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SPEAKERS

Amy, Stump The Chump, Jamie, Guest

Jamie 00:10

Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast. Hello, everyone, and welcome to Two bees in a Podcast. Today, we've got Derek Mitchell talking with us about why you should insulate your beehives in summer. We'll be following that with a Five Minute Management on the body's response to bee stings. And then finally, we'll have Amy asking questions to me from you listeners out there in our segment called Stump the Chump. Hello, everyone, and welcome to another segment of Two Bees in a Podcast. So, Amy, you're probably aware that I answer questions for readers from the American Bee Journal, and I know that at the end of this podcast, we always do our best to answer questions from listeners. And about six or so months ago, I got a lot of questions related to insulating bee colonies. And I've always lived in warm climates and so really never had to think about it much. And I started doing some research, contacting some folks, and when I started answering questions about it, I realized how little I knew about this topic. And it was pretty crazy because a lot of people were starting to share with me some research projects and papers that have been published on, you know, when to insulate, and all those types of things. And, you know, a lot of people in northern climates will insulate or not insulate, and there's two sides of all of this. And so, I know we've had even guests on the podcast talking about this issue. Well, most recently, when I was writing about this issue, someone reached out to me and wanted to talk a bit about insulating colonies when it's warm. And so we are very fortunate today to be joined by Derek Mitchell who works in the Institute of Thermal Fluids at the School of Mechanical Engineering at the University of Leeds in the UK. He's currently working on a PhD in mechanical engineering. Derek, thank you so much for joining us on Two Bees in a Podcast.

Guest 02:50

I'm glad to be here.

Jamie 02:52
Sorry, go ahead. Absolutely.

Guest 04:00

Guest 02:54
Right. I'm a researcher into the heat flow of honey bee nests at this Institute at Thermal Fluids. Now, what are thermal fluids? Thermal fluids are the sciences of heat transfer, condensation, evaporation, you will probably more commonly come across these sort of terms when designing a power plant or a power station or a gas turbine. And so it really becomes quite an interesting idea. Well, what on Earth is somebody who's studying this studying honey bees? Well, I'm finding about how a nest or hive interact with honey bees. There was a guy, an architect called Le Corbusier. He said, "a building is a machine for living in," and so, I'm finding about the machine honey bee live in, in order to better understand honey bees.

Jamie 03:39
I was going to say, Derek, I think that's a great summary. When we had done this podcast episode on insulating colonies during cold temperature, you had reached out and talked about the need for insulating colonies during warm temperature. That's a lot of work that you're doing up there at the University of Leeds. Before we get into that work, though, could you tell us a little bit of, you know, about yourself and how you ended up working with bees in the first place?

Guest 04:00
Well, my wife took up beekeeping, and she wanted to buy a hive and she looked at a wooden hive, and I thought "Okay, I think I can build a better one." And so the whole thing was like an engineer, and I said, "Okay, I need to gather the requirements in order to build a better one, a cheaper one," because the hives were expensive. So, that was the main thing. And so, I started to look for it, and I found there were no requirements. And the more I researched, the less I found, and so, I found myself, first, on the back of an envelope doing some calculations as an engineer, what do these bees need? And they got to keep the 34 degrees centigrade and they could be in a place as cold as minus 40 outside, and I think these wooden hives don't seem to stack up the set of requirements. And from there on end, I was just dragged in looking at it completely as, "What sort of engineering do the honey bees really want for their building?" So, in some respect, you can think I'm designing a building for honey bees, and it just sucked me in. And I've been doing that for nearly 10 years now. And now I'm doing it as a formal researcher. So, it's gone a long way from the back of an envelope. Now I use supercomputers, instead of this envelope.

Jamie 05:13
Derek, I have to confess though, you know, when I got in this topic, like I said earlier, I knew so little about it. Having always lived in warm climates, it just, I've never had to insulate colonies for winter. And so, we covered that pretty thoroughly. And now, this idea of insulating colonies for summers pretty fascinating to me. Have you designed some colonies in your backyard or some hives in your backyard that can do this?

Guest 05:36

Well, right from the very beginning, I've started building hives using highly insulating materials and trying to get them to the ideal of a tree, since that's how I identified, right, honey bees. Natural environment is a trait, so, how warm or what are the thermal properties of a tree, and then build a hive that emulates them. Then, I didn't know very much about honey bees. And it was a little bit of an experiment to try and do it. And so, the first couple of years, that's what I did. And lo and behold, the honey bees didn't behave the way that the people were telling me in the books. No, really? I don't believe you, It ended up, some really strange things started to happen, like having honey bees that don't cluster at minus 13 and things like that. So, it's rather interesting. And then, they all became like the first summer, and the summer was quite hot. Well, the honey bees just seemed to like it. And so there, I was in there. So I've been building my own hives, trying to emulate trees from then. But these are sort of hives that not only look like standard hives, like a Langstroth or a British national that they have over here, which is similar but a little bit different, and even ones that are artificial trees, which are tall and thin and trying to investigate more details of the honey bees' behavior, because a lot of the things that change their heat flow in their nest just haven't been investigated. So, there's absences of basic information and basic dimensions on things just really aren't there.

Amy 07:14
So, I want to talk a little bit more about insulating hives in the summer and what you're kind of talking about, because I think a lot of people think about insulating their hives in the winter, right? It's kind of like wearing, I don't know, a jacket or sweater to keep yourself warm. And so, this idea of being insulated in the summer, you know, why should beekeepers even consider this? And what data do you have that suggests that they should be insulated in the summer?

