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SPEAKERS

Jamie, Dr. Gloria DeGrandi-Hoffman, Honey Bee, Amy, Stump The Chump

Jamie 00:10
Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast. Thank you for joining us on this episode of Two Bees in a Podcast. Today, we're going to be joined by Dr. Gloria Degrandi-Hoffman, who's going to be talking to us about the importance of pollen and supplementation for honey bee colonies. In our Five Minute Management segment, we're going to be discussing why to use a smoker, how they work, and what materials to put in them. We're going to finish today's podcast with our question and answer segment. Hello, everyone and welcome to another segment of Two Bees in a Podcast. Today, it is our pleasure to be joined by Dr. Gloria Degrandi-Hoffman, who is the Research Leader at the USDA ARS Carl Hayden Bee Research Center in Tucson, Arizona. Now, Gloria has been a researcher on many different things related to honey bees and beekeeping, but we brought her in today specifically to talk about the importance of pollen to honey bees and how to supplement, research associated with pollen supplementation for honey bees. Gloria, thank you so much for joining us on Two Bees in a Podcast.

Dr. Gloria DeGrandi-Hoffman 02:01
Thank you so much for having me. This is a real pleasure to be here talking with you, Jamie and Amy. Can you hear my dog?

Jamie 02:14
Must be me. She doesn't like me.

Amy 02:16
She can be part of the podcast, too, if she wants to be.

Jamie 02:18
It's not the first dog that's barked at me. Amy, I bet you're gonna leave all this in the podcast, too.

Amy 02:26
I am. Let's just keep going. Let's go. Yeah. All right.

Jamie 02:30
So Gloria, I tell you, my team and I have kind of been dabbling in nutrition research, and what's been surprising to me is what we know, but also how much we don't know. It's a field that I think that there's lots of opportunity. A lot of people are starting to get in, and I know our listeners are really going to want to hear about all that. But before we go there, I just want you to spend a little bit of time talking about yourself, how you got into bees and bee research in the first place, and how you found yourself the Research Leader at the Carl Hayden Bee Lab. After that, we're going to start really going into questions about the importance of pollen to honey bees and nutritional supplementation and things like that, but first, talk a little bit about yourself.

Dr. Gloria DeGrandi-Hoffman 03:08
Well, I grew up in Pennsylvania, and even when I was a little kid, I was fascinated by insects. I like playing with insects. I had an insect collection, I liked science. I mean, I was one of those kids. I knew at a very young age that I wanted to be an entomologist. I tell people, I was like 10 years old, and they say, "What do you want to be when you grow up?" "I want to be an entomologist."

Jamie 03:36
That's crazy. I didn't even think I knew what an entomologist was when I was ten. That's impressive, Gloria. That's impressive.

Dr. Gloria DeGrandi-Hoffman 03:43
Well, yeah. We actually moved out into a place, my parents did, that had lots of open fields, and they were just filled with insects. That's where the fascination started. So then I went to Penn State and got a bachelor's degree in biology and then a master's degree in entomology. During that time at Penn State, Clarence Collison was my advisor. Some of your listeners may be familiar with Clarence. Clarence is a fabulous advisor. I got interested in mathematical modeling, mostly to try and capture what I was seeing in the field. I felt like just doing statistical analysis on things didn't really capture what was going on, so they were doing some of that at Penn State, and I talked with people there and they said, "If you really want to learn how to do modeling, you need to go to Michigan State." So I was fortunate enough to be able to do a PhD at Michigan State with Roger Hoopingarner, another person that many, many, many people know. He was this terrific major professor. For me, I learned so much from Clarence and from Roger, and so yeah, I went heavily into the modeling and system science and things like that for my dissertation. I built a model that predicted cross-pollination and fruit set in apple orchards. From there, the Carl Hayden Bee Research Center was doing almond pollination, and they offered me a job down there to build a similar model with almonds. I did that, and, well, I've been at the Carl Hayden Bee Research Center ever since. Like I said, I have done research on all sorts of things,

African bees and Varroa mites, and now, I'm doing a lot of work with nutrition and so it's been a great experience.

Amy 06:04
That's great. So I know that we had looked at some of the papers that you were a part of, and I know that a lot of your research, again, is on nutrition and focuses on the importance of pollen in the honey bee diet. So, I think, when beekeepers are thinking about honey bees, they do think about honey, of course, and then they think about pollination. Then, they just think about honey bees visiting flowers for pollen and nectar. I don't think I've ever even thought about it -- why is pollen so important for bees? Why are they attracted to pollen?

Dr. Gloria DeGrandi-Hoffman 06:38
Well, yeah, honey bees, everything that they do in their colonies, building their nest, reproducing and remaking young bees, they do this with nectar and pollen. It's kind of like plants. They do everything with sunlight and water. Honey bees do everything with nectar and pollen. That pollen supplies them proteins, amino acids, in particular, lipids, fatty acids, vitamins, minerals, all the essential components that they need for doing things like rearing brood, and mobilizing their own physiology. So, they do this all with, essentially, two food groups, nectar and pollen. There isn't anything that we have that is really a good substitute for pollen. They're able to get nutrients from it, and then metabolize them, so, yeah, everything they need, nutritionally, is in pollen and nectar.

Amy 07:57
That's so funny. Can you imagine if we just needed to survive off of two things in life?

