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# EPISODE 191 TRANSCRIPT

**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. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast.

Hello everyone, and welcome to another episode of Two Bees in a Podcast. Amy and I have the great pleasure of being joined today by Dr. Mohamed Alburaki, who's a research entomologist at the Bee Research Laboratory at the USDA ARS in Beltsville, Maryland. Mohamed has done a lot of work while there, specifically focusing on the status reports of honey bee diseases and pests in the US. So, Mohamed, thank you so much for joining us on this podcast.

**Dr. Mohamed Alburaki**

Thank you very much for having me, guys, Jamie and Amy, and that is my second time with you guys. I'm very excited about it.

**Jamie**

Yeah. We really enjoy having you on, and I love the work that you're doing. I happen to know a lot about it behind the scenes because you and I work on another committee, but maybe more on that later. We are going to be talking with you specifically about some of the work you've been doing compiling massive data sets related to diseases and pests in the US. But before we get there, could you talk a little bit about how you ended up in the bee research world? We know we've had you on with us before, but we want to make sure our listeners remember you and hear the story of how you ended up with honey bees in the first place.

**Dr. Mohamed Alburaki**

Okay, great. Yeah. So, in fact, I didn't go into the bee world. I was born into the bee world. My father is a beekeeper and so it runs in the family, beekeeping, really. Even my grandfather used to have like couple hives at home. The thing is that I really grew up with bees, and my dad was also a honey bee scientist and professor at the University of Damascus. He’s retired now. He used to work on studying honey bee behavior in general during his PhD work in France. I was observing some of his experiments and stuff in France when I was a child. But I've been around bees my entire life. Before entering officially into the science realm, I was a beekeeper running my dad's business. So, during my trip around, I mean, I was born in Syria in Damascus, and I did my PhD in France. And I had the opportunity also to work in Canada and now in the US. So, I've seen a lot of subspecies here and there, beekeeping practice around the world, and that was really enlightening for me to have deeper perspectives on honey bees in general and especially on honey bee research.

**Amy**

That is so cool, Mohamed. I'm just thinking as you're telling your story, we always hear about generations through commercial beekeeping, but I'm not sure if I know of anybody else, like, you're a second-generation honey bee researcher.

**Dr. Mohamed Alburaki**

Yes, and beekeeper.

**Amy**

And beekeeper!

**Jamie**

Double whammy. Best of everything.

**Amy**

I know. It's really cool to hear that. Well, as Jamie mentioned, we brought you on to talk about, you and your colleagues published 2 status reports on honey bee diseases in the United States, and you looked at this since 2015. We will be sure to share and link these resources on our website and our additional notes section. I'm wondering if you could tell us a little bit about the background of these projects.

**Dr. Mohamed Alburaki**

Absolutely. The story started a year ago. I had been asked to supervise the bee Disease Diagnostic Service at the Bee Research lab at the USDA here in Beltsville. And when I took over the supervision of this lab, I noticed that we have a lot of data that has been kind of communicated to state apiary inspectors, and in some cases, to beekeepers directly. But we've never compiled them in a meaningful manner and put them out there for the scientific community to take advantage of this amazing data that we've been piling up throughout years. The Bee Disease Diagnostic Service, in fact, was established in 1891, believe it or not, you know. So since then, this service has been providing beekeepers and state apiary inspectors and federal and state agencies with a complementary service of disease identification nationwide. The thing is, before 1984, they didn't have any digitalized information. They used to write on classic ARS notebooks and stuff. But then what we did is I was able to collect these old data on computers and then we put them together. So, currently, what we gathered is data from 1984, disease data, in fact, those are results that our lab diagnosed and it's our data. Basically, it's the data of the lab that we receive samples from beekeepers, and then depending on what they want to look into, we identify the disease and then we send them one to one report. But now what we did is we've put this together and we've put them out. We've published two major manuscripts, in fact, very consequential from my personal view, those two manuscripts on data from 2015 to 2022.

So, we have two papers explaining to the beekeepers and the stakeholders what we have in the US in terms of disease, Varroa mite, Nosema spore count, EFB infection, AFB, as well as the AFB resistance to antibiotics used nationwide. So, this is for the small portion of 2015 up till 2022. We did two manuscripts within this range of years. The first one is tackling Varroa mite and Nosema, and then the second one is really shedding light on the brood disease and the AFB resistance to antibiotic. Now, currently, we have a third major manuscript that we would like hopefully soon to have published, which will cover all the data from 1984 to 2015, where we begin with the other paper. The size of the data from 1984 to 2015 is roughly 66,000 analyzed samples. The size of the data that was published from 2015 to 2022 is also roughly 10,000 samples. So, that is basically what the Bee Disease Diagnostic service has been generating in terms of data since 1984.