Guest 07:43
Well, in summer, unlike winter, where you might consider the, you know, if it was a building, they move into one small room. If it was as though we'd move into one room and just keep that one room warm. Honey bees cluster, or they can cluster, but in summer, they're using the full nest. The whole of it is up to temperature and working. And so, heat is going to be leaking out of those, those walls. And since heat, heat is energy, nectar is energy, honey is energy, so you can imagine what was really happening? The equivalent of honey is leaking out of the walls. Now, why does that matter in summer? Well, you've got to read -- I have to use, when I'm talking to my engineering peers, I have to use sort of different terms. And so, what it really comes down to is a honey bee nest is a combination of a air conditioned nursery and a sugar refinery, all in the same building. And air conditioning, well, a honey bee is a self propelled air conditioning unit. It's got a fan, it's got a heater, it's got a humidifier, chiller, you know, wings, thorax, abdomen, proboscis, it all comes down to the same mathematics and physics. And the things that they're trying to do, such as maintain a very narrow temperature and humidity, takes a lot of energy. In fact, people who live in places like Florida will know that they spend a lot of energy running their air conditioning. And it's the same equations, it's the same math, it's the same physics driving that. It takes energy to maintain a constant temperature. And doing the sugar refining, this converting nectar into honey, takes a tremendous amount of energy. So, they're having to maintain high temperatures in a part close to the nectar. And to get an idea of the amount of energy that's involved, if you've ever tried making fondant from a sugar solution where you boil away that water, it takes ages and ages just to try and get all that water out, just to get the sugar to make something a very, very thick syrup close to fondant, you'll know it takes a lot of gas, a lot of time on the stove. And

curiously enough, it takes near enough the same amount of energy for honey bees to do the same, except they're doing it between 34 and 40 degrees centigrade. It's a tremendously energy intensive process. And so, the energy that leaks out through the walls is energy that could have been honey. And so, how thermally efficient the nest is, how little heat gets leaked in through, say the sun shining on it, which disturbs the temperature distribution, the bees are trying to keep the brood out, or how much heat leaks out because they're trying to keep a part of their nest hot so that they can keep, they can refine the sugar into honey, matters. So, if you are able to make it more efficient, the easiest way to make it more efficient is to insulate the nest. Now, honey bees can't insulate the nest. What they do is in the wild, they would live in tree hollows, which are usually very thick, very insulated. But if we wanted to make an air conditioned nursery, or if we wanted to have a sugar refinery, what we do is insulat it. And so, when we are in control of making hives to improve their efficiency, to stop the honey leaking out through the walls, we need to insulate this as well. And so, the real thing comes down to well, what does this efficiency buy us? What does it buy the bees? Well, efficiency means that they can do the same with less bees or get more done. And so that getting more done is either making more bees or making more honey. If your interest is honey, or your interest is in actually producing more bees, that's the reason to do it. And because summer is the most energy intensive time to honey bees, that's when you really need to insulate.

Jamie 11:39
Alright, so, I'm going to just take a pause here because I'm catching up with you. There's like a lot of stuff that you said that I want to follow up with. So, you said that the summer is the time of year when the greatest energy demand?

Guest 11:50
That's right.

Jamie 11:51
I did have a follow up question that I wanted to ask you about that. Let me just -- So, Derek, all of this makes sense. Some of it's, you know, really eye opening to me, I guess what, as someone who's been teaching about beekeeping and thinking about beekeeping for a long time, you know, we always talk about the energy needs in winter to keep colonies or keep the nest warm, or at least the core temperature warm where the colony is. And now you're talking about the great energy demands in summer for honey production, for bee flight, to make more bees, all this stuff. So I want to ask a question that's I guess what -- when I say it in my head, sounds a bit naive to me. So I apologize if this comes across naive, but if maintaining heat in a nest is such an energy driven effort that bees have to do in warmer climates, why does it appear that bees spend so much time trying to cool the nest down? To me that would imply that they're not losing heat fast enough, right, if they're having to put energy at the nest entrance, to fan their wings to circulate air to cool the nest down?

Guest 12:48
Well, it's the same thing. They're trying to make an energy change, basically, maintain a temperature gradient. And a temperature gradients are that you either have insulation, or you have to put extra energy in to maintain that difference in temperature. And that's exactly why your air conditioner, right, if you run your AC in a hot climate, you get presented with a large electricity bill. They spend nectar

cooling the hive down. They spend that nectar in terms of going out and fetching water and bringing it into the into the hive, and then fanning their wings, which uses nectar. So, it's a change in efficiency. Now, if you want to go to extremes, let's take a really hot place like Saudi Arabia. There's been research done there where they've actually insulated hives and measured the honey returns. And if you insulate the hive in Saudi Arabia, you get more honey. Basically, the AC load has gone down, so, the extra nectar that they don't spend in running the AC, it goes into the comb in the form of honey.

Jamie 13:44
Got it, Derek, that makes sense. I was looking at it backwards. I was sitting here saying, well, if they're trying to keep it warm in the nest, why would they spend all the time cooling it? But your argument is that they're hot in the nest because it's not insulated well, so the outside temperature is overheating the nest, right? So, in response, they're having to cool the nest. Whereas if it were insulated, it would be easier to maintain the correct warm nest and they wouldn't have to spend so much energy to cool it down.

Guest 14:11
That's right. It's like, that's exactly it.

Amy 14:14
That makes sense, actually. I feel like, you know, like when I was in grad school, I lived in this apartment and the walls were so thick that it was the same temperature year round because it wouldn't get super hot in the summer. And then it also wouldn't get extremely cold in the winter. I don't know why I've never thought about that before this moment.

Guest 14:33
Yeah. I lived in southern Germany and worked in a, what was basically, a converted shed. Right? Thin wooden walls. It got excruciatingly hot in the summer and it got terribly cold in the winter. And that's the whole thing is you end up with -- nice lots of insulation, you can control the interior environment, right? And it's easier, it takes less energy to control the interior environment, no matter what's going on outside, providing you've got a heater and providing you've got an AC unit to take, you have to lower the temperature and honey bees, self propelled AC units, aren't they?

