Episode 235 Transcript: Viral Infections in Honey Bee Queens with Dr. Leonard Foster

Meet Dr. Leonard Foster: From Hobby Farm to Honey Bee Research

Jamie

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.

Hello everyone, and welcome to another episode of Two Bees in a Podcast. Today, we are joined by Dr. Leonard Foster, who is a Professor in Biochemistry and Molecular Biology at the Faculty of Medicine, as well as the Director of the Life Sciences Institute at the University of British Columbia in Vancouver, Canada. Leonard, thank you so much for joining us on this episode of Two Bees in a Podcast.

Dr. Leonard Foster

Thanks very much for having me. I'm happy to be here.

Jamie

Man, I'm stoked to have you because the topic that you're going to talk about with us today is one that we kick around the lab here all of the time. In fact, we have our breakfast meetings as a lab on Wednesday morning. And just this very morning, before we record this podcast episode, we were talking about how queens are so long lived in colonies and get exposed to all the stressors there.

And you are going to specifically talk about elevated virus infection in honey bee queens and how this leads to all sorts of downstream effects. And Leonard, I just can't wait. So, thank you again for joining us.

Dr. Leonard Foster

Thank you.

Jamie

Well, this is a topic that's fascinating to me. And I think, Leonard, one of the things that I think people are talking about a lot is queen supersedure, queen longevity and viruses. In a research project that you and your colleagues recently published in the Proceedings of the National Academy of Sciences, you touch on all of these issues. So, I'm so excited to jump into that, but I need to maintain my excitement, and then just start from the top. Leonard, could you tell us a bit about yourself, your background, and how you got into research with honey bees in the first place?

How Dr. Foster Began Studying Honey Bee Health

Dr. Leonard Foster

Sure, so I grew up in a small town in northern British Columbia. It's about 8 hours' drive north of Vancouver. My parents were both teachers in the local schools, but they also had a hobby farm, and I don't actually know how my mom got started with it, but from as early as I can remember they had a couple honey bee colonies around our hobby farm, and mostly it was for producing honey.

There wasn't really much in the way of pollination needed on the farm so it was mostly honey, but I've been around bees since I can remember. So, one of the important things to know is my dad was a science teacher, and both he and my mom started the first science fair in our community when I was in grade 4 or so.

And of course, because they had started that, then I got dragged into doing science fair projects. I did a bunch of different science fair projects. I should say I got dragged in because it wasn't completely willingly at the beginning, but I came to like it quite a lot. When I was in grade 9, I started a series of projects that went through grades 9 to 12 where I was looking at the antibacterial and antifungal properties of propolis.

So, my mom helped me a lot on that. My dad helped me on the lab side of things. We did a few projects over the first few years, and then after the summer of grade 11, so going into my senior year, we made contact with a couple professors at Simon Fraser University, which is another big university in our province.

And a lot of your listeners will probably recognize the names, one of them was Mark Winston and the other was Keith Slessor, who have pioneered a lot of the work around the queen mandibular pheromone and its effects on bees. So, we got their input on one of my science projects and that all went well.

I graduated high school and then I started university at Simon Fraser. And during the four summers that I was there, I managed to, or I had the opportunity to work in the labs of Keith and Mark. I was sort of a gopher running between the labs, helping out grad students and whoever needed help.

I did a lot of beekeeping but helped set up a lot of different research projects at that time. Then I went away and did a PhD and a postdoc. They had nothing to do with honey bees. I came back to

UBC in 2005 to start my own lab and had the opportunity to choose what I wanted to study, and I had this background in honey bees.

There's a funding program in Canada that is specifically for non-medical research, and so I thought that I could apply the expertise I learned in my PhD and postdoc to honey bees. This was 2005.

As I mentioned, everybody's probably aware of the big increase in die offs that started around 2007 that was originally called colony collapse disorder. So, all of a sudden, getting funding for honey bee health research, in Canada, at least, became relatively easy and I found myself in this very fortunate position to have just started a honey bee research lab and had all kinds of neat tools that could be applied, and the rest is history. We've been working on various honey bee health projects for the last 21 years or so.

Understanding Virus Impact on Queen Health and Colony

Amy

Wow, that's amazing. You know, Vancouver is one of my favorite places in the entire world. I love it so much, and I wish I would have known about your lab because I was just there a couple of years ago, and the next time I go up there maybe I'll need to visit.

Dr. Leonard Foster

You're most welcome.

Amy

So, we wanted to talk a little bit about the publication that just came out. We'll be sure to link it in our additional notes and resources. But it's called "Elevated virus infection of honey bee queens reduces methyl oleate production and destabilizes colony-level social structure." So, I would love for you to tell us a little bit about just the background and motivation behind this project, and we'll kind of delve into this a little bit more as the interview goes on.