Now, a side note for the data from 1984 to 2015, I will share with you guys for your audience because we love you, I will share some findings that have not been yet published. This data covers -- at that time they used to do more of prevalence, so I think people were not really directly interested in knowing quantitatively the amount of the disease we have. So, the best option for us was really to put it in context of prevalence. Varroa mite, Nosema, we have tracheal mite, sacral disease observation, presence or absence of chalkbrood disease, as well as the classic EFB/AFB identification and the AFB resistance to two major antibiotics, which is the tetracycline and the tylosin.

Prior to 1984, we still have data, but it's written in books. So, we are we're trying to see if we can go as far back as we can, and if it is meaningful, we will hopefully dig into those very old notebooks in the storage that we have here and see if we can compile a story of disease in the US and present it to the stakeholder.

**Jamie**

So, Mohamed, I really think this is fascinating and you answered this or touched on this just a little bit, but I want to go into a bit more detail about it. So, prior to, I don't know, it sounds like 2015ish, maybe a little bit earlier, you've got all of these data sets, maybe even in notebooks all the way back to the 1800s. More recently from 2015 onward, you've got these maybe robust data sets that exist in computer already data entry. How did you go about coalescing all of this into something that you could analyze? Could you talk a little bit about the method of analyzing and putting all of this data into one place?

**Dr. Mohamed Alburaki**

Yeah, that was the challenging part. In fact, the point is that, throughout time, whenever we want to look longitudinally at any data set, if you are maintaining the same methodology, you are good. But the minute you start changing the methodology, the comparison will be like not apple to apples, which is the tricky part. So, what we did, this is why in fact the cut off that we did was in 2015. We could have put out there like the whole scope of the data. But the problem is that prior to 2015, some methodology used in the lab has changed. So, they started at the Beltsville Beel Lab at that time, but in 2015 they started, for example, getting the VIL number for Varroa mite. They were not just looking at prevalence. So, they've kind of upscaled the methodology. Same for EFB and AFB. So, I had to make a decision. We are going to cut where the methodology has changed to be able to have an acceptable comparison of apple to apples.

So, putting the data together is the tricky part if you have changes in the methodology. That is our case here, and that's why we have a cut off at 2015. In order to look at the data, the prevalence is easy. So, you can compare the prevalence from after 2015 in our data, of course. I'm talking about the data we've generated with previous data because it's just binary presence or absence. Of course, you can still have a percentage of a given population for a disease, but that's a different story. So, what we did is there is also an idea of publishing everything since 1984 but presenting the whole scope of the data as prevalence, like a percentage of prevalence.

Because some people would tell you I need trends. I need to see in general. I don't want to go through the details how many mites we got in Virginia or in Maryland on average, which is very interesting information. But for an overview, it would be great to have graphs that show the trend of prevalence and how those diseases are, where they are flourishing, where they are diminishing. Is there a correlation between, for example, the climate region, the temperature, precipitation, etcetera, or it's directly related to the beekeeping practice or how we are good at like maintaining disease level and a threshold that is acceptable for having productive beekeeping business?

**Amy**

So, I really like how you were able to describe looking at the methodology to keep it consistent, and that was the reason for choosing 2015 to 2022. I just have to emphasize how much work that is going through everything and everything that you're pulling out from the literature. So, it is no small task, and we appreciate you doing that.

**Dr. Mohamed Alburaki**

Thank you.

**Amy**

So, the next question that I have is a very short question, but I know is going to have a long answer. What were your findings? What did you find on these honey bee diseases in the United States from that time period?

**Dr. Mohamed Alburaki**

Yes. So, the first thing to understand is that there are general conclusions, but we have also a lot of details and detailed information that are very useful for, especially, state apiary inspectors and state agencies or even federal agencies to see if there is any problem going on in specific geographical location or states. And then this data also can provide information about is there a state that is maintaining relatively lower disease infections compared to other states? And is this related to the beekeeping practice or not? But to answer directly your question, in fact, one of the important things in my view is linking the disease data that we have with the climate regions of the US. So, we know in the US we have like 9 different climate regions. So, after presenting the data, what we did in these two manuscripts, we've analyzed the data vis a vis climate region.