Amy 15:10
Yeah, absolutely. So okay, so I have a couple of questions for you just following up on that. You know, you're talking about how you've made this hive, right? And so, I'm wondering, you know, first of all, what are you using? Like, what kind of materials are you using to make this and, you know, and also how much insulation is needed so that it's optimizing the colony temperature in both the summer and the winter, right? Because you're not going to switch between using a different colony in the winter or the summer. There must be a fine line between those two.

Guest 15:44
Okay, right. Here comes the $64 million question.

Amy 15:49

Yeah, I was about to say, tell us all the math that you know.

Jamie 15:54
Be careful, Amy.

Guest 15:55
It's complicated.

Amy 15:56
I don't understand any of it.

Guest 15:57
It's complicated, and it all depends, right? The ones I made as my first experiments, they're made out of something called polyisocyanurate. It's basically stuff that's made in, get from the building depo, which is this pale yellow stuff covered with aluminum foil on both sides. Have you seen, I'm not sure whether you have that in the States.

Jamie 16:18
We have similar products. Yeah, you can get them from the building stores as well. And I think, usually, I'll only see him with like an aluminum foil on one side. But, absolutely, I know what you're talking about, similar materials.

Guest 16:28
Here in Europe, it's on both sides, right? And so, the whole thing was is I started building out of that, out of two inch thick, of this stuff. It's better insulating than polystyrene, or Styrofoam, if I've got the right translation. And so I made it two inches thick, just really, because it was a convenient thickness to make it out of. And I built it. So it's got two inch thick walls, two inch thick roof, and I made it with a solid floor because it was easy to make it with a solid floor. And later, when I got into doing the actual experiments of measuring how much heat was lost out of one of these hives that I made ,and I compared it to a standard wooden hive, I found I was losing, in my hives, 1/7 of the amount of heat, which made it quite close to what a tree is by pure, pure luck as it happens. And so here, I was putting honey bees into an environment, which was similar in thermal properties to what they would have in a tree, but it had this similar format that you would use in the -- that we use as beekeepers. The hive had frames in, standard frames, bought off the shelf, put in, internal dimensions, identical to a bought off the shelf hive that you can get here in the UK. The bees liked it. They do all the normal things, they do some interesting things in terms of their behavior in winter. But in summer, the amazing thing was they didn't quite appear -- grow at the same time. They appeared to be slightly delayed. And but when they started to build up, they built up credibly quickly. We had, to us, what seemed to be great honey yields. And the one thing it really did was we had to sharpen up our swarm control because you would not just get one swarm, you would also get a cast swarm, a second swarm out of the same colony almost every time. So you, bees were able to do in a more efficient environment, so they can either do the same with less bees, which meant they could build up faster, or they could do more with the same, which meant that they could produce more than one swarm out of the same colony. So, when -- if you've got more than one queen cell, instead of the queens killing off each other to just having one virgin, you'd end up

with two or three would then appear, appear from the same height. So one had to sort of be on one's toes about that. It also ended up with some rather interesting differences, you'd pull out a frame and the thing that we were taught in bee classes, "Oh, well, you're gonna have to shake the bees off to have a look at the eggs." And we looked and there was not many bees on a frame. You could actually near enough see the eggs without having to shake the bees off. So, there were less bees in the nest, or rather, less bees looking after the brood as well, which obviously accounts for why they can build it faster. There are more bees going out foraging, rather than having to be in the brood nest keeping it warm. So, the observations as just a -- as a beekeeper, reinforce this idea it's more efficient. And so, and it all ties up with the math. A honey bee nest that's insulated will be significantly more efficient in terms of what they're trying to do.

Jamie 19:27
So, Derek, you think this would always lead to more honey, more bees, potentially more swarms, or do you think -- I mean ,again, I'm just -- it's such a -- to me, insulating in winter is one of those things that, you know, northern beekeepers talk about, but to me, insulating in summer is such a new thing, right, to my mind. So, I walk through the bees everyday in the back of the University of Florida bee lab as I walk to my car, you know, and these days we're, convert to Celsius, we're in the 30 to 35 degree range. And so I think a lot of beekeepers would be reluctant to insulate in the summer. So, I really like this idea that you're generating these data that more honey, more bees, etc., but you think this is so beneficial that all beekeepers should do it?

Guest 20:08
So, what about, what about pests and diseases? Have you all seen any benefits of using this? Well, we have bee farmers in the UK and, okay the UK is generally cooler than the, some parts of the US and generally, not as cold. But we have bee farmers who are running things like thousands of polystyrene hives, which are effectively insulated versions of wooden hives. And for them, it's really, it's a commercial decision to go to polystyrene because they get more honey. 20 -- one guy was quoting, that I quoted in my papers, talking about 20 to 30% higher honey yields out of polystyrene hives. And he really sees things in terms of better. He's collected a lot of information on it. And he really reckons that they survive better in winter because they have a better summer. Because he, because they end up with, they got a good population, they got plenty of stores, in terms of pollen, ready, they're all set up for going through winter. So, if you consider saying that a winter is won in the previous summer, then the whole thing is about efficiency in summer, not necessarily about keeping the colder in winter. Well, I -- Well, okay to you, at the University of Florida, a lot of these things haven't been researched because the whole idea of using insulation and polystyrene hives is, well, relatively new, but not that well researched, because there are various things which make complications into it, like ventilation, and should you ventilate or not. And anyway, when you start getting terms like humidity into the mix, I've -- we've only ever treated once one year, and since then we haven't bothered to treat. And when we inspect the bees and go looking for Varroa, we don't seem to see very much of it. Now there is Varroa, and we look at the number of, amount of deformed wing virus, but I'm dealing on a small number of colonies here. So, as we go to having something which has got all the proper controls, and the rest of it, is like I haven't done that. However, there are some research mechanisms that could be at play here. People have noted that high humidity, high nest humidity inhibits Varroa from breeding, or rather high humidity, Varroa breed less successfully. Now, when you end up with having insulation in a hive, the