Dr. Leonard Foster

Sure. So, the background goes back a few papers before that. There's been a couple of researchers in my lab, particularly Allison McAfee, that may be well known to some of your listeners. She's been looking at various aspects of queen health and queen fertility.

She's now a research associate at our group. We had a graduate student, Abigail Chapman, who just finished her PhD, who was working alongside Alli and looking at the impacts that virus infections might have in queens.

We had a paper in 2004, I think it was in Scientific Reports where Abby was the first author looking at viral infections in honey bee queens and what that might do to egg laying ability in those queens.

And we had an additional interesting observation there that the virus infection seemed to be linked to premature supersedure in those queens, kind of suggesting that the worker bees had some way of recognizing that the queen was infected.

Maybe it was because her egg laying output was lower, which is certainly known to trigger supersedure by workers. But there may have been something else. But we weren't certain when we finished that paper up. My lab has developed a new set of tools, which are broadly known as metabolomics, but it basically is a method for detecting and measuring the amounts of various small molecules and lipids that are present in samples.

After this original paper linking virus infection to lower levels of egg laying and supersedure, we started applying this new technology to look at whether the pheromone profile of queens that are infected with virus might be different.

That led us to observe that methyl oleate, among other compounds, was different in bees that were infected with viruses. And then that sort of led us to ask what function might methyl oleate be having in the colony?

The compound itself is not unknown at all to honey bee researchers. It's been known to be produced by queens, but the effect or the role that it played in colony structure was not really known, I think, before this study.

Jamie

All right, so Leonard, we're going to dive straight into the study, but just with the next question, with the one I'm asking, I want to pivot back to something you've said a little bit because I don't know that it's something people think about. And I mentioned it early in my introduction, you know, queens are the longest lived individuals in the nest.

So, they are the ones most exposed to the stressors in many capacities. So, you know, you're talking about queens and virus infection. Can we spend a second on that? Because I just don't see this talked about much at meetings and amongst beekeepers and scientists. Can queens get viruses, number one? Number two, what do we know about how they acquire them and, number three, which viruses infect queens in a measurable way?

Dr. Leonard Foster

Yeah, so it's a vitally important question, and I think it doesn't get a lot of attention because normally the way that you confirm that a bee has a virus is you mush the bee up and do a PCR test on it. And everybody's obviously reluctant to sacrifice their queen just to confirm whether she's got a virus or not.

Because once you know that she's got a virus, the queen's dead. So, there's nothing you can do about the queen anyway. So, it's just generally not looked at, whereas it's pretty easy to grab a sample of workers from a colony and submit those for a PCR test or whatever is being done.

In addition, there's a few viruses that beekeepers are very familiar with, at identifying the symptoms of in the colony. Certainly, sac brood, deformed wing, black queen cell virus, those are ones that are relatively easy to almost certainly diagnose accurately just by visually looking at a colony or at bees.

But queens tend to never show those overt symptoms, or at least beekeepers would rarely see them showing those overt symptoms because if they had deformed wings, for example, the queen probably never would have been able to mate and therefore would never make it to maturity.

Never, never start leading a colony. She might get trapped where she's managed. If she's raised by the colony, she emerges, goes and kills all her other sister queens before they emerge and exerts her dominance that way. But then she can't fly out and mate, that colony's not going to go anywhere.

So, either that queen gets killed or the colony dwindles and dies off. But in general, the beekeeper would very rarely see that a queen has symptoms of a virus. But for sure the queens can get viruses.

I'm not aware of a virus that infects workers that can't also infect queens. Not sure that people have looked for all of the viruses we know of in workers, but whenever someone's gone looking hard enough, certainly you can find queens that have those viruses.

But what some of our research and research from others has shown is that if there's too high levels of viruses in queens, they're probably not producing very well. They probably get superseded fairly early, so any queen that's got a very high level of virtually any virus probably doesn't make it very far or far enough to get noticed unless it's in a sort of controlled lab environment.

As for where they get the viruses, they can get them from, as far as we know, sort of all the usual ways that workers would get viruses. So, they can get them vertically. That is, that the mother of the queen, if she's infected, it gets into her egg, the virus gets into her egg, develops into a queen, she acquires it from her mother.

They can probably acquire viruses, virtually all viruses, sexually. So, when they mate with a drone they can get it. There's some evidence that some viruses can be transmitted through trophallaxis. So, from one worker feeding a queen, if virus got into that food that the worker was passing to the queen, then probably the virus can take that way, although that's probably a lower chance of it happening that way.