So basically, the states that are composing a specific climate area or region were analyzed together. And then we've looked if there is any sign of correlation, for example, between disease and climate region. In fact, we found correlations. Now, it's tricky. It's not easy. Why? Because our beekeepers are moving their bees around, you see. So, we can't cover all the factors and all the variables, but we can definitively see, because a lot of those beekeepers are stationary beekeepers, they're not all like, for example, from the Northeast region or elsewhere, they're not all really moving. So, a big chunk of them are sideliners or stationary beekeepers. So, the indication that that we had is that there is a correlation and it's significant, statistically speaking, between the disease and the climate region. That's definitively something that popped up during the analysis of our data. And I can give you some examples if you'd like.

For example, AFB, we found that AFB is significantly higher in the Northeast region. It was identified as a lower infection in the South region. While if we look at the EFB, EFB was much lower in the West region, which comprises California and Arizona. This classification of the climate region is not arbitrary. It's what is retained by the federal government. It's the official classification of climate region by the federal government, and I guess also state authorities. They go with this classification. And for the EFB, it was significantly lower in the West climate region and the highest was identified in the South. The South, for example, has the highest EFB nationwide, in terms of infection, and has the lowest AFB. So, now the question is why this is happening. So, we know diseases are generally very well affected by the climate, with the humidity, temperature etc., as well as the beekeeping practice. But those are too many factors to study together from our perspective with what we have. Some variables, we can't control them, but some others we can. We can do statistical analysis and modelling to really see if there is a tendency vis a vis a specific variable that we want to study. And in our case here, vis a vis the climate region, we've seen differences between the variables or the disease that we've reported and the climate regions. Of course, there is also strong variability among states. But we didn't go far to say why, because in fact, we don't know. We've kind of proposed our theories that this could be for this reason or that reason.

One example is, for example, we've identified that high resistance of Paenibacillus, the bacteria causing the AFB in Texas. The resistance was over 55%. So, we're asking ourselves what's going on in Texas. I mean, our beekeepers, for example, use extensively the tetracycline, but it was not the case for the other antibiotics that we've screened. For the tylosin, it was not the case. And you can see, also, nationwide, we see that in general we have a higher resistance to tetracycline compared -- the commercial name is Terramycin, I think, just to make this point clear, but the official name is tetracycline for this antibiotic -- compared to the tylosin. Well, this is one of the interesting things that that we can get over such data. And the most important thing in my view is really at least to give nationwide averages of what is going on in the beekeeping industry in general. Now, the point that I want to emphasize is that we need to be careful about our data because our data represents symptomatic population. So, it's different the way they've been sampled. It's not a randomized trial. We made that clear in each manuscript. In fact, we are studying the disease in a diseased population already. And if you compare this, and we did that in one manuscript, we've compared our data with the National Honey Bee Survey data wherever they cross, where we can overlap the data. And then, we've seen that all our averages were significantly higher than the National Honey Bee Survey data. Why? Because folks in the National Honey Bee Survey, they are screening in randomized trials. So, they don't consider, oh, it's healthy, it's not healthy. It's a randomized screening. For us, there is a bias. This bias is that the state apiary inspectors, when they are sending a sample, have already identified symptoms of disease. This is why our population is symptomatic, and our data is within a symptomatic population of bees. That should be made clear, and we can see it in the data when we compare our data with the National Honey Bee Survey that we are all the time, Nosema or Varroa mite or EFB, we are always significantly above their rates that they've provided and published.

**Jamie**

So, you've talked about this a bit, but you mentioned that you've got two manuscripts already published. We are going to make sure and link those in the show notes. As Amy noted, you also have one forthcoming. But all of this is since 2015. You talk about this history of data all the way back to the 1800s. So, you do have plans, you and your group do have plans to expand the scope of this project to include these data before 2015? And if so, how are you going to go back to that archived data and get it into the system? That sounds like a lot of work.