Jamie 08:04
Pretty boring, I think. So Gloria, one of the things that's been interesting to me as my team and I have dabbled in some nutrition research -- in fact, we just graduated a student who did her master's work with nutrition -- is how much your name and your colleagues' names come up when we do literature searches for honey bee nutrition. So you've just established that honey bees need pollen. I think our listeners will know that and they'll appreciate it. But what's interesting to me is that it's very routine in commercial beekeeping operations to try to supplement pollen, and I know you've done a lot of research on how different pollen sources or multiple pollen sources can affect the health and physiology of honey bee colonies. I also know that you've done a lot of work with diet supplements as well. So could you tell us an overview of your specific research related to pollen, its importance to honey bees, as well as supplementing pollen in honey bee colonies?

Dr. Gloria DeGrandi-Hoffman 09:04
Sure. Actually, I got into nutrition research by working with a team to develop a protein supplement and I learned a lot in that process. Actually, I thought a lot about nutrition during that process and it sort of formed, in my mind, a kind of a conceptual framework to do nutrition research. What emerged from that is, I guess, you could say that framework is that during that colony's yearly cycle, they have different nutritional needs, similar to other animals or even to ourselves as we go through life. In the spring, when that colony is building, there are specific nutrients that need to be in pollen for them to rear brood

and accelerate growth of the colony. It's so important for a colony to gain a lot of members early in the spring and early summer, or they're not going to be able to make it through the following winter. So all of that build-up and all of the momentum for that build-up goes on in the spring. The pollens that are there have to support that. It's similar to what goes on with other herbivores in the spring when they are trying to support reproduction and taking care of their young. They're eating plants that are high in nutrients. And then during the summer, there's more or less a maintenance of that population. But then as we go into fall, especially in areas where there's winter confinement, now the nutrients in that pollen, it's not so important that they're there for rearing brood, because queens are slowing down and some are shutting down. But what's important is that you have the nutrients that bees can store in themselves, and also in the colony, that are going to be able to help them withstand winter confinement, being able to thermoregulate their colonies, activate their hypopharyngeal glands and start rearing brood later in the winter, sometimes before they even come out of the colony. Well, the nutrient demands for that in this framework are assumed to be different than they are in the spring. So, we've done research looking at spring pollens and fall pollens in different areas and how bees utilize those, and although we need to learn a lot more about it, what we found out to this point seems to support that framework.

Jamie 12:06
So Gloria, I'm taking notes while you're speaking, and my goodness, there's like a thousand questions I want to know, but I'm trying to keep myself at bay. So, I'll maybe ask one or two here as a follow-up. So, honestly, you talking about this is the first time I've thought about this idea that it's maybe not just volume of pollen or straight-up pollen availability in spring, winter, and fall. You're arguing that there's evidence that it's the type and quality of pollen during these times of year, and it almost needs to change to support colonies, whatever the condition or experience they're having at that moment.

Dr. Gloria DeGrandi-Hoffman 12:46
Yes.

Jamie 12:46
That's incredible. So that's interesting because when we start talking about pollen patties later, we develop these one-size-fits-all things, but I'm wondering if there's evidence, then, that there needs to be some research on altering diets as the colony ages or progresses throughout the year?

Dr. Gloria DeGrandi-Hoffman 13:04
Yes, I mean, I think that that's one of the things. It depends what you want to use, a protein supplement or a pollen substitute for. If it's just a stopgap measure until the next set of plants come in to bloom, and you have healthy colonies, and maybe you have a little pollen coming in, okay, there's a lot of give in that system with the pollen substitute or protein supplement. But if your colonies, for example, are in an area where there is really nothing for them, and that's going to go on for a couple of months, all right, then now, those protein supplements are going to not fill the nutritional needs of the bees and each brood cycle is going to be more nutritionally stressed. There's a legacy that happens in populations that are nutritionally stressed where each generation is shorter-lived, more susceptible to disease. So you're sort of on a downhill cycle. In addition to the nutritional working, I do a lot of modeling and model honey

bee populations and such. Once that population momentum starts going downhill, it picks up momentum, and there's no pulling it back up. I mean, beekeepers can try putting lots of frames of brood in a colony, but if you don't have those, that nutritional stress is taking a colony to its demise. And what usually happens is something comes in and finishes it off like a disease or virus, Varroa and that sort of thing.

Jamie 13:27
So, Gloria, one of the things that I was thinking about while you were talking about this idea of legacy of nutrition, stress populations, that's another interesting concept, this idea that subsequent generations of bees are increasingly more stress, shorter-lived, etc. Then you've got this maybe secondary stressor or other stressor that comes in and ultimately takes the colony out. What do we know about colony nutritional stress and how that impacts queens? The reason I asked that is because workers, six weeks of life in the summer, six months, in some places, overwinter, but the queen is the bee in the whole colony that gets maximally exposed to whatever stressor is in that house because she has the longest lifespan. So what does nutritional stress do to her, specifically? Not the ability for her to lay lots of eggs because if they have lots of pollen, they can rear lots of brood, but I'm talking about her specifically, shorter lifespans, susceptibility to disease. Do we know what these nutritional stressors might do to the queen?

Dr. Gloria DeGrandi-Hoffman 16:02
I haven't done any research, myself or like, what, what it does to queen longevity, and I mean, the queen is fairly protected there. She'll lay eggs, and if the colony is nutritionally stressed, the bees are just going to eat the eggs. They just keep recycling those nutrients. But you'd think, just for the reasons you just mentioned, Jamie, that stress on the on the queen has got to be there as well. I mean, she's part of a colony. Of course, if the colony is stressed like that, if they lose the queen, it's going to be difficult for them to replace her. Yeah, we lose a lot of colonies from lack of good pollen sources, I guess you could say.

Amy 17:00
I had a question about nutrition stress as well. When we're talking about nutrition stress, I know that you had kind of touched on just not having pollen, so kind of a dearth season, so I'm wondering if you've examined the honey bee nutrition stress in a monoculture, because I know you've done research in almond orchards. It makes sense, I guess, in my mind that diversity is important and having different sources of pollen is important, but has that been looked at, you know, just the stress on a monoculture versus just not really having anything at all?

