Notes from the Lab:

The Latest Bee Science Distilled

by Scott McArt

One thing I often hear from beekeepers is that they're interested in the emerging science on pollinator health, but it's hard to stay informed. They either don't have time to keep up with it or the scientific articles are simply too dense. To help remedy this situation, we've decided to summarize some hot-off-the-press research in plain English, cutting through the dry jargon and complicated methods. We want to highlight the most exciting science that impacts beekeepers in a concise, accessible, easy-to-read column.

Our first featured article has received a lot of chatter in both the scientific community and beekeeping blogosphere: "***A worldwide survey of neonicotinoids in honey***" written by Edward Mitchell and colleagues, published in the journal **Science [358: 109-111 (2017)].**

The authors tested nearly 200 honey samples from around the world for 5 different neonicotinoid (a.k.a. "neonic") insecticides: acetamiprid, clothianidin, imidacloprid, thiacloprid, and thiamethoxam. They found traces of at least one insecticide in 75% of samples, two or more insecticides in 45% of samples and 4-5 insecticides in 10% of samples.

Wow, neonics in 75% of worldwide honey… where do they come from? Neonicotinoids are currently the most widely used insecticides in the world. Three main factors lead to their accumulation in honey: Neonics are systemic insecticides, which means they accumulate in all plant tissues, including nectar.

1) Neonics can stay in the soil for several years before potentially being taken up by crops or other plants.
2) Bees collect nectar across great distances (on average ~1.5 km from their colonies). Thus, pesticide residues in honey bee colonies are considered an excellent measure of contamination in the surrounding landscape.

Are the neonic concentrations they found in honey dangerous to bees? When evaluating risk, it's important to consider that the 5 neonicotinoids tested vary greatly in toxicity. Toxicity is typically reported as an LD_{50}, the dose that kills 50% of adult bees in a cage study. The LD_{50} for thiamethoxam is 5 ng, which means if one worker bee consumes that amount, it has a 50% chance of surviving. But that same bee would have to consume 1,732 ng of thiacloprid to reach the same chance of surviving. In other words, thiamethoxam is roughly 346 times as toxic as thiacloprid.

The authors found that total average neonic concentrations in honey were 1.8 nanograms per gram (ng/g). They note that 0.1 ng/g is the lowest concentration at which an observed detrimental effect of a neonicotinoid (thiamethoxam) has been shown in honey bees. However, the study found low concentrations (average <0.035 ng/g) of the most toxic neonicotinoids (clothianidin, imidacloprid, thiamethoxam) and higher concentrations (average <2.40 ng/g) of the less toxic neonicotinoids (acetamiprid and thiacloprid). Without knowing the specific neonic composition of individual honey samples, unfortunately we are left without a critical piece of information to assess risk. Some of the honey the authors tested clearly posed a risk to bees, since maximum concentrations of the highly toxic neonics were observed up to 6.3 ng/g. But more information than is contained in the paper is needed to understand the pervasiveness of risk to bees among the 198 honey samples tested.

Are the neonic concentrations they found in honey dangerous to humans? One reason neonicotinoids have been widely adopted owes to their low toxicity to humans compared to other classes of insecticides. Neonic residues are found in many foods we eat, especially some fruits and vegetables. None

of the individual neonic residue levels found in honey were above limits authorized in food products by the European Union or the United States. However, 2 of the 198 samples (0.5%) were above limits if the sum of the 5 neonics was considered. Thus, it's unlikely that the trace residues of neonics found in most honey samples pose significant health risk to humans.

Until next month, Scott McArt

Scott McArt, an Assistant Professor of Pollinator Health, helps run the Dyce Lab for Honey Bee Studies at Cornell University in Ithaca, New York. He is particularly interested in scientific research that can inform management decisions by beekeepers, growers and the public. For further information, visit their webpage https://pollinator.cals.cornell.edu/ and like them on Facebook: https://www.facebook.com/DyceLab/