**Dr. Mohamed Alburaki**

Yeah, you are absolutely right. But the good news is I think I missed saying that, because the data is so relevant in our view and massive, what we did to facilitate, especially for the state apiary inspectors and any other people that would like to see what is going on in their state, because Jamie, you are in Florida, your main interest basically is to look what's going on in my state first, and then yeah, of course we've got this desire to really see nationwide and worldwide too. I mean, we're a small village after all the globalization stuff. But what we did with Bee Culture Magazine since June, I think last June, we've decided to publish state per state report in term of prevalence to really facilitate the information. We've so far published 4 states. So, what we did is we've analyzed the data in term of prevalence since 1984 to 2022, and we are presenting longitudinal data with very, very simple to understand graphs without really details just to see the trends. And this is very interesting in fact, and they are like 2-page articles, easy to grasp, easy to understand, and then they just give you the bottom line. They give you from 1984 to 2022, how many samples our lab received, we break them down per year. So, even state apiary inspectors can look and see, oh, okay, what our state did in 2005, how many samples we've sent to our lab to identify disease. And then we went over just the prevalence as a percentage from zero to 100. And we've offered graphs that show this trend since 1984 to 2022.

We also discussed the seasonality. So, we did an analysis for Nosema, for example, per month within that state. So, the state that we've so far tackled is 4 states. We started with the biggest contributor in terms of sample size, which was Ohio, and then we have North Dakota, if I remember well, we've published Maryland, New York before North Dakota. So, we have Ohio. Those are the biggest contributors, and then New York and then North Dakota and Maryland. So, the plan is to publish the 10 biggest contributors. I should thank Bee Culture for hosting those series of articles, especially Jerry Hayes, because we think that this is very relevant for beekeepers and for the scientific community, and they can be also very useful for people in their state. If they want to present information about the disease in the state, they can just use the graphs or the data from the Bee Culture magazine. And then at the end of every article, we've summarized, quantitatively, in terms of the VIL number, Varroa mite per hundred bees, and Nosema as well as the resistance to tetracycline and tylosin from 2015, because we have this data in terms of quantity, up to 2022 in a table. And we compared that with the US national average, like in a very small table, but very informative table and powerful table, as well as the number of samples that were analyzed during the range of years. That can be used. The people of the state of New York, for example, can compare their average in their own state and see the US average and make a decision where they are. Are they behind or above the average?

**Amy**

So, what do you plan to do to continue the project in the future? So, past 2022, do you plan to update the reports, and if so, what would that look like?

**Dr. Mohamed Alburaki**

Yeah, that's an awesome question. So, for the published work, we did a cut off year, which was 2022. Compiling this data, analyzing all stuff, it's time consuming as you guys know. So, our plan is first to present to this to the community, to the scientific community and beekeepers and stakeholders, all the data that we have that was accumulating. And then we're going to move hopefully to put out every other year or potentially every year, depends on the size of the sample we are receiving from our stakeholders, a report, a simple report that will show the status of the bee disease in the US in general and per state like we did with these two manuscripts. But it's going to be shorter, eventually, and less intense because we will not have 10,000 samples to put together in a single manuscript. So, we'll have higher resolution in term of analyzing the data and showing people what's going on, because, on average, our lab analyzes, usually, and we receive an average like 1500 samples a year nationwide. Some states contribute more than other states. So, that's something we can't control. But for us, at the end of the year or at the end of every other year, this is to be seen, what we will do is we will continue this effort, hopefully, because I feel that this is very important, and it's needed for the stakeholders, and for us as scientists and beekeepers alike, to see where things are going. And then we can look at the past with all those reports. Hopefully we'll have three, we have two manuscripts out, but we'll have a third major manuscript out. Then people can make their own decision and see, nationwide, how the diseases are trending and what can be done to keep them under an acceptable threshold or see also is there like better practice that are showing better results or not and how we can improve our beekeeping activity and also the performance of our colonies. So, there is a lot to learn from this data and also other data. We've got fantastic data on going on here in the US.

**Jamie**

So, this is really fascinating. It sounds like you're doing a lot of work. It's going to be a great resource to bee scientists as well as beekeepers here in the US, and a good model for how this could be done elsewhere around the world. But I'm curious, Mohamed, what are some other things that you guys are up to in your laboratory beyond compiling the data related to honey bee disease and pests here in the US?

**Dr. Mohamed Alburaki**

In fact, my main assignment is not the bee disease lab by the way. It’s like a kind of an additional hat. I have my own research running on in my lab, but I've postponed some of my priority because I thought that the bee disease service that we have and the data that were not compiled and put all together in a strong, meaningful way really needed to be taken care of. And we did this. We are almost like really at the end of wrapping up all the data we have prior to 2022. Now, as I said, after that, we will potentially, hopefully next year, have 2023 and 2024 in one report.