Dr. Gloria DeGrandi-Hoffman 17:37
Well, any type of pollen is better than no pollen at all. But yeah, I mean, I'll tell you, colonies coming out of almonds, if they go into almonds in good shape, taking come out of almonds just booming. When you're in an almond orchard, that's really all you see. There's not a lot of diversity there. Now, it depends on on the plant that we're talking about. If the monoculture, for example, is cucurbits of some kind, okay, well, there's gonna be nutritional stress there. But it just depends, I think, what the plant is, what its pollen composition is in terms of amount of protein, how digestible the protein is, lipid levels.

Lipid levels are so important, fatty acid levels are so important to brood production and hypopharyngeal gland development. It just depends on what the nutrient content is, and whether the bees can digest it and access those nutrients.

Amy 18:56
Sure, that actually kind of goes into my next question for you. So I'm part of Facebook beekeeper groups, and we have a lot of questions that come in, basically, of people taking pictures of different pollen baskets on the honey bees. So people are wondering what kind of pollen is going into my colony? You're talking about different lipid levels, fatty acids, and how that's very important, but how would I, as a beekeeper, know what that is for my bees? Is there a way to identify what kind of pollen is going into my colony?

Dr. Gloria DeGrandi-Hoffman 19:31
I think for most beekeepers, over a course of time of keeping bees, one of the things about keeping bees is that it really connects you to the floral patterns in where your apiaries reside. You can look at the landscape and say, "Oh, yeah, the hardwood should be coming into bloom now. We've got fruit trees coming in where the clovers are blooming," and you begin to be familiar with what those sources are at various times of the year, and you see the bees bringing them in and they're bringing in this color pollen, and it's gotta be this. So for the main pollen and nectar flows, I think, just through experience, you kind of get an idea of what the bees are bringing in. I remember when I was at Michigan State, and the goldenrod would be blooming in the fall, you knew they were bringing it in as soon as you went into the apiary just because of the way it smelled. You'd look at the bees and knew what those were. So that sure is one way. Now, some of the other types of pollen, there are folks out there who specialize in pollen identification through using microscopy, a light microscope. Pollen has all different shapes. It is characteristic of different types of pollen, family, plant families, sometimes you can even tell genera by light microscopy. But the way that we do it now is we use molecular markers, so this thing called ITS sequencing. That's a molecular tool that can identify pollen to genus, sometimes to species. So we have molecular tools for it, now. It's fast, and it's not very expensive, and so that's the way that we do it.

Amy 21:53
That's awesome. That's very cool. We have a monthly management calendar where we have a list of things that are blooming in the area, even just with North, Central, and South Florida. And so all we do is really put the plant name, and so I know that there are people who are wondering, what color of pollen is associated with this plant? But it gets a little difficult because there may be multiple things that have, you know, yellow pollen, right? That makes it a little bit more difficult for us to be able to identify that, so that's neat to hear about.

Jamie 22:24
I will say that beekeepers increasingly just seem to be very concerned about the nutritional health of their colonies, and it was interesting to me, Gloria, that you're talking about the lipid content of pollen, how important that is, and hypopharyngeal glands development, all these things. It really just makes me want to talk a lot about pollen substitutes. But before we get there, I do want to ask one more point. I think one of the interesting things to me that's come out of these losses of honey bee colonies is these

beekeepers who are polled, at least in the United States, asking them what their chief issues are. Every year, in the top five, you get weak in fall and bad weather, I usually take those two off the list. They're hard to kind of discuss in a context of management. But then, we talk about Varroa, we talk about queen quality, and then they always seem to point towards nutrition. It's like all beekeepers know that nutrition is a big deal. A lot of them worked very hard to manage around it. You've talked already about some downstream effects, potentially on the queen or colony longevity. I'm just curious how poor nutrition specifically can impact colony ability to handle things such as pests and pathogens, because it kind of becomes a chicken-egg argument, right? Was it Varroa that killed my colony? Or were they nutritionally stressed, and therefore susceptible to Varroa? So can you talk a little bit about that relationship between nutrition and diseases and pests?

Dr. Gloria DeGrandi-Hoffman 23:50
Sure. Just like if we don't have good nutrition, we're more vulnerable to diseases, and if we do get sick, it takes us longer to get better, and sometimes we just don't do well at all. Nutrition is what you're putting into your body, or the building blocks for all your physiological processes, including immunity, and it's the same with honey bees. The nutrients that they need to mount immune responses are tied up in the types of food that they're eating, and there seems to be something with pollen, and it hasn't been captured in any pollen substitutes or protein supplements that actually cause lower levels of virus and lower Nosema levels, feeding pollen into those colonies versus feeding a protein supplement. But the other thing that has to be included in the importance of good nutrition comes back to this population level and having good nutrition so a colony can build up numbers. Large colonies, in those populations, there's a lot of resilience in the population. They can withstand quite a bit and bounce back. They're designed for that. If you think about it, when a colony is large and booming, and lots of brood, it runs out of room, sometimes its nest gets warped and it'll shut down brood rearing. It'll take several thousands of the individuals in that colony, and they'll leave. The population that's left there with a new queen has to go out mate and so there's this break in brood rearing, and they don't miss a beat. They bounce back. Several weeks later, that colony is rolling along, and that's all a numbers game, the amount of brood you have in the colony, the age structure of your adults, allows those populations to have that kind of bounce back that resilience. That loss of bees can be anything, it can be a pesticide that comes in and knocks out part of the colony, it can be a disease, it can be even Varroa mites that would knock out part of a colony, but if it's got good nutrition and continues to rear brood and a suitable age structure, it can withstand those. But if you get nutritionally stressed, and you're not making a lot of brood, and adults are nutritionally stressed so they're foraging earlier in their lifespan, and they're not living quite so long, oh, boy, they don't have any resilience at all. As a matter of fact, they're kind of a house of cards. You come in and you add mortality from a pathogen or parasite, and it pulls the cards out and the whole thing collapses.

