



Notes from the Lab:

The Latest Bee Science Distilled

by Scott McArt

What would happen if all beekeepers simply stopped trying to control varroa mites? Well, there would likely be a massive worldwide population crash of the managed western honey bee (*Apis mellifera*). And in the process, there would likely be an epidemic of viruses that spilled over from collapsing honey bee colonies into the numerous species of wild bees and other insects that are susceptible to those same viruses. Without exaggeration, halting varroa controls could result in a worldwide pollinator health and beekeeping catastrophe.

But what then? Would *Apis mellifera* go extinct? Probably not, since there are already several isolated populations of *A. mellifera* that get along just fine without treatments for varroa. Thus, there are already western honey bee populations that have evolved to control varroa on their own. And not only that, the way in which each of the populations control varroa is strikingly similar. This is the intriguing

topic of our ninth “Notes from the Lab,” where we highlight “**Rapid parallel evolution overcomes global honey bee parasite,**” written by Melissa Oddie and colleagues and published in the journal *Scientific Reports* [8:7704 (2018)].

Wait, there are several isolated populations of *A. mellifera* that get along just fine without treatments for varroa? Yes, you read that correctly. Oddie and colleagues highlight four of these “surviving populations” in their study – one population from Oslo, Norway, another population from Gotland, Sweden, and two populations from Avignon and Sarthe, France. Each of the populations has survived for >17 years without a single varroa treatment. And that’s probably just the tip of the iceberg. Other recent publications have shown that treatment-free *Apis mellifera* populations are present in South America and at least three states in the eastern United States.

The presence of these “surviving populations” that persist in the face

of varroa suggests the bees have figured out how to control varroa on their own. In only a few decades or less, evolution via natural selection has resulted in genetic lines of *Apis mellifera* that keep varroa at low enough levels that they don’t overrun the colonies.

Fantastic, how do the “surviving populations” do it? This is the main focus of Oddie and colleagues’ study. To figure this out, the authors made a few astute observations. First, they compared the number of reproductive mites in brood cells from the “surviving” compared to “susceptible” colonies from the same geographic areas. They found that reproductive success of the mites in “susceptible” colonies was 10-30% greater, on average, than reproductive success in the “surviving” colonies. In other words, varroa was much better at reproducing in the normal colonies that weren’t from the isolated “surviving populations” that had presumably undergone natural selection.



Fig. 1 The evidence of a recapped cell is not entirely obvious from the top view (a.), but once the cap is turned over you can see whether the glossy pupal cocoon is intact (b.) or showing a darker, matte circle where the cocoon is no longer present (c.). This hole can be as small as a pinhead, or encompass the whole cell cap.



Fig. 2 Researcher Melissa Oddie (right) working with local beekeepers in Norway to cage queens for the experiments run during the study.

Second, they noticed the frequency of uncapping and recapping of brood cells was significantly greater in the “surviving” colonies. And not only that, the “surviving” colonies specifically targeted mite-infested cells to a much greater extent than the “susceptible” colonies.

Finally, tying these two observations together, the authors conducted an elegant uncapping experiment and found that uncapping/recapping the brood cells resulted in a 15% reduction in the number of mites that produced viable offspring. In other words, the bees from the isolated “surviving populations” were better at finding mites in capped brood and uncapping/recapping the infested cells, which ultimately reduced reproductive success of varroa.

I’ve heard of Varroa Sensitive Hygiene (VSH) and this sounds a bit different. What gives? The uncapping/recapping behavior noticed by Oddie and colleagues does fall under the umbrella of VSH behavior, but it’s not as extreme as fully removing all capped brood that’s infested with varroa. Thus, the VSH behavior of the “surviving” populations is not as drastic towards combatting *Vvarroa* as some of the current artificially selected varroa resistant lines. At the same time, the VSH behavior noticed by Oddie and colleagues is also more cost effective in terms of population growth of the colony. Viable workers are not simply thrown out of the colony before they emerge. Instead, the worker cells are uncapped, which disrupts varroa reproduction (the

specific mechanism still isn’t known, but is likely due to changes in temperature or humidity, to which varroa is particularly sensitive). This allows the colony to keep a more consistent work force and not waste the food and effort that went into producing those workers.

So, this anti-varroa behavior evolved similarly in four different places? Yes, and this is perhaps the most intriguing aspect of Oddie and colleagues’ study. Because they found the specific uncapping/recapping behavior evolved independently in four distinct locations, this behavioral trait is likely an easily evolvable and highly successful method for combatting varroa. In light of those facts, perhaps more effort should be placed on comparing its effectiveness to current artificial selection efforts for VSH and other varroa resistant traits.

OK, I’m convinced. How do I get these bees for my apiary? Of course this is the reaction that many astute beekeepers will have. But it’s important to point out something that Oddie and colleagues discuss at length when describing their “susceptible” control colonies (we also discuss this at length at our annual Dyce Lab queen rearing workshops!). As Oddie and colleagues point out, local adaptation is known to be a significant factor in the health and success of honey bees, often more important than other genetically determined traits. Thus, if you’re looking for successful bees, look first in your neck of the woods. Then look for (and select for!) specific traits.

Until next time, bee well and do good work,

Scott McArt

REFERENCE:

Oddie, M., R. Büchler, B. Dahle, M. Kovacic, Y. Le Conte, B. Locke, J. R. de Miranda, F. Mondet and P. Neumann. 2018. Rapid parallel evolution overcomes global honey bee parasite. *Scientific Reports* 8: 7704.

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