humidity level can go up if the honey bees let it, and if there isn't honey cells exposed, the humidity can rise. And that's, you know, straightforward building science. I'm an engineer. I know if you insulate, put in the vapor source, put in the heat source, you can end up the humidity continuing to rise. And so, it's quite possible to get something like 90% relative humidity inside an insulated hive. No problem. And some people have been measuring this and showing in insulated hives, you get that. And in fact, it's exactly the same issue that people have been finding out when they had insulated, very highly insulated houses in Germany and Denmark where the only source of heat is the people inside it. And so they end up -- the humidity starts to rise because the humidity isn't being condensed. A conventional hive is actually a thin-walled hive that's losing a lot of heat. It's actually a dehumidifier, rather than something which maintains humidity. And you may think, "Well how can that be?" Well, if you go into your refrigerator and you put a block of cheese out there and you don't wrap it up and you leave it there, you'll find it goes hard. All the waters come out of it, and that's because the cold surface of the back has actually been dropping the water out of the air, has been condensing down on that. So, the air inside has become less humid. So, if you can raise the internal surface temperatures, then the humidity inside is going to rise with the respiration of the honey bees. And yes, you'll get condensation, but the condensation inside is going to be a lot warmer. In fact, it can be -- you can get condensation with reasonable amounts of insulation on a honey bee hive. You can get condensation, something like 30 degrees centigrade on the roof, but then 30 degrees centigrade water isn't a threat to the honey bees. In fact, it's a, it's a source of water for them. In fact, honey bees seek out hot water, hotter water. So, there you go. It's -- everything seems to turn on its head once you start to go off conventional beekeeping law, once you start to insulate. And also, in terms of ventilation, the whole dynamics of what happens when you think of venting the top changes when you start to insulate. Things like chimney effects become magnified if you actually insulate. And my first experiments with honey bee hives saw this happening. On a cold day, I actually built a ventilator into the top, and I opened it, and you could actually see the water vapor condensing all around it. And obviously, the interior of that hive was very humid. So, I closed -- when I closed it up again and turned it, when I had another look at this vent, the honey bees were all over it, busily trying to propolis it over. They were -- they knew that they didn't want that to escape. As I say, once you start to insulate, the rules start to change. The behavior of the honey bees start to change, particularly in terms of timing. So, there's a little bit of a downside for commercial beekeepers who are used to doing things a particular way of trying to get a whole series of honey bees to appear at a certain time, the rules change. So, one has to adapt to what the honey bees are doing, rather than trying to use all the rules that we brought out of the past.

Amy 25:24
Sure. I'm just thinking, you know, here in Florida, we have a lot of -- a lot of humidity. And so, I'm just thinking about, you know, the potential for mold or fungus. And you know, I'm sure the bees can take care of that. But that's kind of my first thought, you know, when I think about humidity and condensation.

Guest 25:40
Right, when you consider the inside of a hive, at 34 degrees centigrade, and then when you consider what's outside -- I've been to Florida and I've been out one of those days where, you know, it's you can be out in T-shirt and shorts, and it's still raining, and you still feel cold, which for somebody from the UK is quite a strange experience. So, let's say it was 24 degrees centigrade at 100% humidity, you take

some of that air and heat it up to 34 degrees centigrade. Now, it's only 50% relative humidity. In fact, you can actually desiccate your honey at that, with that amount of water vapor in the air. So, when you try and take, what we consider to be high humidity, and what's high humidity in a honey bee nest, it doesn't -- they don't really match up at all. In fact, it's so counterintuitive, I have a pocket calculator with me programmed to do the conversions so I can --

Amy 26:29
That's okay, we won't make you do the calculations here on the podcast.

Guest 26:32
But essentially, for every 10 degrees increase in temperature, the air can carry twice as much water. So, what's bringing humidity 24 degrees centigrade is arid at 34. And so when it's raining in the UK, it's 15. It really is like a desert compared to being inside a honey bee hive at 34 degrees centigrade. If you take the same air, the same amount of water and heat it up --

Jamie 26:56
I feel like I'm getting such a great lesson in thermo fluids. This is really fascinating, Derek.

Amy 27:01
I know.

Jamie 27:01
So, okay, I think, like I said, I think one of the struggles that we'll be living in warmer climates, it just, it seems, the idea seems radical. And I think all good ideas start off that way. So this is exciting. So let's say that all the data support all of this and insulating hives is the way to go. One of the things that you mentioned a little earlier about Styrofoam boxes that you have in the UK, now most Styrofoam boxes I've seen sold in the US are kind of big and bulky, right? Their walls are very thick compared to the traditional, for example, Langstroth wooden hives. I'm not saying this is good or bad, I'm just saying that it seems like it takes a lot of styrofoam to provide the insulation we're talking about. With that said, I think about our commercial industry that these beekeepers who have, you know, maybe thousands of colonies or hives and having to convert those to insulated. Are you excited about the direction that all of this research is taking, and think that it's just a matter of time that beekeepers begin to buy into the need to insulate? And with that said, do you think there's materials available today that would make it where the hives that are changed don't have to have two or three inch thick walls, but could still match maybe the standard wall thickness of a Langstroth hive, but improve insulation of those hives significantly. In other words, it would make it easier for commercial beekeepers to convert because the dimensions are still similar, even if they're getting more insulation benefit.