Amy 27:17
So, moral of the story is to keep your colonies healthy and fed.

Dr. Gloria DeGrandi-Hoffman 27:24
That's it for all of us. Good nutrition is the key to good health, yeah.

Jamie 27:31
Diet and exercise, right?

Amy 27:33
Exactly. So Gloria, what nutrition management strategies can beekeepers use to make sure that they have the health of their colonies? This is a question that we receive all the time. What is your recommendation? Should we be using pollen patties? What does the research say? Your answer is going to influence my answers to everyone else in the world that asked me this question.

Dr. Gloria DeGrandi-Hoffman 28:01
Well, the gold standard is to have lots of flowering plants. I think beekeepers have done a really good job about being advocates for pollinator plantings and need to continue that, the importance of that. There's a lot of land out there that could be available for planting flowering plants that are going to flower at different times of year and be available to honey bees, and that's sort of the top-of-the-line nutrition. Then, if there are breaks in pollen availability and you have to put a protein supplement or pollen substitute in it, just adding a little bit of pollen to that improves its quality tremendously. I tell you, one of the things that I learned while we were making diets and trying to get the formulation for a protein supplement for bees, was like, I went around and, I never really looked at my dog's food bag or cat food bag. One of the things that they have on those is it has all the, especially the high end ones, all these food groups that are part of the dog's natural diet. It's chicken or lamb or whatever in it, that's part of the dog or cat's natural diet and it's marketed that way, that it's got that diet in it, and then they add other things, fillers and stuff like that. And that's all the dog lives off. Except if you're my dog and you catch a squirrel or groundhog or rabbit or something, and you eat that too, but for the most part, most civilized dogs eat just their dog food. We have a completely different mindset. We're trying to completely substitute with pollen substitutes or protein supplements what is the natural food for bees. I can tell you even the best diets I don't think are even close. Taking the approach that people have put food together for dogs and cats and stuff are putting some of their natural food in there, and if you have to supplement in the spring, put spring pollens in there, supplementing in the fall, put fall pollens in there, and you're going to improve the quality of those protein supplements tremendously. One of the things that we can do is if you have enough colonies, having pollen traps on just some of the colonies that are kind of your food gathering colonies. You'll gather that pollen at different times a year so that you can put five to 10% of it into your protein supplements. We found in a study that a grad student in our lab did, we had lower virus numbers, lower Nosema numbers, with just five to 10% pollen in the different commercially available protein supplements.

Jamie 31:40
So Gloria, you're painting yourself here into a corner because I've got so many questions about this. You're saying great things. I believe it all and love what you're saying. So my question is -- well, let me preface this question with a story or two. I always get in trouble for sharing this information. But we've done a few diet studies here at UF over the years, and I have never been able to get -- oh, this is dangerous to say, but I've never been able to get a commercially available pollen sub to do anything to a colony over doing nothing at all. So they've never improved colonies over the negative controls, and anytime I say that, I get a lot of backlash from commercial beekeepers and other beekeepers who

swear by their home remedy diets or whatever diet that they're using. I wonder, in the case that you're making here, where the total composition of these pollen subs that you're suggesting here be actually five to 10% pollen. I'm wondering, then, what good are the pollen subs at all? I mean, do you think there's much benefit to the pollen subs? Or do you think they absolutely need -- they need to be supplemented with pollen so that they're of any use at all. I'm curious your thoughts on that. I know it's a dangerous topic because the whole commercial industry uses these things left and right all over the place. But I'm just curious about your thoughts, given you study this so much.

Dr. Gloria DeGrandi-Hoffman 33:01
Well, Jamie, we've seen the same thing. The first brood cycle, especially as a colony was healthy and had a lot of pollen coming in beforehand, the first brood cycle on nothing but protein supplements, I mean, yeah, they do fine, and you don't see any difference. It's when you start getting into that second or that third brood cycle. So now, we're like nine weeks, 10 weeks out, two and a half months. Okay, now you really start seeing the stress of the lack of nutrients, whatever it is that is in those protein supplements. I know that they are put together with nutrients that bees use, all the essential amino acids that are there. I think, though, we found those aren't accessible to to bees. I mean, they don't digest much of the protein that is in protein supplements and, yeah, I mean, they're just not a good substitute for any length of time for a protein supplement. I mean, they're sort of the filler in the dog food. You have to add, I believe, some of the natural diet to really have a chance of making them effective in maintaining colony health.

Jamie 34:45
I think that's intriguing. I wonder if someday there'll be a business that pops up in our business like a sub-business where that's what they use their bees to do is collect natural pollen that they then sell to beekeepers to supplement them throughout the year. I know there's a lot of other questions that would go along with that, transmission of viruses or foulbrood or things like that, but I like your recommendation of having some colonies who just sit around with pollen trap cells on so that you can harvest that pollen and mix it into your pollen subs. I'll tell you, Gloria, as I look through the literature, as I hear you talk, I think this is an amazing opportunity for researchers out there to really make significant impacts in the industry, and that's pollen sub development, that the pollen subs unquestionably, universally improve colony health, and I think there's so much work to be done in that field. I think a lot of what you're doing is starting to push knowledge in that direction. So I think everything that you've said, really, really interesting. So can you tell me, just out of my curiosity, what are some of the most promising things you've seen in the world of nutrition over the last few years?