And then they could also acquire viruses from Varroa, of course. But again, if a queen is infested with Varroa, then she may not have much longer to live as well. But they can get viruses all the usual ways also.

Amy

Of course, now I have like a million other questions and follow-up questions that I could ask you related to, you know, queens. It's really interesting. I guess, you know, if the queen does have the virus, maybe the beekeeper can notice it, but just in an indirect way, right? Like what you had said, just like a decrease of egg laying or maybe the worker sent something and they'll, you know, supersede her or something like that.

Dr. Leonard Foster

Yeah, exactly. It's very unlikely that it's going to be as overt as seeing deformed wings on the queen. But yeah, if someone's paying close attention, there's other things that could be seen in the colony that could imply that the queen has a virus.

The problem is, I don't think most of those symptoms are specific enough to say that, oh yeah, I see that, therefore, the queen must have the virus. Because there's probably other reasons that those things could be happening in the colony. But certainly, there's some indicators that you could see in the colony.

Amy

So, Leonard, can you tell us a little bit specifically about the purpose of the study? And then I guess, you know, you're talking a little bit about, you know, having to eliminate the queen to see if she had the virus. And so, I'm interested to know the study design of what you all did with these queens?

Dr. Leonard Foster

Sure. So, we've been involved now, probably, for five or six years, I guess, in studies of both field maintained and lab-maintained queens and they've unfortunately led to the sacrifice of at least a few hundred queens, but all with the research purposes in mind.

So, started off with some of our studies where we were working with beekeepers who had identified or who had reported to us that they were seeing a higher-than-expected levels of failing queens. And so, this led us to ask, well, why might those queens be failing?

So, we worked with different beekeepers in our region. When they had a queen that they thought was failing, we would sample it. If we were able to get there early, we would try to – early enough before the beekeeper really wanted to get her, get the queen out of there.

We would in some cases try to measure the egg laying rates of those queens in her own colony. But in the end, we would collect those queens. We would also buy from the beekeepers some control queens that they thought were doing reasonably well.

But as I said, we'd buy them from them. So, they weren't just donating them, but we'd get some control queens and some failing queens. And then we started looking at the level of sperm, and particularly alive sperm that were in her spermatheca.

Because the hypothesis there was that the failing queens probably had less sperm or less viable sperm and that that might lead to lower levels of egg laying, which was then leading the beekeeper to assume that this queen was failing for some reason or another.

Sure enough, we were able to find links with failing and the viability of sperm in the spermatheca. Those are all very destructive methods. They have to kill the queen, measure the sperm, and count how many of those are alive. So those queens were never going to go back into circulation.

That also led us, though, to start looking at the levels of viruses and the other factors that might be affecting the health of those queens or the fertility of those queens, including the size of her ovaries. That led us to find that there was a link between the overall level of virus infection in queens and the size of her ovaries.

So, the more copies of viruses that could be found in a queen, the smaller the ovaries tended to be. So that has a very direct impact on the egg laying ability of those queens. That, then, also led into some studies looking at the role that heat exposure might play in queen health and, in particular, semen viability in the spermatheca.

And then that led us back into these other studies that we started off talking about where we're looking at the virus levels in queens, not so much focused now on the ovaries, but on other things that might be going on with queen health, including this sort of fortuitous observation that the levels of viruses seem to be linked to higher levels of supersedure.

And then at the same time, we were developing these tools that I mentioned earlier for looking at the pheromone profile of the queens. So, we all of a sudden had this ability to be able to measure the differences that the bees might be sensing in these queens that were either infected or uninfected with viruses.

And because supersedure is very much colony-level behavior, it really implies that there's some pheromone, maybe coming from the queen or maybe coming from somewhere else, that the bees are being triggered by to lead to supersedure.

And that's where the methyl oleate was identified as likely candidate from those initial screens. We went back into colonies and tried to use methyl oleate to suppress supersedure. And sure enough, if you add additional methyl oleate into the colonies, the workers are less prone to try to supersede the queen.

And it seems like the methyl oleate that is being given off by the queen, because it's decreased during a virus infection, that's what's triggering the supersedure, the lower levels of methyl oleate. So, if you put enough methyl oleate back into the colony, the workers are no longer or are less inclined to try to supersede that queen.

Queen Pheromones and Suppressing Supersedure Behavior

Jamie

All right, Leonard, so there's a lot in this space to unpack and we're going to talk to you shortly about some of these other stressors. You know, you mentioned heat, for example, the role it might play on queen health. We'll talk about that in the future. But when you're listing your findings, I really want to zero in on this methyl oleate.