Guest 28:28
Unfortunately, no. The best you can get is this PIR material. They notice that if you want to keep this same internal dimensions as the Langstroth hive, it's going to have to be relatively thick, unfortunately. Because the whole thing about heat flow out of a building, right, or whether you -- a hive or a real building -- it sort of comes down to the ratio of the internal dimensions to the external dimensions and the thermal conductivity of the material, how good the material is. The thing is, honey bees in a tree,

their internal dimension is only 200 millimeters on average. Yeah? If you look at Seeley's original work, average, it's about 200 millimeters across, eight inches across. But the outside of the tree is more likely to be 12 inches more than that. So that ratio is really very good for the honey bees. And that's what they've evolved for. That's what they've optimized to. And to be honest, honey bees have been doing this thing for 20 million years. They've got the -- they found the answers, they've got a head start on me. So, really, it's going to have to be biting the bullet about a compromise on what we can actually use in trying to get close to a tree, but we're not going to -- probably not going to make it and so it's going to be looking at things like can we have 30 to 40 mil on the walls, can we do something like make the roofs thicker? Because heat goes up there. Or even things about what we do with bee space, which is part of, parts of my research, which I'm in the middle of. There are things about what we can do with the floor and the -- and the entrance. There are things for instance, one of the things that's coming out is that a large chunk of what we're losing from our hives, in terms of heat, is radiation. Because of the strange parts of the geometry and the temperatures, we're losing a fair chunk from radiation, so maybe the external color surface coating can help us with that. And then there's the idea of using mesh floors. They actually lose quite a bit of heat out through the bottom through radiation, and even a small breeze actually sets a perturbation of air going upwards into the nest. So there are things there that need to be looked at. The actual entrance opening, that entrance opening can be six inches long. And even though it might be quite wide, it might be, say, an inch across, that's got something like five times the air resistance of even the reduced entrance that you would have on a -- on a wooden hive. So there are a number of things we can do as regards to compromise. And so the real thing is we need to do some more research about how to optimize that compromise. Just making a polystyrene version of a conventional hive isn't really going to get there. There's going to be -- we're going to have to try and be a little bit more inventive, and do some more engineering.

Jamie 28:33
Okay.

Amy 31:18
Sounds like we need to get a couple of grad students to be working on this project. Right, Jamie? I feel like --

Jamie 31:26
Maybe more like 20 graduate students.

Amy 31:28
Yeah, right?

Jamie 31:30
That's why Derek's doing this, right Derek?

Amy 31:32
Well, I was about to say, I feel like Derek probably looks at everyone using a Langstroth hive, and he's just like, "That was so last year." You know, that's so last year, there's so much potential for future hives that we can use to make it optimal for honey bees.

Guest 31:47
Well, the real challenge is making it optimal for honey bees and beekeepers at the same time.

Amy 31:52
Exactly.

Guest 31:53
I think what we need to do is explore how to get -- come to a new compromise between the two.

Amy 31:58
All right, so that actually leads into my last question for you. Where do you see the future of hives? Where do you see this heading?

Guest 32:07
There are some -- I think the real thing we got to do is understand more about how the honey bees actually fly this thing, drive this thing, work this device we call a honey bee nest. And I don't think all the results are in. So I think we're gonna end up putting a lot more insulation. We may well make them taller and narrower. Curiously enough, it looks as though what we've got to do is try and put in as many features that are in a tree nest that we can live with. And that is where I think it's going to go. 20 million years of optimization is unlikely to be wrong.

Jamie 32:44
Derek, every time we have someone on our podcast to talk about their area of expertise related to honey bees, I'm constantly amazed, not only at the humans studying them, but even maybe more so the honey bees themselves. I mean, we've all known that honey bees are great botanists, they're great at raising young, they're great at pollinating ,on and on and on and on. But, you know, having talked to you today, we're finding out how miraculous and marvelous engineers that they are, how well they do and all the thermo regulatory work and how they, quote, figured that out, right?

Guest 33:16
Every time I look at some of the details, I end up doing another simulation, another insight. It's like you look at a honey bee cell, just look at a honeybee cell, right, a honeycomb cell, and the dimensions of it, the height, the size of it, and the length of it. And the fact that it's nearly horizontal means that when they're empty, they're probably as good an insulator as you can buy in Home Depot, right, for 25 mil thick there on the bottom. But that also means that the microclimates at the bottom end of the cell where they place the egg is almost completely insulated from the intercellular gap, intercomb gap. So that's engineered. So it's -- it just keeps on going on and on. The more I go, "Oh, that looks like a neat idea, I wonder, oh, they've already done it."

Amy 33:58
Yeah. I'm going to let you think about it, because my head hurts thinking about what you just said, microclimate at the bottom of a cell.

Jamie 34:08
I think we've all chosen good careers, I think is what the take home message is, right?

Guest 34:13
Well, even if you look at a cell, right, take the walls of the cell. And this is somebody else's research. I looked at it as an engineer this way. "Oh, this is fantastic." As beekeepers, we see the -- we see, you know, brood comb and it starts to go black after the bees have used it a few times. And when we try to extract the wax, we end up with this terrible black gunge that we have to try and, you know, try to dispose of. But actually, as an engineering material, what they have built up with the various layers of silk from the cocoon, they've in fact built up a composite material that's very light and very strong, which actually strengthens the entire structure of the combs inside the nest.

Jamie 34:50
This is fascinating. They're just fascinating.

Guest 34:53
The engineering with honey bees, it really does take a heck of a lot of maths to catch up with honey bees.

Jamie 34:59
The first engineers, right? The first engineers. Well, Derek, thank you so much for joining us on this episode of Two Bees in a Podcast, sharing with us information about how honey bees insulate hives and advocating even insulating during summer. I think your research is fascinating. I think the more I look into this insulation thing, the more I'm convinced, and I really appreciate you spending some time with us.