In my lab, I mean, my background by training, I'm a geneticist. So, I worked on honey bee genetic diversity in the Middle East and in Europe and in Canada. And we did also some genetic studies in the US here. I think we talked about it last time I was with you guys. For me, for my team, we've got a lot of stuff running on here in the lab with the other scientists. But me personally, I've got also other projects running in my lab, and I'm mainly interested in researching on the queen aspect, the queen performance, the queen quality, how to improve this aspect of queen supersedure and low quality of the queen nationwide, and then how we can improve the colony productivity. One of the other angles that we're working on in collaboration too is hive thermoregulation. How the thermoregulation of the hive and the insulation material of the hive, how can we get it better to minimize winter mortality? We did also some work on testing the polyurethane hives that we have in the market against the wooden standard Langstroth that everybody is using. Is this material more insulating? Is it helping in the winter for bees to minimize winter loss or not? And then we've discovered interesting stuff in that topic. In fact, the insulation of the material, because we've seen some new findings saying that in fact, those boxes that we have, especially when you are in a region with inclement winter, that they are not providing proper insulation, and bees are potentially either dying from starvation because they need to thermoregulate in the winter and then they're consuming all the honey they have and then they're running out of honey and then they're starving. Well, that's one option. Or, because of the lack of proper thermoregulation, diseases are spreading quicker and they're flourishing in the hive. So, it's not easy to determine a single cause, as you know, but at least this is one of the things that we've worked on.

And then the interesting thing in that topic is that we've found difference in the thermoregulation in the cluster or within colony cavity between haplotypes. Different haplotypes, they have different wintering behavior or cluster, and they have the ability, we still need to confirm that on a larger scale, to thermoregulate their colony in a different manner. So, that was an interesting finding that I'm pursuing currently and see if we can get more information about it. That would be why it's interesting because this would help us minimize winter mortality or even just boost the performance of our colony if we assign specific haplotypes to specific climate region. So, the weather in Texas is completely different than what we have in Maine or in the northern part of the country and so on and so forth. So, that would potentially help the overall survival as well as the performance.

Now, I'm not going to talk today about the adaptation aspect because I think I tackled it last time when we're talking about the genetic diversity of the population of the US. That was a paper we published last year. Also, I'm looking from an ecological perspective about -- we did some study and we're still doing on the landscape composition. How the landscape composition is affecting colony performance and where to put our bees for a better reward. That is also something that we've published data showing that when we have urban activity in a given geographical area, it's better for bees. We have higher pollen diversity, higher index for pollen diversity, and then we have more sustenance of the pollen as well as the nectar yield throughout the year than if we put our bees in monocultural area or big crop area. That was also identified in previous studies, but here we've got really more concrete information, and we've linked it to the thermoregulation and the weight of the colony. If they are in that location, how they are doing in terms of thermoregulation, size, weight of the colony, as well as productivity of honey. And then we're looking also about the disease.

So, disentangling all those factors is very tricky. This is why we don't sleep at night, as scientists, because we're always thinking about how we can find the proper model to really point out the major factors that are triggering all the cascade in our bees. And I worked also on diet behavior, toxicity of bees, gene regulation vis a vis toxicant or agricultural pesticide. We've got some interesting findings of the diet behavior and the olfactive receptor of the bees. If we provide them with two diets, for example, one is tainted with a pesticide, are they going to be able to distinguish that or avoid the syrup? And then we did it vis a vis the different phenotypes that we have, whether they are like foragers or nurses, do they behave the same? And do they have different capacity in metabolizing those pesticides that we frequently use for pest control and crops and other shrubs or trees? And then, of course, I'm also dealing with a couple collaborations with Europe, Middle East and yeah, that's a lot of stuff. It's very exciting, in fact, but it's very demanding too.

**Amy**

There is no shortage of the amount of research projects that still need to happen, right? That was a great example of a lot of great work and a lot of effort put towards research and all sorts of different topics. So, thanks so much for sharing that with us.

**Dr. Mohamed Alburaki**

Thank you.

**Amy**

So, I guess lastly, I know that you and Jamie are part of an international working group. Is there anything else that you want to share with us, ending this episode? Anything you want to share with us about that group or about anything else?