So, you said, if I understand correctly, as queens have these higher virus loads, they reduce their methyl oleate production, and as a result this is a trigger for worker bees potentially to supersede queens. Am I understanding this correctly?

Dr. Leonard Foster

That's our current model, yes. OK, I think the data does support that.

Jamie

OK. So, when you talk about then, subsequently, adding methyl oleate back into colonies, which would reduce that supersedure number, it seems like – I'd like to know a sense of scale here, like how much does virus reduction reduce methyl oleate so that you guys are able to come back in and make up that difference that's meaningful enough to reduce supersedure?

Dr. Leonard Foster

Yeah. So, we did have to look at quite a number of queens to arrive at this conclusion. The overall levels that we could or that the change in levels, I guess, it's more of a correlation with viruses rather than a specific full change.

Like as you get more virus, the methyl oleate level changes. But the number of virus particles that can be in one queen can be huge. It can be in the tens of millions easily, or even hundreds of millions or billions.

So, it can get very, very large. But the general trend is as the number of virus particles goes up, the methyl oleate level goes down and probably exactly where the threshold is that triggers supersedure behavior, we're not exactly clear. It's probably somewhere in the range of two-to-three-fold decrease in queen emitted methyl oleate that is triggering the response.

Jamie

And remind me, how are you adding this methyl oleate back to colonies?

Dr. Leonard Foster

Yeah, exactly. Not so much like an aerosol, but more of just a spray.

Jamie

Fascinating.

Dr. Leonard Foster

Yeah.

Jamie

So gosh, this is the scientist in me bubbling out because I want to understand these things. We're going to ask you later, too, how can beekeepers use this information, so maybe I'm getting ahead of myself, but I think about this when you are adding this methyl oleate back to colonies to make up for the reduced amount produced by the queen who's heavily infected with viruses.

From a practical standpoint, as you're adding this stuff back, what's the risk of queens staying alive longer than they ought to from a replacement perspective? I hear you giggling because you can understand why I'm asking this question.

Dr. Leonard Foster

You've hit exactly on it, like, we've had a lot of questions from beekeepers and from our university's press office that was helping us publicize these findings, pushing us on, like, what's the practical impact here?

And you're right, just because you could spray methyl oleate on your colony and suppress supersedure doesn't mean that that's a good idea because the supersedure is evolved in bees as a pretty important mechanism to make sure that the colony can continue on if the queen is failing for some reason.

So, you don't necessarily want to stop that from happening because there must have been some reason for the workers trying to supersede that queen. It might be, as we're talking about, it might be because they're infected with a virus, but it might be some other reason that the queen is not performing up to the level of the workers.

And the workers aren't, they're not gossipy. They're not sort of human in the sense that they might have ulterior motives for replacing their queen, like jealousy or something like that. They're not thinking in that way. They're purely observing that this queen is not doing what we need her to do as a colony and therefore, we're going to replace her.

So, stopping that is certainly a risk to the colony, or trying to stop that from the beekeeper’s perspective is going to risk hurting the colony more. I think the most important thing that this work shows us is more of an understanding of some of the intricacies of the pheromone blend that the queen is producing.

And, in particular, one of the roles that methyl oleate seems to play in part in the queen pheromone is in suppressing super seizure. And so, understanding that will certainly guide more bee research in the future and better understanding of pheromones. And you could imagine there might be more applied types of research or products that come out in the future that tweak the pheromone blend a little bit for different uses, depending on what beekeepers might want to do with it.

But just, generally, I think you've hit exactly on the key point that applying methyl oleate to your colonies is not going to be a great way to just stop supersedure. Yes, you might stop supersedure, but you're going to hurt yourself and your colonies more by overdoing that, I think.

The Effects of Heat Stress on Queen Fertility and Viruses

Amy

So, I know that you and your colleagues have also studied – I wanted to ask about a study that you did with heat and what role heat plays on queen health. We've had Allison on a couple of times, and so I think some of our listeners are familiar with some of her work. But can you elaborate on some of the research related to heat?

Dr. Leonard Foster

Sure. Yeah, this was work that was done with Jeff Pettis and David Tarpy and Marta Guerna and several others over many years. There are several different studies, but the main observation was that the queens seem to be less effective at laying healthy eggs after being heated up to around 40, maybe 41 or 42°C.

And the main effect that that heat seems to have on queens is on the sperm in her spermatheca. There are other effects that we can measure certainly in the queens at a molecular level that are caused by the heat.

And I'll come back to one of those in particular 'cause it does link to the virus observations, but the heat itself seems to impact the sperm viability. If the sperm aren't viable, the queen can't use the fertilized eggs and then she starts laying only drones.