Guest 35:21
Thank you.

Jamie 35:22
Everyone, that was Derek Mitchell from the Institute of Thermo Fluids in the School of Mechanical Engineering at the University of Leeds in the UK. He's currently working on a PhD in mechanical engineering and, of course, sharing with us his knowledge of insulating honey bee hives. For additional resources, visit the podcast page on our website, UFhoneybee.com.

Amy 36:10
And today's Five Minute Management, Five Minute Management, we are on the second segment about sting management. So, in our last episode, we talked about how stings work. Now, today, Jamie we are going to talk about our body's response from stings. And so, you have five minutes to discuss how our body responds to stings. And I'm starting the timer now.

Jamie 36:33
So great, Amy, thanks for covering this topic. I think it's very important for beekeepers and one that we often don't cover. Usually, when folks go to new beekeepers seminars, they're learning how to put

boxes together and the biology of bees and the diseases and pests, but stings are a reality. In our last Five Minute Management, we talked about how they work. Well, now we can talk about how we respond to them. And I think this is really important. But I want to give a couple caveats. First of all, number one, I am not a medical doctor. So all I'm doing is reciting to you listeners out there what I've read through the beekeeping literature. In fact, I produced a document on this for the American Bee Journal some years ago, and we'll make sure to link to that document in the show notes. But there's a table in that document, which is table two, and I called it normal and allergic reactions to honey bee stings. So, human bodies have typical and atypical responses to bee stings. And in all of my research for putting that document together, there were six categories of responses. And again, the caveat is, you know, I'm not a medical doctor. So, if you are stung, and you are worried about your body's response to it, you need to seek medical help. Alright, so the first reaction that our bodies can have is a normal non-allergic reaction at the time of the sting. This is something, usually, everyone experiences. You'll get pain, sometimes sharp and piercing, you can get burning, itching, you can get redness around the sting site, you can get a white area immediately around where the sting went in, the puncture mark. You can get swelling, and it can be tender to the touch. And incidentally, you can get, you know, pretty mild versions of all of those things, and what I would call maybe, significant versions of those things. And, and nearly everyone who gets stung has at least that normal response. Now, the second response is a normal nonallergic reaction hours or days after the sting. So, the difference here is is the very first category happens when you are stung. The second category, it happens some hours or days afterwards. And that usually includes itching, residual redness, a small brown or red damaged spot at the puncture site, that's something I get on my fingertips. When I get stung on my fingertips, I get all of these little tiny little blood clots as it were, kind of at all the sting sites. And you can get significant swelling at the sting site. And again, these first two categories are nonallergic, they're just the body's response to the venom that's going into it. The third category is what is called large local reaction. So, local means it's close to, or around, the same site. So, what you get is a rapid or massive swelling around the sting site. And it can extend an area of 10 centimeters or four inches or more from the sting site and frequently increasing in size for the next 24 to 72 hours, and it can last a week in duration. This is a reaction that a lot of folks think is an allergic reaction, whereas it's not, where you might be stung, for example, around your wrist, and your whole hand and forearm swell a day or two later. So that's not necessarily an allergic reaction. It's still a reaction at the site of the sting. The fourth category is a cutaneous allergic reaction. And that's where you get hives, rash, massive swelling, often remote from the sting site, you can get some generalized itching, some generalized redness. It's non life threatening, but it's usually worrisome to the sting victim. When they see this happening, they get nervous that they're having an allergic reaction. And again, anytime you're worried, you should seek medical attention. The fifth category and the sixth categories are both allergic reactions. In the fifth category, it's non life threatening. In the sixth category, it's life threatening. And again, I'm not qualified to make that call. So, you have to ask a doctor when you're -- when you're worried about it. But in category five, the non life threatening systemic allergic reaction is when you can get allergic inflammation inside your nose, around your eyes, you can get some minor respiratory symptoms, you may get abdominal cramps, severe gastrointestinal upset, maybe nausea, vomiting, diarrhea, etc, weakness, and fear or other subjective feelings. And Amy, as you can imagine, if you're having any of those symptoms, you're instantly worried. And while it may not be life threatening, you may not know that at the time, so it's always best to seek medical professional help, in that case. And of course, the sixth category is the one that's most worrisome. That's the life threatening systemic allergic reactions.

And that's where you have shock, unconsciousness, abnormally low blood pressure, respiratory distress, swelling of the throat, face, tongue, mouth, tissue, etc, rapid pulse and dizziness, and that could indicate that you are having a significant allergic reaction and that you're in danger of dying, so you definitely need to seek medical attention. Again, I feel like I've said it 15 times over now, when in doubt, seek a medical professional. But what is important to know is the vast majority of us only have non allergic reactions to stings, you know, only a minority of folks are actually allergic. I've read that somewhere between 1 and 3% of the population actually can have life threatening allergic reactions to bee stings. And one final word here is that folks can actually develop allergies over time to bees. You can work bees for 30 years and have no significant allergic reaction to bee stings. But, you know, the 31st year you get stung one or two times, and your body now recognizes it in a way that leads to an allergic reaction. So, I've known of folks, who've had to give up beekeeping for that reason.

Amy 42:17
All right, well, I felt really bad for you, because you almost got there. But then you went a little bit too long.

Jamie 42:22
Well, you know, it's one of those things, like, well, it's such an important topic, we need to make sure that folks hear it all the way through. And again, there's a great document, well, I hate to say that when I'm the one who wrote it. There's a really good document that covers all of this, the body's response, and there's a good table where you can see all of these things. And it's funny, Amy, my dad when I was a young boy, he had a category three reaction to a bee sting, and I didn't recognize it at the time, and my mom was a nurse. And, you know, we labeled him as allergic and he never again helped me with my bee colonies. But in hindsight now, knowing what I know, it was just a large local reaction, his whole arm was swollen. But again, that's certainly within the realm of normal. So a lot of folks jump out of bees because they have what they consider an alarming reaction, when in reality, it's just one of those first few categories. But it's always best to talk these things over with an allergist or medical doctor.