**Dr. Mohamed Alburaki**

Yeah, absolutely. So, Jamie, in fact, is leading the honey bee task force with COLOSS where we are trying really to do kind of what we've done in the bee disease lab, but on an international scale, like worldwide mapping of disease and knowing where we have the hottest spot in terms of disease etcetera, etcetera. So, this effort is amazing. It's ongoing under the leadership of Jamie, and we've got regional representatives who are building our team to really screen what we have in the literature in terms of disease, compiling all that and making a database where people can come and see, okay, I want to see what's going on in Germany or in France or in specific state here in the US. And then they can have in a friendly manner the data, or potentially a web interface or an app. We'll have to decide on those aspects in the future. We want to facilitate the transfer of information and the accessibility of disease data worldwide. And that is basically the overall objective of the COLOSS task force that we are working with Jamie and other people from overseas. Now, finally, I think, yeah, it's important to present the data to our audience and stakeholders, but also, it's relevant to think about why this is happening.

Now, the point that I want to make here is if we see trends and differences between states, and the US is complex because we've got this transhumance aspect, we've got this model of beekeeping that is different than elsewhere. We've got the pollination service here and there, almond here or other crops here and there. So, beekeepers are moving, especially the commercial beekeepers, they are moving their hives. This has been studied on how much this is potentially putting stress on our bees. But the point that I want to make here is that I do believe that putting all this effort together should help us also with discussion and debating what is the reason that we're having this huge significant mortality every single year, whether it's summer mortality or winter mortality, it doesn't matter. But overall, like 40 percent, 50%, this is crazy. We're losing half of the bees and then we are repopulating. That's a lot of energy required by beekeepers. So maybe, we need to start thinking about more sustainable ways in the beekeeping practice and look at the data and see why and not really researching behind the symptoms of the thing that we are seeing, but rather trying to cure the main reason. One aspect that we discussed last meeting with you guys was the low maternal genetic diversity in the US. And I can't emphasize, I really need to emphasize a lot on that point because from my view is that this is really alarming. If we continue on that path of recycling the genetic background that we have here in the US, it's already very minimal. Recently, I was analyzing some data from some African subspecies and believe me, this is shocking because on very small population size on jemenitica for example, or on intermissa for population of 4000 sample hives if you want. The habitat diversity was skyrocketing up to like 0.98 here in the US with this huge geographical area and country that we have, we were like barely hitting 0.5. So, could it be that the reason we are struggling and facing all these troubles, especially now with Tropilaelaps, we don't know what's going to happen, but we've got a lot of other diseases, Varroa mite, we’re dealing with. We need to try to figure out a way what is the major factor or the few major factors, and then try to tackle them as not curing symptoms, but really going fundamentally to the main reason potentially that is leading to this yearly loss that we are facing in this country.

**Jamie**

Well, Mohamed, you've given us a ton of information to consider. You sound like you don't sleep, ever. You sound incredibly busy, and so I know that I look forward to seeing more data and more reports coming out of your laboratory. I know our listeners will as well. And I just want to thank you for joining us on this episode. It was very useful information you provided.

**Dr. Mohamed Alburaki**

Thank you very much, Jamie and Amy, for having me and thank you very much for your audience too. We want the beekeepers to know that we are here to serve them. And if you guys have any questions, you can reach out to me or to Jamie. I'll be happy to answer any further questions, and hopefully this meeting was informative for everyone. And thank you very much, guys, for having me.

**Amy**

Jamie, I met Mohamed at the American Honey Producers Association in San Diego. I think that was last year when he was giving a talk on his report, and I just thought it was so nice to have data collected from all over the nation. Sometimes, I feel like we're kind of in our silos, right? I mean, we're doing research in labs, and we try to identify researchers here and there and the work that they're doing, and it's very localized a lot of the time. So, it was really nice, I think, to have at least something that was put together. All the papers that he was going through and the information that he was able to pull out. It's a lot of work. So, it was really nice to see. And I can't wait to hear what our listeners have to say as far as the data that they pull out of it when they look at the article.

**Jamie**

Yeah, Mohamed is in a really very fortunate position because, essentially, the USDA Beltsville lab, so the USDA lab based in Beltsville has had a honey bee disease and pest diagnostic laboratory for many, many decades. And so essentially beekeepers can send samples there. The Beltsville lab will tell you what you have in those samples. And that's what he has. He just has that historical stockpile of data. And when he got hired into the position, he's able to say, hey, I'm sitting on a gold mine here. We can look at the spread and the prevalence and the distribution of all these pests and pathogens throughout the US, historically. And I think that's great. And then what he mentioned about that COLOSS script that he and I are working; we're trying to do kind of something similar internationally where we look across all the data sets ever published on all the disease and pests and try to pull them together into a single source from which we can draw information. It's going to be a lot of work. But you've seen from Mohamed's efforts that it's very possible. They've got great products coming out of it. Those papers that we're going to link.