Dr. Gloria DeGrandi-Hoffman 35:59
The most promising?

Jamie 36:03
It's okay to think about it for a second. What are some things in the nutrition world that you've gotten really excited about? Like, I'll give you a little bit of help. One of my former students was at a conference where you were actually speaking, and she came back super stoked about all of your research related to lipids and the importance of lipids in diet because a lot of these pollen subs helps

people focus on, "We've got to make sure there's protein in there because that's what pollen does, it's protein." But she was so stoked about what you were saying with lipids. She's like, "Wow, mixing lipid in might be what's actually most important." So, I would argue, one of your very own results is something that's really incredibly exciting in the nutrition world. So, are there any other things like that that you see that you've seen recently? You go, I think we're closer, this is really exciting stuff.

Dr. Gloria DeGrandi-Hoffman 36:58
Yeah, I mean, omega three fatty acids are really important to be part of the diets, and for things like hypopharyngeal glands development. One of the things that we've gotten into, I think this is exciting, is looking at plants and the nutrients that flowering plants present to bees. First of all, looking at how much variation there is in the nutrients depending upon where the plant was grown, what type of soil was grown, and what kind of stresses that it was grown under, and how that might affect the nutrient composition of pollen. Another thing is that selecting for plants that will bloom at particular times of year to fill in these windows when there are pollen dearths. A group of ARS labs working together, we've just started this, but to begin to look at these sorts of things because, I mean, ultimately, we want to expand pollinator plantings. But put in those pollinator plantings, plants that have the nutrients that bees need to keep healthy, and right now, I mean, we don't know how much variation there is, for example, if you grow sunflowers in North Dakota, on the soils and the conditions in North Dakota, what nutrients are in those pollens versus growing those same varieties of sunflowers in Tucson under our conditions? Or is the nutrient composition of pollen the same? Does it differ by environment? That's a study that we have going on right now. But I think that that may be true for a lot of plants. What kind of cultural practices can we have that would actually improve the nutritional value of pollens? So, yeah, I think that we're kind of working more from the plant and flowering environment and making nutrients available to bees rather than kind of protein supplements, but expanding the availability of flowering plants for bees and for managed colonies.

Jamie 39:45
Gloria, I agree. There seems to be a great emphasis these days on planting for bees, and I think that that is going to grow. When the public comes to us and asks us, "What are ways that we can help bees?" That's one of the easiest things that general public can do and they can wrap their minds around and understand to help. So listen, this has been a fascinating interview. Gloria, thank you so much for joining us and sharing your knowledge about honey bee nutrition as well as the research that you're doing to address this very important topic.

Dr. Gloria DeGrandi-Hoffman 40:13
Thank you. It's been a pleasure to be here. Thank you for having me.

Jamie 40:17
Absolutely, everybody, you've had the pleasure of listening to Dr. Gloria Degrandi-Hoffman, the Research Leader at the USDA ARS Carl Hayden Bee Research Center in Tucson, Arizona. She's an expert on the importance of pollen to honey bees' nutrition, impacts on honey bee colonies and even developing diet. So make sure you go to our show notes and check out the links to her and her lab, as

well as some of the publications that she has on this topic. So thanks again for joining us on this segment of Two Bees in a Podcast.

Honey Bee 40:50
Have questions or comments? Don't forget to like and follow us on Facebook, Instagram and Twitter @UFhoneybeelab.

Amy 41:13
We are at the Five Minute Management segment, and Jamie, the topic for today -- let's see, I've got to get my timer ready. Today's topic is: why do we use a smoker?

Jamie 41:31
Amy, I think I'm going to totally ace this one because there's no way it's going to take me five minutes to talk about this. But I think that beekeepers should always have a smoker lit when they are working colonies. Now, there are a lot of beekeepers out there who will disagree with me. They're in the minority. Most beekeepers I know use smokers when they work their colonies. However, there are some who say that you should be able to work colonies gently enough that it doesn't require a smoker. I've worked colonies on six of the seven continents, and I can tell you, there's times where colonies just won't listen to me and I need a smoker. So I think they should always be lit. For that matter, I think that they should always be used. I think it's actually fair to the bees to do it. It keeps them calm, reduces, I think, their stress, and I think it saves a lot of them from trying to come out and get you. So I think you should use it, you should always have one on hand. Why do we use them? This is something all beekeepers are fully aware of, which is we use them to keep the bees calm. Historically, the reasoning was when you smoke a colony, it tells the bees that there's a fire nearby, potentially, and then they gorge on honey and they're focused on preparing to address that situation rather than coming after you. But I also actually prefer the second explanation, which is bees communicate with pheromones. So when we go into their hive, they tell one another "Hey, there's an intruder here. We need to go out and get this individual." And they have an alarm pheromone that they use to do that. When you get stung, there's alarm pheromone deposited on wherever you're stung, the sting site and other bees will attack that area. So the smoke masks the alarm pheromone. It allows us to work them calmer, and it makes it a better experience, I think, for both the bees and the beekeepers. So I absolutely use a smoker. I endorse using it, and I do not believe that it's super stressful on the bees. I think the opposite actually is the case. I think it makes it a better experience for the bees and the beekeeper.

Amy 43:41
So is the theory about them gorging on honey, is that true or no?

