
It's everybody's favorite game show, Stump the Chump.

Amy 27:15

Welcome back to the question and answer segment. Jamie, the first question we have today, so this question is coming from the mountains of North Carolina, and the person is wondering about queens and their drone laying. So some of the queens that they have in their apiaries are laying drones, well, most of them are laying drones. And then later on in the fall, some of them continue laying many drones, while others kind of slow down a little bit. What is going on here? This is not a laying worker situation. There are lots of different stages of worker brood in the hive. What do you think is happening here?

Jamie 27:48
Yeah, so what I would say is this is certainly within the realm of normal. I'll expand a little bit and explain what I mean. So this kind of falls within the realm of -- and everybody who listens to this podcast knows that I say this a lot -- but this falls within the realm of 'biology is messy.' So it is normal for bee colonies to slow their production of drones as summer begins to stop and they transition into fall. When I say a colony, the question is asked from the perspective of why the queen? Why does the queen lay drones longer in some colonies than in other colonies? Well, there are really two things that are controlling it in the nest. Number one, queens are only able to decide if they lay a drone egg or not. But workers are the ones who will decide whether they will carry that egg all the way through the developmental stages to an adult drone. So a queen can continue to lay drone eggs further into fall, but it looked like the colony is not investing in any drones because the workers are aborting the eggs. And so you've got queens and the workers using nutritional and environmental cues to determine when to stop producing drones. So imagining an apiary with two colonies, it's clearly unreasonable to expect two queens, one in colony one and colony two, to process the stimuli exactly the same, exactly at the same time, therefore, stopping to lay drone eggs at exactly the same time. Likewise, it's unreasonable to expect the worker bees in the two colonies that are processing the same environmental stimuli, it's still unreasonable to expect them to respond on the same day to stop producing drones. And so what you have with any given behavior in the honey bee world, you've got this bell-shaped curve where the vast majority of the individuals will perform the behavior in the circumstances. But outside of that main part of the curve, the main hump in the curve, you get the tails of the curve where you still get the behavior happening, maybe less so. This is just one of those examples. Why do some colonies produce drones further into the fall than other colonies? Well, it's just part of a natural variation. The queens have to make a decision, the workers have to make a decision, they're processing cooling temperatures, lessening daylight, they're processing those environmental stimuli different, they're processing their nutritional needs differently. Maybe one colony is slightly stronger so they're able to bring in more pollen, which pushes the queen to lay more drone eggs and the other colony is slightly weaker, and they're bringing in less pollen, so they produce fewer drones. So there's a lot going on as colonies are making, quote, the decision to transition away from producing drones. So it's very reasonable in an apiary of 2, 10, 15, 30 colonies to see every colony stopping that behavior at different times, maybe even a month or two different just because biology is messy. It's all within the normal curve of the bell curve.

Amy 30:57
I feel like there needs to be a coffee mug made with your face with a face with a question mark on top that just says biology is messy.

Jamie 31:04
I don't know about my face on it. But certainly, maybe someone out there will hear that and send us one.

Amy 31:14
Our listeners don't know this but we have an ongoing joke here at the lab where we put different variations of Jamie's face onto coffee mugs here. So we can all have a coffee mug with Jamie Ellis' face on it. So if you want to send one over, we're happy to take them in.

Jamie 31:28
Start your day with Jamie. I can see it now.

Amy 31:31
Alright, for the second question that we have, a beekeeper who is really tired of dealing and battling with wax moths. We are all tired, yep. All tired of battling wax moths. So this beekeeper is actually wanting to build a cold storage, a cold walk-in storage unit so that they can take all of their equipment and put it into this storage unit, and they want it to be reasonably cost-effective, as we all would like it to be. And so they're thinking about keeping it around 36 to 38 degrees Fahrenheit. So the question really is, at that temperature, would that be effective at preventing wax moths? Would it kill the larva? I guess this is an overarching question, right? I mean, not just wax moths, but other pests and diseases that are in that colony. And so what are your thoughts on that 36 to 38 degrees and what that looks like?