He's got a future project that will be published soon. There’s power in having all of this information in one place. And I think our listeners, and even us, we might even underappreciate where this will head in the future. But I'm convinced that once these data are publicly available, then we're going to be able to do so much for bee health moving forward.

**Amy**

Definitely. I mean, here at the UF Honey Bee Lab, we have a museum. Even just looking at the history of what beekeepers use or understanding different pests and diseases from the past, he was talking about how things are published in books. And recently at breakfast meeting, we were even talking about different active ingredients and when they started being used by beekeepers. And it's just things that I think you don't typically think about, it's kind of cool to just have out there.

**Jamie**

Absolutely. Such a great resource, but the key is, Amy, so much of this stuff is handwritten in books or notebooks. And once that gets entered into these kind of massive data sets and when the immersion of AI, we're going to be able to do so much with these historical data sets that really hopefully improve bee health and the well-being of honey bee colonies and the productivity of colonies and all of that stuff. So, it's just a win-win, the more stuff that we can put together. And that's really what Mohamed and his team's doing right now.

**Stump the Chump** 40:08

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

**Amy**

All right, everybody, welcome back to the question-and-answer segment. Jamie, the first question, I pulled this from our lab meeting this morning. So, our audience may know this, but every single week on Wednesday morning we have breakfast meeting, and we work with our students to talk about different research projects. And one of the students said, "I found 2 queens in a hive." So, I decided, well, we've probably asked this before, but we'll do it again. So, the first question that we have today is what should you do if you find 2 queens in a hive?

**Jamie**

I do nothing. That's a great question and hopefully that was a succinct answer but let me explain why. So, just quickly, I did a lot of behavioral research when I was a PhD student in South Africa, worked with observation hives a lot, watched bees a lot, and I noticed with some regularity multiple queens showing up in those hives. And I'm like, well, maybe this is just a characteristic of African subspecies of honey bees, right? I was in South Africa; I was looking at these African honey bees. Maybe that's just what it is. And when I came back to the States, I was looking for it and started finding it a fair amount of the time, maybe 10% of the time, 15% of the time I'd find a colony that had two queens, and it seemed to be a much higher percentage, say, in spring. I started thinking, well, maybe this is a relatively normal thing. I mean, if it's happening in 10 to 20% of colonies, that's not an accident, right? So, I started hypothesizing multiple reasons this may be the case. Maybe the old queen's pheromone output's decreasing and the colony doesn't think they have a queen, so they try to make a new one. Or maybe they're just requeening a bad queen and the new queen and the old queen haven't fought to the death yet. Maybe it's swarm season. Whatever the case, the 2 queens would coexist. There was a time in my life I would have taken out one of those under the assumption they shouldn't have to.

However, I've noticed that if I leave it alone, it usually reconciles itself in one to two months. And I keep thinking about it like this. If one of them was bad and needed to be replaced, and I'm looking at them both and making a judgment call on which one needs to come out, then I might be making a mistake and choosing the inferior queen, or, for whatever reason, choose the one that's not supposed to be there. I've noticed that if I just leave it alone, it tends to go away with no consequence to the colony whatsoever. So, when I see 2 queens, I go, wow, this is cool. And then I think, why might this exist? But I leave it alone and, usually, one to two months later, the colony just has 1 queen. So, that's usually my approach to it. I don't see this as a problem.

I'm beginning to see this more and more as normal. And in fact, I looked this up not too awfully long ago and found an author who wrote that this might be, again, they were hypothesizing, a way for colonies to boost their populations quickly, especially in spring when there's a lot of available resources in the environment. So, it's almost like, hey, let's create a two-queen system. Let's take advantage of all these resources by producing so much brood, and then we'll kind of shut the system down once the flow is over. I mean, the catch is, today, you and I are recording this episode in November and our students saw 2 queens in a colony yesterday. Why would it persist into November under that context?

But nevertheless, it's definitely one of those things that needs to be studied further. But from a management standpoint, I do nothing. I would just let it stay.

**Amy**

Sounds good. All right. The second question that we have is also related to queens, and this individual is asking about catching a swarm. So, after catching a swarm, how long does it take for the queen to start laying? And I'll finish what they wrote in the question, but that's essentially the question. How long does it take the queen to start laying? They said, I know swarms have a strong tendency to build comb in the wild. A swarm may not have comb ready. So that would, I guess, assume that the queen would need a few days to fatten up. I'm reading this verbatim from the question. So, I assume the queen needs a few days to fatten up and get back to laying eggs.