Jamie 43:46
So I've had this recent discussion with some folks and some people still adamantly believe it's the case. There's no question that bees -- they're hardwired to respond to natural events and a natural event that they might experience in the wild is a fire, right? So there's no doubt that the smoke does trigger a cascade of behaviors that helps them do that. But the explanation that always had given to me, Amy, is that bees get exposed to the smoke, they think it's a fire, they gorge on honey, and now they become

too heavy to fly so they can't come get you. I'm like, well, what natural system would cause a bee to get too heavy to fly if there's a fire coming. Right? So my guess is that it does change their behavior. It might prep them to get ready for leaving the hive if necessary, but I think the biggest contribution is the masking of alarm pheromones.

Amy 44:36
That's fair. Okay, so we have two minutes, and I'm just gonna ask you a couple of extra questions because you definitely A+ that one. Congratulations.

Jamie 44:46
I bet you're gonna get some comments though. I think there'll be some people who disagree with some of this stuff I say, but that's okay.

Amy 44:51
Well, can you actually over smoke bees? Is that a possibility?

Jamie 44:55
You absolutely can. I've worked bees of varying temperaments. So the more gentle a colony is, the less smoke it's going to receive from me. But likewise, the more defensive a colony is, the more smoke it's going to receive from me, and I've smoked colonies heavily. I do see a lot of people not using the right amount of smoke for the right response that the bees are giving you. So people can over smoke gentle colonies, or use smoke when it's, frankly, not necessary. You can also over smoke bees to the point that you can drive them out of the hive or you can flavor the honey that you're harvesting. A lot of folks are very much purists, they won't over smoke the supers when they're removing them and only maybe smoke the brood chamber to avoid having that smoky taste in the honey.

Amy 45:45
Got it. All right, we have 45 seconds, I'm going to ask you the last question. What maerials do you suggest people use in their smoker?

Jamie 45:54
Yeah, so I use a lot of things that are just around me and available. So pine straw and grass, as an example. Wood chips are very popular for a lot of beekeepers, wood pellets are being sold by a lot of the equipment companies. A lot of the countries I've visited around the world, people will use dried animal dung. I mean, animal dung is basically processed grass, right? So they'll use that. This is going to go over the five minutes, I can promise you, now. But I actually answered a similar question for the American Bee Journal, one of their readers not so long ago, and I had a couple of individuals contact me and mention to me that not all woods and not all grasses and materials are made the same, just like we would be careful to keep out of our smoker burlap sacks that have been maybe treated or have oil residues. There might be some woods and some grasses that we might not want to use in our smoker because burning those things can produce toxins is dangerous for us, as some of these other things are. I've never seen a list of those things. A couple of these individuals did mention a few types of trees,

etc. So what I always tell people is when in doubt, use dried grass, pine straw, wood shavings, and these, generally, are the better available options for us.

Amy 47:13
Awesome. Thank you so much. That was our Five Minute Management segment.

Stump The Chump 47:22
It's everybody's favorite game show, Stump the Chump.

Amy 47:41
Alright, it is question and answer time. We have some great questions that we've received. You know what, Jamie? The other day, one of my friends who is not a beekeeper told me that he listened to our podcasts, which I thought was kind of funny, and I said, "Oh, really?" And he said, "Yeah, you know, you guys get really deep into bees." And I'm like, "Well, yeah, what else would we be talking about? Of course we do." And he goes, "No, it's like really scientific." And I'm like, "Yeah, that's the point." So anyway, I guess we've just become honey bee nerds talking real deep into honey bees.

Jamie 48:12
It's what it's supposed to be, right? I bet some folks probably feel like we don't explore it in detail enough. But we try to have a mix because there are lots of different types of beekeepers who listen to us, right? Hobbyists, sideliners, and commercial, so we try to have something for everyone. Hopefully, we're able to do that.

Amy 48:27
Absolutely. Okay. So for our first question for the Q&A today, this person is asking about the difference between, I guess, workers and queens and laying workers. So what are laying workers? Are they a middle ground between a worker and a queen? Has there been any research done to actually explore workers and their laying habits?

Jamie 48:49
So that's a series of interesting questions. Essentially, what happens is when a colony goes queenless, they try to re-queen themselves, and there are times where colonies fail that process. They go, essentially, completely and hopelessly queenless. They're now past the point that they can make a new queen. There are no young bees available. When that happens, in the absence of the queen long enough, some of the workers' ovaries can begin to develop and those workers can begin to lay eggs, and we call those workers laying workers, right? It makes perfect sense. Now, the downside is that workers cannot mate neither could they store semen if they could mate. They don't have a Spermatheca. So they can't fertilize eggs. Workers are only able to produce unfertilized eggs, which for most of the honey bee subspecies, results in drones. So colonies that are headed by laying workers are doomed. Furthermore, they're a little difficult to requeen because laying workers will start to take on the pheromonal bouquet of a queen. They start sort of smelling like a queen. So it's very difficult to put a new queen in there because the bees sort of think they have one. The questioner is asking, are these workers closer to queens than they are to workers? And in reality, they're closer to workers than they

are to queens. When bees are producing queens, they can give varying amounts of royal jelly to those developing offspring. The later in that female larva's life she is pushed towards becoming a queen, the less of a quality queen she will be. So for example, if they take a three day old larva to make a queen versus a two day old larva to make a queen, the three day old larvae has less advantage to being a quality queen because she has one less day to get the royal jelly she needs and be tended like a queen, etc. So what this does is it produces what we call pseudo queens. They have a lot of the physical characteristics of a queen. They have more developed ovaries than they would if they were a worker. They look more like a queen, their stinger is smoother, things like that. But they're not optimized as a queen because even though they have developed ovaries, they're not as developed as they could be if they were a full queen. And so that's why we start saying things like when bees supersede themselves in emergency situations, they often go to the available offspring to make a new queen. If they start feeding inferior offspring, you can get smaller inferior queens. With that said, laying workers are still far more worker-like than they are even pseudo queen-like because most pseudo queens still look like queens, still have a lot of physical attributes, whereas laying workers were present as workers in the hive when there was a queen. Now that queen is gone, and now they just have a few developmental stages of their ovaries and they start laying eggs. But otherwise, they don't morph to look like a queen, and so they're far more worker-like than they are queen-like. They're just simply workers that can lay eggs now.