Stump The Chump 43:27
It's everybody's favorite game show, Stump the Chump.

Amy 43:45
Welcome back to the question and answer time. We've got a couple of questions for you, Jamie. And there's a little bit of background, so I'm going to read them straight from what our email was. You ready?

Jamie 44:00
I am ready. Let's do this thing.

Amy 44:02
Okay. So, for the first question, this person was telling us that in April of this year, they had a hive that absconded. One day, they were there, and they were gone. That's the meaning of them absconding, right? So they -- this person doesn't know where they went. And so they ordered and installed two nucs at the beginning of June. The bees seemed to settle in nicely. Several days later, this person noticed

that they saw some robbing activity. So there was a mass chaos at the opening of the hive, bees are flying everywhere, none of them are really interested in this person. They ended up closing the entrance in order to robber screen for each hive. So this person put the robber screen on, closed it up, but, you know, had like one small opening. Today, this person noticed that the robbing behavior started again. And so, they even shut down the small opening. And so, this person thinks that the absconded hive from April is now trying to rob the new hives. So what do you think about that?

Jamie 45:01
Yeah, so there's a lot of stuff going on here, right? And so, just for the benefit of all the listeners, colonies abscond, which otherwise looks similar to a swarm, but in the case of an absconded colony, the entire colony leaves the nest. Swarms, the colony splits in half and half stays behind, half leaves to go find a new nest site. When colonies abscond, everybody goes with a swarm and leaves behind an empty hive. Absconding is not quite as common in the bees we keep as they are in like African derived bees. So when you're in Africa, those bees will abscond quite frequently. Certainly, when I was living in South Africa for those three years, but in the US, I don't, I don't believe in my life that I've ever had a colony that I've kept abscond. So it's not, it's not an overly common behavior, but it can certainly happen. And they usually abscond in response to stress or disease or pest pressures or maybe food, lack of food, etc. Okay, so in this particular case, the colony absconded, moved into the feral environment, it's out there established somewhere. And in this particular instance, two more colonies were brought in and robbing started. So what is robbing? There are times of the year when resources are unavailable to bees in the environment. And in those cases, bees will often rob weaker colonies. So, bees from strong colonies might go to weaker colonies, go into those entrances, fight bees, grab some honey or nectar, and then fly home to their hive. And the way that you can know robbing is happening is when you have a lot of fighting at the nest entrance, and when you see bees trying to get into a hive in all areas of the hive, except the nest entrance. You'll see them trying to go in under the lid or at the feeder, between the seams where two supers touch, you know, they're just trying to find their way in everywhere, and including the entrance. So in this particular case, you've got two colonies being robbed and the reader's -- or the listener's asking, well, maybe it's that feral colony, the one that absconded. And so what I would say to that, it's really difficult to know, I would argue that the two colonies are probably robbing one another just as much as colonies from the outside of the ones that she's managing, are robbing them. So, any colonies in the environment, as well as colonies in the apiary, can engage in robbing behavior. So, what I would recommend to stop the robbing is do, first step, kind of what the listener did. They got a robbing screen, a robbing screen is something you put on the entrance of the hive that the bees from that hive learn to navigate. But bees not from that hive, they fail to learn how to navigate it, so they end up going to a specific spot on the robbing screen, can't get in, and it slows robbing. If that continues, you can reduce the entrance to where there's only one or two bees that can pass through so that there's not this big flow of bees that can go in. You also need to make sure bees cannot access that hive anywhere else, cracks in the lid, cracks in the boxes, underneath the hive. You also need to ensure that if you're feeding them, that you're not spilling sugar water anywhere on those hives, it might be attracting other bees. And if you do all of those things, and they are still being robbed, you have to consider moving the bees to another location because, clearly, the robbing pressure is high there, and then you can move them back a few weeks later to see if robbing dwindles. I rarely move bees under robbing circumstances. I always, almost always simply restrict the entrance and monitor them to try to limit the amount of space that other bees have to go in.

So it's certainly possible that this colony that's absconded is engaging in this robbing behavior, but it's equally likely that the two colonies that are being managed are robbing one another. And there could be other colonies in the feral environment participating as well.

Amy 46:07
So is it true that if you have an entrance feeder that that promotes robbing, or no?

Jamie 48:58
It is, Amy, basically, if you think about it, there's multiple ways to feed bees, right? There's ways that you can put feeders directly inside of hives and those tend to attract the fewest, fewest robbers. But if you put feeders outside of hives, for example, through the lid of a hive, which is very common in commercial operations with those big glass jars, or at the entrance of a hive, that makes the food somewhat accessible to bees from other colonies. Now, if you feed bees on top of the hive, the only way that they're going to rob that is twofold. Number one, maybe you got a lot of sugar water on the outside of that jar, and they're just licking the outside of the jar, but in order to get to it by going through the hive, they have to go through the entire hive, right, through the entrance, through the nest, all the way up to the top. So I think the risk of robbing in that scenario is lower. Now, when you put that same feeder in an entrance feeder and stick it onto the front of the hive, the bees that are from the other colonies only have a few inches that they have to navigate to go directly to the feeder themselves. And so, if robbing is a really big issue at that moment, you should consider not using entrance feeders for that spell. And even hive top feeders can attract robbers and start the process, even if they're unable to rob through the lid. And so, a lot of folks who find themselves feeding during periods of nectar dearth when robbing rates are high will use exclusively in, in-hive feeders, feeders that go inside the hive.