Jamie 32:22
Yeah, I'm kind of nervous about this question because I did find answers to this question and there's a lot to unpack here. So let's just start by me answering the exact question the beekeeper's asking. The beekeeper is asking if I keep it in a refrigerated room around 38 or 39 degrees Fahrenheit, will that stop the wax moths? And so I'll pause here and say, why would you want to be refrigerated rather than frozen in the first place? That's usually because it's cheaper to build a refrigerated unit than it is to build a frozen unit. So the beekeeper's simply arguing here that, I can achieve these temperatures with a refrigerated unit at a pretty low cost. So is this something that's going to work? And for those of you who are listening to us outside the US, 38 Fahrenheit is about three degrees Celsius. So the question then is, if I can build a refrigerated room at 38 degrees Fahrenheit or three Celsius, will that control wax moths? So I did find, in the literature, an answer to that question. And the answer to that question was, and I'm quoting from a recommendation made by a research scientist, a cold room temperature of four degrees, so that's not freezing, that's four degrees Celsius, so that's somewhere in the neighborhood of about 36-37, a cool room temperature of four degrees Celsius or 36-37 Fahrenheit will suspend all development of the wax moth lifecycles. And in fact, it may kill some of the stages of wax moths. So a couple of things to say here. It's not technically necessary to kill the wax moths, you just simply need to suspend the wax moths. The research suggests that four degrees Celsius, 36-37 degrees Fahrenheit, will do that. The beekeeper is saying, if I can get it to 38-39, will that essentially stop wax moth damage? That beekeeper is right on the edge of that temperature that's reported in the literature to suspend the wax moths. So my gut tells me that 38 is more than sufficient, 38 Fahrenheit, 39

Fahrenheit is more than sufficient to stop the wax moths from causing significant damage to the combs. But since it's just above what I read in the literature of that four degrees Celsius or 36-37 Fahrenheit, I'm a little nervous saying go full steam ahead. I would argue that it's much, much, much better to go the freezing route where there are very clear recommendations. For example, if you take the freezing route, minus 15 Celsius, which is somewhere around five Fahrenheit, from the freezing perspective, minus 15 Celsius, which is about five Fahrenheit, if you keep combs at that for two hours, that's enough to kill all stages of the wax month. Minus 12 Celsius, which is about 10 Fahrenheit, it's three hours that combs need to be at that temperature. If it's minus seven Celsius, or about 20 degrees Fahrenheit, four and a half hours of the combs being at those temperatures will kill all the wax moths. I was doing a little bit of research before we got on the air and the average freezer temperature, refrigerator-freezer, the average freezer temperature is 20 Fahrenheit or lower. So that would be somewhere in the neighborhood of minus seven Celsius or lower. That temperature for 24 hours or longer will kill the wax moths. But again, the beekeeper is interested in refrigeration. Well, I would argue that what they are proposing, that 38-39 Fahrenheit, that 3, 4, 5 Celsius is right there on the edge of what we know will work. My gut tells me it will work. But I would hate for the beekeeper to go through all that trouble, and then find out it doesn't. So what I would argue is that you could set your refrigerator to that temperature, put a few combs in your refrigerator, and look at those combs over time to ensure that they are not being damaged by wax moths. And if you can confirm within your refrigerator, which is keeping a very similar temperature to what you're proposing, if that works, then you could go ahead and build the refrigerated room like what you're recommending.

Amy 36:40
Sounds good.

Jamie 36:40
That's a lot of jibber jabber, right? I did explore a lot of temperatures. But long story short --

Amy 36:45
You know, what Jamie? That's what our podcast is. It's a bunch of us jibber jabbering.

Jamie 36:49
Well, I guess the take-home message is if you freeze the combs, you're okay. If you refrigerate them below four Celsius, we know you're okay. But if you're at five, six Celsius, I just don't know if that's going to do it. Probably will do it. That's the temperature range that he's proposing. So I would just run a test couple of combs on my refrigerator just to confirm before I go all in and invest in that strategy.