Amy 52:12
That's really interesting. So has there been any research done with how they decide which workers are the ones that develop ovaries?

Jamie 52:20
You know, Amy, to my knowledge, there's very little research on that topic. It is fascinating and waiting to be done. One of the things I'm curious about are why some workers, just like what you said, are the ones that become laying workers. If you think about it, a colony has 20,000 individuals, and there's a queen that dies, and they become hopelessly queenless, and let's just say 10 laying workers develop. Why those 10 among the 20,000? I think it's just a great area of research just waiting to be investigated. There's a lot more that I can talk about in this regard. Are all those workers from certain patra lines? Are all those workers ones that already had slightly more developed ovaries than the other workers? They just weren't using them because the queen was present? It's difficult, Amy, because when a colony goes queenless and laying workers develop, it's hard to find those workers. I mean, you basically have to catch a worker amongst thousands of other workers with her rear end in the cell.

Amy 53:24
Laying eggs. Yeah.

Jamie 53:25
That's right. It's just hard to do.

Amy 53:28

Alright, so that actually kind of puts us into the next question. A lot of the questions that we've received, it comes with a backstory. So I will go ahead and kind of summarize what the questioner has asked us and told us and then, we can get into the discussion, I guess, of answering the question that they have. So this person usually uses a Queen Mandibular Pheromone, which we discussed in a different, separate Q&A. They use that, actually, to help with catching swarms, or just doing bee removals. They'll usually use the QMP when they're not sure if they have the queen or not. They do look for the queen, but don't spend too much time with it. They use a QMP for it. And so I guess what had happened was this person had finally used the QMP to remove the bees and the workers went into the box and, eventually, he did find the queen of the original colony, tried to put her into the new colony, and they tried to ball her. So what is going on here?

Jamie 54:38
Yeah, it's the first time I've heard a story like this. First of all, I think this use of QMP is very interesting. So for all of our listeners, QMP, just like Amy said, is Queen Mandibular Pheromone. You can purchase it, impregnate it into these like plastic strips. They almost look like really small straws, except they're not hollow. They're just these cylinder-shaped things. We use them a lot in research, Amy, like you said, as we alluded to in an earlier Q&A that we did some episodes ago, but we use them a lot in research. So this particular listener is saying, well, they catch this swarm, or remove this colony from a wall, for example, they're not sure they have the queen. So they put this QMP strip in the hive to stabilize those bees in the event that he or she failed to capture that queen, and then upon finding the queen the next day and trying to introduce it back into that hive, the bees balled it. So what happened? My guess is what happened is that the bees accepted the QMP strip as their queen over those next 24 hours. When this bee removal specialist then found the queen and put it into the hive, the bees considered her foreign, even though it was within the last 24 hours. So maybe in this case, if that were to ever happen, again, is remove that QMP when you're going to introduce that queen back into its hive, and consider caging that queen for a couple of days before releasing her just to avoid that conundrum. I've never heard a story like this. But my guess is it's just an example of bees very quickly accepting something that wasn't even a queen as their own queen, and now, no longer recognizing that individual that hasn't been in the hive the last 24 hours as their own queen, What an interesting story. I really appreciate the listener for sharing it with us.

Amy 56:27
Yeah, definitely. Do you think that the 24-hour period was maybe too much time? If you had to guess, how much time would it take for them to just accept another pheromone, whatever that may be? And not accept their old queen back again?

Jamie 56:43
Amy, my common response to that is that biology is just messy. So I'm surprised to hear it happened. Honestly, I'm surprised to hear it happened within 24 hours. I would have never guessed that to be the case. I would have guessed it would have taken 48 or 72 hours. So my guess is that 12 to 24 hours is sort of on the low end for acceptance. I just think about requeening a hive, the quickest I could ever release a caged queen into a hive after she's been sitting in the hive is 12 hours. I'd expect them nine times out of 10 to kill her at 12 hours or 24 hours. But once I cross two days or three days, or certainly

four days, I believe that they've accepted her and I can release her with confidence. So you got this synthetic queen. I mean, this thing is not even a real queen, right?

Amy 57:27
It's just a strip.

Jamie 57:28
Exactlty. And so it's just amazing that they would do that. But, biology is fascinating. I'm surprised to hear the story in the sense that I've never heard it, but when thinking it through, I'm not surprised that it's happened. It was really just a neat thing.

Amy 57:44
Okay, so for our third question, we actually received an email from a club and they're looking to start a queen rearing program, both for education and because they want to sell queens. So the question is, they're wondering if they need to purchase artificially inseminated, VSH breeder queens, knowing that they're super expensive. So what should they do? What do you recommend? Do they need to be purchasing once a year? What about controlling drones at different DCAs if they choose not to use these? What do you think?

Jamie 58:16
So there's certainly a lot here. Amy, I don't know how you managed to do it, but you made all three of these questions about queens. So, I'll give you a good job. That's really neat.

Amy 58:24
Thanks. It wasn't me. It was the listeners.