There are a couple reasons this is relevant. We kind of got into it from a practical perspective where it seemed that queens that were being shipped into Canada, mostly from Hawaii and California, sometimes there'd be batches where the queens just never seemed to do very well.

And so, the question was why? Jeff Pettis and some of his collaborators put temperature loggers in with the queens during shipment and observed that sometimes there were spikes in temperature that these queens were being exposed to. We believe it was probably when they were being held in shipping containers on the tarmac at an airport maybe, or maybe in a cargo hold where the plane sat for too long.

Who knows exactly where it was happening. But certainly, they were being exposed to temperatures around 40 or 41°C. And then we also had a heat wave in the Pacific Northwest a few years ago where temperatures were getting into the 40s, where before they would barely ever break 30.

So, they got very, very hot. And then this led us to ask, well, what happens to queens that are in colonies where they're getting exposed to these levels? And if the bees aren't good enough at regulating the temperature in a colony because there's not enough water around or whatever, they don't have enough air circulation, then maybe queens could get exposed to those higher temperatures directly in the colonies.

So anyway, there's, as I said, a whole series of studies there. The main effect seems to be on sperm viability in the queen's spermatheca. But I did mention there was other things that we can measure that happened. And so, one of these things that we were able to detect with the instruments that we use in my lab quite a lot, mass spectrometry, was that there were very large increases in a couple specific classes of proteins.

And one of these classes is known as heat shock proteins. So, these have been known in Drosophila and yeast and every other kind of organism that we look at as being very important in helping the organism respond and adapt to higher levels of heat.

That's where the name comes from, they're heat shock proteins. If you change the temperature that an organism is exposed to fairly rapidly, these proteins are turned on to help the organism survive that heat. And the way they do it is they stop other proteins from being misfolded and degraded and then removed.

And then the organism dies because these other proteins that it needs to live don't exist anymore. So, these heat shock proteins kind of help stop that process. But it also turns out that viruses, one of the features of virtually all viruses, is that they take over the protein production machinery of the host that they're infecting.

So, a honey bee virus gets into a honey bee cell, and it takes over the machinery in that cell that the cell normally uses to produce its own protein. The same basically happens in every other virus, whether it's SARS-CoV-2 in humans or tobacco mosaic virus in plants.

Anything, any virus basically works in a very similar way, with some subtle differences from virus to virus. But what the host cells often do is up regulate or turn on these heat shock proteins that I mentioned before that are normally associated with increases in heat. And the reason is the viruses have taken over the protein production machinery to such an extent that all the other machinery that's in the cell is kind of overwhelmed and can't help or can't support this massive increase in protein production that the virus is really demanding of the cell.

And these heat shock proteins seem to slow that process down. They kind of, in a few different ways, probably stop the ability or maybe not stop completely, but slow down the ability of the virus to completely dominate the cell of the host organism.

And so, what we have some evidence of is that if you heat shock honey bees, like expose them to higher levels than they normally should get exposed to, like let's say 38° or something like that, where a normal colony that's functioning properly is around 32 or 33°, heat shock them to 38°, which isn't a big increase in temperature, but it's enough to turn on these heat shock proteins in the bees. That then makes those bees slightly less susceptible to virus infection. It's not a huge effect, but it is a measurable effect. And that suggests that there might be a way to pretreat bees by heating them a little bit to make them a little less susceptible to viruses.

The practical ways that might actually be used in a beekeeping operation are not so obvious, but it's an interesting initial observation that certainly requires a bit more investigation.

Applying Research Findings to Improve Queen Management

Jamie

Leonard, this has all been fascinating. I really have been following this research on queen's supersedure and knowledge around it a lot through Allison's work and Dave Tarpy's work and your work. And it's really just crazy fascinating to me that you guys have gotten to this point.

And I think this is kind of the grand finale, then, of questions related to all this. Beekeepers, you know, they report queen issues as among their top issues facing, you know, causing colony death and they cite queens not living as long and supersedure. And you guys are chipping away at that.

I know you've got more you want to do and the future direction you want to have. But stopping right now, what can beekeepers glean from you and your colleagues work? What can they take to their apiaries based on all the research that you guys have done?

Dr. Leonard Foster

Yeah, you're absolutely right. Wherever you are in the world, if you ask beekeepers what the main causes of their colony losses are, queen failure is right at the top, or right near the top. That was one of our big motivations for getting into this as well.

We were hearing from beekeepers the same things, and from a scientist's perspective, queen failure is quite unsatisfying. Like that doesn't really tell you what was going on. There are so many possible reasons why a beekeeper might think that a queen is failing.