Amy 50:29
That makes sense. Alright, so for the second question we have, if I were to prophylactically requeen my hives annually, maybe with a VSH queen, or maybe not, what is the best time of year to requeen? Is there a good biological reason to do it any particular time of year?

Jamie 50:48
I can't really think of a biological reason to do it a certain time of year. Most folks like to do it, you know, and again, I'm using this word, "most," very generally. Most folks like to do it in spring. The problem with requeening in spring is that's when queen demand is highest. So it's hardest to get queens that time of year. So, if you, if you think about it purely from a biological perspective, colonies make queens most during spring, because they're making queens to replace the old queen that left with a swarm, right? And that's strictly from an unmanaged colony perspective. So in that scenario, requeening early spring before the major nectar flow or during the nectar flow is biologically when bees would do it anyway. But, of course, requeening during that time is potentially, very, very detrimental to your honey productivity, because you're requeening at a time of the year that you don't want any breaks in the brood cycle. So correspondingly, a lot of beekeepers will requeen colonies after the honey flows, number one when queens become more available, but also in an effort to not mess up colonies during production season. There's even a cohort or contingency of beekeepers who preferr to requeen in late summer, because queens are even more available. And then that way, they've got a young queen, you know, a six month old queen or so leading the colony next spring when they come out of winter. And that's a really good

way of having really young queens just ready to go when you're going into your major nectar flow in spring, when purchasing queens is not otherwise an option. So, a lot of folks really like those kind of late summer queens, just because they're available, they tend to be -- they're often cheaper that time of year, and it ensures that you'll have, you know, a queen who's only about six months old in spring, when spring rolls around. So, you know, there's really no best practice in this regard. I think the best practice is to requeen annually. I think that's the key thing to do. Apart from that, it's really just whatever's convenient for your management situation.

Amy 52:52
Awesome. Okay, so for our third question, it's another queen question. And this person tried to requeen a colony with a cage queen, they dequeened the hive, so there was no way that she survived. They put the new cage queen in a few hours later, and then came back three days later. The bees are fighting, stinging the queen cage, and so this person started looking through the hive and found another queen. So, under what circumstances and how often do hives have mother daughter queen present at the same time? And, you know, this is actually not the first or second or third time I've heard of this situation. We actually had someone just last week call us because they found three queens in a colony. So, why would that happen?

Jamie 53:37
Yeah, so it's a weird occurrence. And I, I've even written about it recently. And maybe we talked about it a little bit on the podcast before, I can't remember. But I will say I started noticing this myself when I lived in South Africa, because I did a lot of work during my PhD days using observation hives. And so, when you watch bees in glass beehives, you start to see things that you don't otherwise see when you're just managing them in wooden hives because I was visiting those hives three times a day looking at them. And I would routinely, in my test hives, find colonies with multiple queens. It didn't usually last long, maybe a month max, but it was very common, common enough to when I moved back to the States and started keeping bees here again, I would notice it in my colonies. And I've never kept a lot of colonies at one time just because, you know, I'm a busy person. And we have a lot of bees here at work, and I work with other people's bees. But you know, when I would keep just a few colonies on my own, in my backyard, I would even notice it with some regularity in there. So, it kind of led me to predict that our colonies might have multiple queens as much as 10 to 20% of the time. And that's potentially way off. It's purely based on anecdotal observations that I've made. I've never been able to read information related to this topic. But the reason I'm pointing it out is just purely from experience. And most people don't know their colonies have two queens because when they look and find a queen, they stop looking. And so, usually, folks will only notice that they have two queens in the colony if they see a queen on one side of a frame, and then they flip the frame and see a queen over there and go, "Gosh, she got over here really quickly," and then they flip it back and go, "Wow, she got back here quickly again." And then it dawns on you, maybe there's two queens. So I would say it's relatively a frequent occurrence. If you have 10 colonies, you're probably, if you look hard enough, you probably see it once or twice a year in your colonies. Now, why does this happen? I simply don't know. My guess is, every time I talk about this my guess is there are probably times of the year, for example, during swarm season, where multiple queens are emerging at one time, and they just haven't found each other and followed each other to the death yet, right? So that's that's one possible scenario. Another possible scenario is, perhaps, you have an aged queen. Maybe she's old and her pheromonal output is

decreasing. So, the bees don't know she's there, so they make another queen. And that new queen becomes what they believe the reigning matriarch in the hive, when you've just got two laying queens in there. Even if that happens, I don't see it lasting that long. So, you know, I've got a number of hypotheses. None of them have been tested. But I started to get this question enough that it makes me kind of want to look at this topic and see what leads to it. But it's an interesting observation. When I see it happen, I usually let the bees just sort of out themselves. I don't like to make that decision because I might end up choosing the queen that was the problem in the first place, which is why they made the second queen. So, almost always, it remedies itself within just a few weeks or maybe a month or so. So, I rarely take the step to dequeen them myself if there's multiple queens in the hive.

Amy 56:42
Alright, well, thank you. So, everybody, don't forget to send us your questions on social media, send us an email. We'll try to get to your question as soon as we can. Hi, everyone. Thanks for listening today. We'd like to give an extra special thank you to our podcast coordinator, Megan Winfrey and to our audio engineer James Weaver. Without their hard work, Two Bees in a Podcast would not be possible.

Jamie 57:25
For more information and additional resources for today's episode, don't forget to visit the UF/IFAS Honey Bee Research Extension Laboratory's website ufhoneybee.com Do you have questions you want answered on air? If so, email them to honeybee@ifas.ufl.edu or message us on Twitter, Instagram or Facebook @UFhoneybeelab. While there don't forget to follow us. Thank you for listening to Two Bees in a Podcast!