Amy 37:12
Yeah, absolutely. And I'm glad we have somewhat of a number as far as the freezer goes because I know that we receive that question pretty often. People will send us an email and say, "If I freeze, I'm trying to kill wax moths, I'm trying to kill different larva, how long do I put it in there for?" So about 24 hours or more for freezing temperatures, I think, is pretty great.

Jamie 37:31

It seems more than sufficient. Yeah, it seems more than sufficient. Zero Celsius is 32 degrees Fahrenheit. So if you can get below 32 degrees Fahrenheit for 24 or 48 hours, that's usually more than enough. But, of course, this beekeeper here wants to store combs at a temperature over a prolonged time and that four degrees Celsius or lower is really your target. And just to convert that again to Fahrenheit, since I can't in my head work both, that is in the neighborhood of about 39 degrees Fahrenheit. So that beekeeper proposing 38-39 is exactly where you need to be. You just need to make sure that temperature stays there or lower.

Amy 38:10
Alright, so the last question that we have. This beekeeper wanted to melt down old comb to use it to wax their new plastic foundation. The question is whether the heat generated in the melting process is high enough to kill off any harmful whatever could be in the comb? What are your thoughts on heat-generating and solarizing the comb?

Jamie 38:32
This is an interesting question because the beekeeper is being ingenious. They want to reuse their own wax to be able to use it to coat new plastic foundation. I like that. There's no reason to throw it away or sell it. You can use it on your own. But what happens if that wax carries with it a pathogen that you then introduce to the new colony that you're putting on top of that foundation? Well, this is a realistic concern. The melting temperature of wax beeswax is around 140 degrees Fahrenheit, which is about 60 degrees centigrade, and that is moreso insufficient to kill something like Paenibacillus larva, which is the causative agent of American foulbrood. For example, American foulbrood can be killed at 30-minute exposure to 130 degrees centigrade, that's 266 degrees Fahrenheit. So most scenarios where you're melting beeswax for the purpose of coating it on new foundation will not kill the thing that we are worried most about, and that would be Paenibacillus larva, the American foulbrood causative agent. Yes, there are some bacteria, fungi, and maybe some viruses that can be denatured at lower temperatures, but the one thing we worry most about will not be affected at the temperature that beekeepers are using to melt wax. So, really, if you're thinking that you've got American foulbrood in your wax, then I would, obviously, not use it for the purpose of coating foundation. You might use it for candles or making Christmas ornaments or something like that, but I definitely would not use it for reuse in colonies. And honestly, that would be the only thing I worry most about. American foulbrood, Paenibacillus larvae, can form spores and these things are incredibly heat resistant and time resistant and all sorts of things resistant. A lot of the other stuff might be killed simply by the melting process. If you melt beeswax, you might get enough heat to kill some of that stuff. But American foulbrood is not something that you're going to realistically control just by melting wax for coating it on foundation. So if you suspect it's got American foulbrood, don't use it for that purpose. If you don't think it has American foulbrood, then by all means, you can melt it, and, for the most part, feel pretty good about reusing it on foundation.

Amy 40:46
Sounds good. All right, everybody. Thanks so much for your questions. Don't forget, if you have other questions, feel free to send us an email: honeybee@ifas.ufl.edu or send us a message on one of our

social media pages. Thanks for listening to today's episode. This episode was edited and produced by our podcast coordinator Mitra Hamzavi. Thanks, Mitra.

Jamie 41:18
Visit the UF/IFAS Honey Bee Research and Extension Laboratory's website, UFhoneybee.com, for additional information and resources for today's episode. Email any questions that you want answered on air to honeybee@ifas.ufl.edu. You can also submit questions to us on X, Instagram, or Facebook @UFhoneybeelab. Don't forget to follow us while you're visiting our social media sites. Thank you for listening to Two Bees in a Podcast.