So, is there any research or is there a number of how many days and how long it'll take for a queen to start laying?

**Jamie**

Yeah. So, a lot of good points are made in the question. One of the questions is, I'm assuming it's going to take the queen a few days to fatten up. That is true. If you think about it from a swarm perspective, a swarm biology, specifically, perspective, you’ve got this colony that wants to swarm. It's usually the old queen that swarms with the bees. So, she is too heavy to fly. She's laying eggs. So, worker bees in the nest will start restricting her diet. They will get on her back and buzz her, which caused her to run around the nest. And through diet and exercise, the queen loses weight. When she gets down to her flying weight, so a lighter bee that's capable of flying, the bees will swarm, and they'll cluster. That cluster will look for a new home. When they find it, they'll fly there. The queen will fly with them. They go into that new cavity that has no comb, etc. Now, you've got this queen who's lost a lot of weight, who hasn't laid eggs in a few days and there's no comb in the nest, and the questioner's saying, well, when will she start laying eggs?

Well, it does probably take a couple of days for her to fatten up, maybe two to three days. She'll start eating more food, she'll be fed by the worker bees in the nest, she'll gain some weight, and all of that process allows the bees to start constructing comb in which she can lay. So, I would say it probably takes two to three days before she starts laying. Now, if you were to capture that swarm and put it into a hive that already has drone comb, you might see eggs as few as two days, but my guess is it's more like two to three days. If you will let them move into a cavity in the wild, it might take three to seven days, depending on how quickly that swarm can build mature cells that are deep enough for the queen to lay in. But it's just a matter of days. It's not like a very long period of time. I would say, certainly by the time a week has rolled around, you'll have a lot of eggs in that nest.

**Amy**

Sounds good. All right. So, the third question that we have is what is royal jelly and how is it made?

**Jamie**

Love that question. I don't think I've ever answered that question beforehand.

**Amy**

Really? No way.

**Jamie**

I know it's crazy, but I do know the answer. Worker bees that are younger worker bees and are capable of feeding immature bees, the larval bees, those worker bees are called nurse bees. So, worker bees have two sets of glands in their heads that they use to make the food that they feed to their young. One set of glands are called the hypopharyngeal glands, and these are responsible for making a clear liquid that is mostly proteinaceous, so a clear liquid with proteins.

The second set of glands are called mandibular glands, and they make a milky white liquid that's mostly lipids. So, hypopharyngeal glands, clear liquid, mostly proteins, mandibular glands, milky liquid that's mostly lipids. And it's the ratio of the hypopharyngeal secretions to the mandibular secretions that's responsible for the difference between brood food that they feed workers and drones and royal jelly that they feed developing queens. So, what is that difference?

Well, as a worker ages, days one to two, they're getting about 20 to 40% white fluid and about 60 to 80% clear fluid. By the time they're at days three and four, they're getting 100% clear fluid. And again, the clear being the hypopharyngeal gland secretions. And then, on days 5 and 6 they're getting mainly hypopharyngeal gland secretions with honey and pollen. Queens, on the other hand, continue to consume royal jelly, which is much more similar to that food that's produced on the 1st and 2nd day. So, a 20 to 40% white fluid and 60 to 80% clear fluid. So, that would be mostly hypopharyngeal secretions with some mandibular gland secretions as well. But it's the mandibular gland secretions that are responsible for making that milky white appearance. So, there you go. That's what royal jelly is, and it's made in the heads by glands of nurse worker bees. These bees themselves, in order to be capable of producing this brood food, have to eat pollen as young adults to mature those glands. So, there you go, Amy.

**Amy**

Can you imagine if we just like -- there was like -- I don't even know what I'm trying to ask because this sounds so -- never mind.

**Jamie**

I'm scared to ask. If we did the same thing, is that what you're about to say?

**Amy**

I mean, I guess we kind of do, but I was just thinking excretion out of your head to feed your baby.

**Jamie**

Yeah, I got you. I read between the lines. Hopefully, you guys enjoyed that, listeners.

**Amy**

Oh, my goodness. All right, listeners, if you have questions, you know how to reach out to us. Don't forget to send us an e-mail or reach us on one of our social media pages.

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

**Jamie**

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