Sometimes, probably very often, it is actually a problem with the queen. Other times though, the queen might be getting the blame in the way that the head coach of a sports team often is the first one to be sacrificed if the team's not behaving well.

But it's fair. The queen is the most important bee in the colony, and most of the time it probably is something that's going on with her. As far as what beekeepers can do practically, we do actually think that this methyl oleate story might have some immediate practical use.

And the main situation that we think it might be useful is in pollination contract kind of situations where, if the crop you're pollinating is kind of right during a time when supersedure is a little bit more prevalent, then applying methyl oleate to your colonies to keep the queen there and keep the colony going along while it's needed for the pollination activities.

That could be useful. As we touched on before though, you don't want to keep applying methyl oleate to suppress supersedure because there's got to be a good reason why the bees want to supersede that queen. So, if you do that, then I think, if you do try to suppress supersedure for a short time, I think you would want to have a plan in place to replace the queen yourself as quickly as possible.

Or maybe, if you don't have that ability, then you can remove the methyl oleate and let the bees supersede her themselves. So, I think there's a practical application there. I think the other big thing that comes out of this whole body of research we've been talking about is the role that heat plays in queen health.

And if you've got egg to death control of your queens, that is, you're raising your own queens and they stay in your colonies and then they die and you replace them, then you should be able to control this fairly well, control their exposure to heat fairly well.

Beekeepers, I think they're well aware that they need – If the bees are outside of the colony and you're kind of keeping them in a cage, you have to make sure they're well-watered and that there's good air circulation. But where this knowledge of heat and the role it plays in queen health is more important is if you're shipping queens, buying queens from someone, or maybe you're the seller and you're shipping them to someone.

It is absolutely critical to pay very close attention to what temperatures those bees might be exposed to when they're being shipped, because if they go up to 40°C, they're probably not going to be very useful to whoever's on the other end hoping to use those queens.

That being said, a little bit of heat does seem to be OK. Like I said, maybe around 37 to 38°C might have some beneficial effects, but I think most beekeepers are not in a situation where they could control the temperature accurately enough to bring all their bees up to 38° and then return them to their colonies.

So, unless you've got really good control of that, I would not advise any beekeeper to go down that road just yet. But I do think there's probably some opportunity in the future for heat treating bees, particularly queens, to make them a little bit more resistant to viruses.

The last thing I would say is don't ignore symptoms in your colony that might be suggestive of a queen that has a virus. The virus infection of the queen could certainly lead to her appearing to fail and truly failing. But rather than just saying, oh, this queen is failing, I think it's useful for beekeepers to dive a little deeper and try and figure out why.

Because if it's a virus infection of that queen, her offspring are likely, if you graft queens from her, those offspring queens are likely to be virus infected as well. And then you're just keeping the problem going in your apiary.

So, if I could say one quick thing, it would be watch for symptoms of viruses in your colony that might suggest your queen is infected and take all necessary precautions to make sure that virus doesn't get propagated.

Jamie

Well, Leonard, that was great. I so appreciate you joining us on this podcast. Like I said earlier, this idea of queen supersedure and what leads to it's fascinating. And all the research you and your colleagues have done really makes me feel like we're getting closer to the answer, which ultimately, what we want, will lead to better management for beekeepers who complain about queen issues so much.

And I think that this would be a great movement in the direction of producing long-lived, healthy quality queens. So, Leonard, thanks to you and your team. Thank you for joining us on the podcast. We appreciate all of your input.

Dr. Leonard Foster

Thank you guys, I really enjoy talking about bees and appreciate you reaching out.

Wet vs. Dry Grafting for Queen Production Success

Stump the Chump

It's everybody's favorite game show, Stump the Chump.

Amy

All right. Welcome back to the question-and-answer segment. Jamie, I'm really excited about the next three questions I'm about to ask you.

Jamie

Me too.

Amy

Only because you know what questions I'm about to ask.

Jamie

They're great, great questions again.

Amy

Here we go. So, the first question that we have, someone is getting into grafting. They're starting to graft queens and they're wondering, you know, when they're selecting larva, are there tools that move both the larvae and some royal jelly? And I guess, you know, a follow up question to that is if you're moving the larvae, do you need royal jelly for that larva to survive? What are your thoughts?

Jamie

Yeah, interesting question. Well, here's a couple of things. I learned how to graft a long, long time ago when I was in high school, and I remember reading at the time it was better to prime cells with royal jelly because it's easier to float that larva off a grafting tool.