Jamie 58:26
Perfect, well done. All right. So I totally understand what's going on here. So the local bee club is trying to get into their own breeding of queens. I applaud that. That's super cool, exciting. But they're right, to start with breeder queens is expensive and to bring in breeder queens every year is expensive. So maybe they could do it upfront to get the program up and going, but they're not necessarily sure if they can continue to do it well into the future. All right. So it's not necessary to do it well into the future. The way that these things usually work best is -- let me just kind of work my answer through with just a very basic story. Let's say that this club has 20 members, and let's say that they bring in this breeder queen and they graft and they give cells from that breeder queen to all 20 of its members. So what they would benefit from doing is that they would have those 20 members, maybe, keep some super basic stats on their performance the following year. These colonies produced lots of honey, these colonies are general, these colonies were whatever. Then, the five of the 20 club members whose five colonies were the top five performing would give their five queens at the end of the season back to the club, or allow the club to graft from those five queens to make next year's club queens. So, think this through again. Let's just say, again, that you've got these 20 members who are putting their club queens into a lot of their colonies, the five best colonies are chosen based on performance and gentleness at the end of the year. In the next year, instead of buying a new breeder queen, you simply go to those members,

collect your top five colonies, graft from them, and bring those back into your breeding program. Their principal reason that they're wanting to go back to the breeder queens every year but can't do so because of the money is that the breeder queens are being produced in a very controlled situation where there's lots of measurements being taken, where the winners are being advanced, and the drones are being controlled. So there's the benefit of that, but I can totally understand from the club's perspective, what do we do after that first year. So like I said, the first year, you just buy it, you graft, you distribute those queens, you simply ask your club members for some basic data, you choose the five top colonies from performance that year, and next year you graft from those five to restart your breeding population at the club. There was a second part, Amy, if I remember correctly, what do you do about drones? Well, drones could be a problem if the club is managing a breeding yard because they need to have colonies there producing drones. But it's less of a problem if the club allows the participants to be the breeding yard. So how does that work? Let's go back to my story. Let's say this club buys a breeder queen, distributes cells amongst all its members, and let's say that's represented over 150 colonies. Well, whatever the top five colonies are, if you graft from those next year and just give them queen cells back to the members rather than mated queens, then the queen is going to emerge from those cells into the club members colonies, and they're going to mate with the drones from those colonies that were from last year's breeder queens offspring. So, basically, there's this cycle of, we will seed this effort by purchasing breeder queens this year but we're going to maintain the breeding program through our members' apiaries by choosing the winning colonies, grafting cells and distributing those cells back into the members who allow the queens to mate in those yards. Next year's top five colonies are the breeders for the following year and next year's top five colonies are the breeders from the following year. As these get mated in the club members' colonies, you maintain those stocks. It's a little looser, a little messier, but it helps control the drone and keeps you from having to purchase new breeder queens every year.

Amy 1:02:42
Sure. Now the other part of that question, and this just may be part of the evaluation process, is looking at overwintered queens. So would you say that that's just part of the process of figuring out if those queens do overwinter in their colonies over winter that those would be kind of like the survival of the fittest, the best that survive, okay?

Jamie 1:03:02
Amy, spot on. The club would need to decide on the characteristics that are important to them. So I would argue gentleness, productivity, brood production, a handful of things. But I would argue, just like what you said, overwintering capacity needs to be one of those things, and maybe by the time March rolls around every year, you look at the collective data, and from all the cells that you distributed last year, producing all of those queens and all of those club members colonies, you select the three or four or five best colonies to start the process over again. You graft from them, you distribute those cells under your club members colonies, you measure all those datasets over and over and over and just every year, you just do the same thing there. There are some pretty good models for this. I know, for example, there's the Russian Queen Breeders Association. They don't do it as a local bee club. They do it as breeders across multiple areas. But you can see some of their models for how to maintain lines and things like that, how their members have access to breeder queens and things. And there's just lots

of examples of this. There's especially true of these folks who are very focused on these local populations of honey bees. You see that a lot in Europe. If you just Google some of those things, you'll very quickly get to some organizations that are trying to employ similar strategies to offer queens to its membership in a way that's sustainable and works well and produces a bee that works well in the area.

Amy 1:03:07
So my last question is how much do breeder queens go for?

Jamie 1:04:33
Yeah, Amy, I've seen them go for, $250, $500, $1,000, or more. So the reason breeder queens are so expensive -- let's pretend for a second that I'm a queen breeder. I might have 100 colonies and I'm very detailed, taking close measurements of all of these things. And the colony that just performs the best, I will graft from that queen, and those resulting queens are my breeder queens. Remember, that's only half of the genetic equation, that's just the queen. So I might take the trouble to instrumentally inseminate those queens with drones I collected from good colonies in my yard. So I've taken lots of steps to produce a queen, who, herself, is not made to lead a production colony. It's simply made to produce offspring for other individual's queen programs, and so as a result, they can be hundreds of dollars, if not thousands of dollars, if a lot of effort has gone into producing them.

Amy 1:05:33
Sure. That's pretty cool. Queens are so awesome.

Jamie 1:05:36
It's really neat, yeah.

Amy 1:05:38
They're just so cool. Whenever I'm speaking to farmers or anyone in ag, they can relate to queen breeding, they can relate that to cattle breeding or horse breeding or poultry breeding. And so whenever I let them know, yeah, there are queen breeders out there, people are like, what?

Jamie 1:05:58
I know. When I tell people you can instrumentally inseminate queens, it usually blows their mind because they know it with cattle. But yeah, it just takes a small needle. That's usually the question that they have. That's it.

Amy 1:06:11
That's it. All right. Okay. Well, everyone keep your questions coming. We're really enjoying them. Thank you so much. Hey, everyone, thanks for listening. Today we'd like to give an extra special thank you to our podcast coordinator Lauren Goldstein and to our audio engineer James Weaver. Without their hard work, Two Bees in a Podcast would not be possible.

Jamie 1:06:38

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