So, if you're new to this conversation, grafting is simply the process of using a specially designed tool to go into the bottom of a cell, grab, you know, a 12-24 hour old larva, scoop it up and move it somewhere else.

Usually in the context of the bee world, they're moving it to a queen cup for the purposes of queen production. They'll graft a row of queen cups, so maybe 20 different queen cups. They'll have two of these rows on a frame, so 40 different queen cups. They'll go into a queenless colony and so the worker bees will make these 40 queen cells.

So, grafting is usually used in the beekeeping world for the purpose of producing new queens. All right, so when I was taught grafting and told about it, the idea is you can prime the queen cups with a little bit of royal jelly and what?

I was told, as you mix a little bit of royal jelly with a little bit of water, touch a little matchstick into it, then you touch that matchstick in the bottom of the cell and that gives you a little tiny pool of kind of royal jelly/water. So that when you graft up that larvae and move it over to the cell, it's easy to get that larvae off of your tool and into the cell where you're placing it.

So that would be a wet graft. The cells have been primed. They've been wetted with royal jelly to make it easier for that larva to just float off of your tool in the transition. However, there are plenty of people who dry graft. The question is basically saying hey is it better to wet graft or dry graft?

I know that a lot of tools are designed to take royal jelly with the larvae. Some tools are easier to just scoop up just the larva. What's better? Honestly, practice is what makes perfect in this case. I know people, plenty of people, who dry graft. That's simply moving a larva from one cell to a cell that has not been primed with royal jelly, and they get great acceptance rates for their cells.

I know people who wet graft and do the same thing. So maybe wet graft is an easier introduction to manipulating that larvae. You know, maybe early on it's easier. Maybe you'll have a higher success rate because you can float that larva off and not damage or in the moving process.

But at the end of the day, I think people can be equally good wet and dry grafting. It's really just about practice. And grafting can be frustrating at first, but I think at the end of the day, it really doesn't matter too much.

Amy

Yeah, definitely. You know, I love grafting. It's actually one of my favorite things to do. It's really therapeutic for me to graft. And I think, you know, I guess I would argue that the size of the larva, like the age of the larva, is probably something more to consider. And then, you know, when you're grafting, not flipping that larva over, right, and not putting them upside down.

So, I did a program in the Dominican Republic for two weeks. I brought some beekeepers down with me who taught grafting. And I remember we kind of experimented, and in the Dominican Republic, they have a lot of coconut water. And so, we thought that we would try to put coconut water in for a wet graft. And that actually worked pretty well too. So yeah, that was interesting.

Jamie

The questioner goes on to say, OK, yeah, maybe it doesn't matter about acceptance rates, the bees are going to build out queens from both, but is there a long-term benefit to the queen? I'm just not aware of any research on benefits of wet and dry grafting. And honestly, I just, it's hard for me to struggle to imagine that it would really matter because the moment you put those larvae into a colony, they start getting bee attention nearly instantly.

So, I think it's really impossible to move a larva with no royal jelly. Your tool is going to scoop up at least a little. And that would be enough to keep them going before you put them in a colony. At that point, the bees take over and they're just mass feeding those individuals. So, I can't imagine, you know, 20 minutes or even an hour of that's going to make a big difference in the long term.

Amy

Yeah, definitely.

Jamie

And survival of those queens.

Amy

OK.

Do Bees Avoid Religious Images? A Coincidence?

Amy

So, we're going to move to the second question, and I will say that usually we don't talk about religion and here we are talking about religious iconography.

Jamie

There you go.

Amy

I had to practice saying that word like 5 times before this episode.

Jamie

You did a great job.

Amy

Thank you. Thank you. So, this the questioner sent us a picture, and they said that they'd heard about this phenomenon where bees avoid pulling comb on religious iconography. Is there any scientific reason for this, or is this just a huge coincidence?

Jamie

OK, interesting question that I've also never been asked before. So, the iconography here to give it a little bit more detail is it looks like a picture, a religious picture with a well-known religious figure. The bees had built comb all around the image but didn't build it specifically on top of the well-known religious figure.

Amy

OK, but wait. I mean, is this in a frame?

Jamie

It's in a frame. I think it's in a frame because if you look at the picture, the top bar is a frame. And so, what it looks like to me is that someone just put a picture of this individual there and the bees hadn't built around it. And so, the question is, is there scientific reason or a coincidence? I think it's 100% coincidence.

I think if you leave anything in a colony long enough, bees will build wax over it. If they don't, it's possibly a surface that they don't want to build a wax on and not necessarily an individual. I happen to be quite religious, so I'm not dancing around the issue, I promise. But the point that I'm making is I don't think the bees are avoiding putting comb here because of who the individual is. I think either it hasn't been in there for very long or it's got a surface, you know, a glossy surface, a painted service, whatever, that they're not wanting to build over.

I've seen bees not build on lots of different things before, right? So, I think it's just coincidental. And you know, we're humans, we can see things that often aren't there, right? So, I just don't know that there's anything here in this context. Fascinating question. And again, I'm religious, so I'm not debunking it for that reason, I'm just saying I think it's pure coincidence in this case and that it's probably not a real thing.

Amy

You know, that’s the beauty of this cast, Jamie, is we always have, we just always have the best questions. And questions that I would have never thought about ever. So, I do love it too.

Jamie

But now I'm going to be very mindful of this. I kind of want to go Google it online. Like, oh my gosh, look at that. So, maybe I'll be changing my comment in the next few weeks.

Amy

Definitely. OK, so the last question that we have. This person has noticed that on a lot of beekeeping videos, you know, people are out there, they're using their cameras, they're using their phones, they have microphones. This person has noticed that in the beekeeping videos that the bees really seem to attack the camera or the microphone.

I mean, is this coincidence? Is this something that, you know, do bees not like electronic sounds? Or is it because they don't like that cameras are black? And, you know, I guess we've had people in the past who have come here to take pictures and I'm wondering if they've they were stung just, you know, by having the camera in their hand. What are your thoughts on this?

Dark Colors and Movement Attract Bee Aggression

Jamie

Yeah. So, I do have kind of, I'm going to say strong and inform – I've obviously never done a research project, but I think it boils down to one, well, two easy things. The first thing is cameras are almost always black, and the accompanying equipment, video cameras, tripods, microphones, I mean think about it, everything that we use to video and pick up sound, for the most part, those are all dark colored things.

You know, I've been at UF for almost 20 years and I have given countless interviews, radio interviews, newspaper interviews, magazine interviews, video interviews on the news, etc. And people want to suit up in a bee suit, and they want to go out with me so they can video. The first thing I always tell them is your cameras are going to get attention because they're black.

And I said, and you're going to be frustrated because you're going to need to wear gloves. But gloves will limit the dexterity you have with the camera, right? It's hard to control a camera with a bee glove on. You might can push the take the picture button, but it's hard to control settings.

And I said, so, you're going to be very tempted to, you know, take your glove off. But trust me, if the bees get agitated, they're going to go to your cameras. They're going to because they're attacking dark colors. It'd be the same thing as if they were wearing black socks, right? If their cameras were white, but their socks were black, their ankles would be what's getting stung.

But because cameras are black, I think that's important. The second thing is they're also the thing that's moving, right? So, it's that black thing that's kind of zooming across the space to get the right picture. They're the thing getting close to the bees. And I think those two things alone really get cameras a lot of attention. So, usually, what I do when I'm working with individuals who want to film or take pictures, etc., I'm like, listen, I know you don't want to wear gloves.

I get that. Hold the camera in your left hand. If you're right hand dominant, take the glove off of your right hand. Keep your hand in your pocket, and when there's something you want to see, slowly bring out your gloved hand and take a picture and put your gloved hand back. So, I think it's just a color thing. I don't think there's anything special about it. I think it's just color.

Amy

What about like a flash?

Jamie

I don't know that flashes are that bad for bees. I haven't usually seen that set bees off. I really think it's just the fact that those cameras are dark and they're the thing moving. And honestly, too, where are people putting cameras, Amy? At their faces. And the veils are black and their face illicit carbon dioxide. All of those are things that bees don't like either, right? And so, I think, it's kind of like the perfect storm with regard to cameras and tripods and things like that.

Amy

I'm not going to lie, I had to, like, really think about where people put their cameras for a second. When you said that, I was like, on a tripod? Like I don't know.

Jamie

Yeah, it was a terrible question. I'm sorry. That was my fault.

Amy

It's OK.

Jamie

But you're pulling it up to your face and you're breathing out CO2. And if you didn't have your veil on, the bees would be trying to sting your eyes or your nose or your mouth. So, it's all at that space and that's just what the bees like. So that's my story and I'm sticking to it.

Thank You for Listening to Two Bees in a Podcast

Amy

That's fair. All right, listeners, you know what to do. We love the questions that you all send to us. There's a never-ending list of questions that, you know, still haven't been asked. So go ahead and send us an e-mail or message us on one of our social media pages.

Hey everyone, thanks for listening today. We would like to give an extra special thank you to our podcast coordinator, Jeffrey Carmichael. Without his hard work, Two Bees in a Podcast would not be possible.

Jamie

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 An Equal Opportunity Institution. 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.