Notes from the Lab:

The Latest Bee Science Distilled

by Scott McArt

This spring, I received several phone calls from beekeepers, growers and pesticide applicators regarding the risk posed to honey bees from insect growth regulators (abbreviated as "IGRs"). These chemicals are used as insecticides to control insect pests, especially in agricultural settings. And since many of them are developed to be insect-specific (e.g., they target leaf-chewing caterpillars, not bees), they can potentially minimize risk to the friendly insects while controlling the pests that cause crop damage.

Due to the flurry of interest in this topic that was crossing my desk, I was pleased to see a new cutting-edge publication on IGRs and bees. So, for our eighth "Notes from the Lab," it's time to delve into the risks posed to honey bees from IGRs, where we highlight **"The effects of the insect growth regulators methoxyfenozide and pyriproxyfen and the acaricide bifenazate on honey bee (Hymenoptera: Apidae) forager survival,"** written by Adrian Fisher and colleagues and published in the ***Journal of Economic Entomology*** **[111:510-516 (2018)].**

Before we get into their study, a quick analogy. I'm sure everyone is familiar with the hormone called testosterone. If you've lived through puberty yourself, or you've seen junior high school boys go through puberty, you know that hormones can greatly influence behavior and physique!

Well, think how testosterone influences adolescent males and multiply that by 100. Now you're starting to understand how juvenile hormone influences insects. If some insects are exposed to too much juvenile hormone, they get stuck between being a larva and pupa and never complete development. Or their eggs can become sterile. Or they face several other scenarios that can lead to a slow or quick death. In other words, if you spray juvenile hormone on some insect pests, it could be a really effective chemical that kills the bad guys!

OK, now for the study. The authors observed that several chemicals were being sprayed on California almonds during bloom, including the IGRs pyriproxyfen and methoxyfenozide and the miticide bifenazate. None of these chemicals were developed to harm bees, which is why they were being sprayed during bloom while the bees were out pollinating the almonds.

So… were the chemicals safe for bees? To answer this question, the authors set up a nice assay that mimicked how bees would be exposed to the chemicals during pollination. They collected several forager bees, put them in a wind tunnel (basically, just a fancy box that you can blow air through), and sprayed them with several doses of the IGRs or the miticide: 1/2x, 1x, 2x, and 3x the recommended dose that pesticide applicators would use. Importantly, they found that foraging bees were about 5 times more likely to die when exposed to each of the chemicals compared to controls (bees sprayed with water only).

Wow, 5 times more likely to die… but I thought IGRs and miticides weren't supposed to hurt bees? Unfortunately, before this study, there was actually very little known about the effects of pyriproxyfen, methoxyfenozide and bifenazate on honey bees.

Let's take methoxyfenozide, for example. Methoxyfenozide is known to be quite effective at controlling lepidopteran pests (caterpillars and moths) by lowering their fertility and interfering with development. Thus, it's a relatively popular pesticide that's sold under the trade name Intrepid®. But is it safe for bees?

In methoxyfenozide's Preliminary Environmental Fate and Ecological Risk Assessment (September 2016), the US Environmental Protection Agency (EPA) stated that while submitted field studies did not indicate adverse effects on the brood, a recently submitted lab study indicated that risk to larvae exceeded the "level of concern" under the 2014 Guidance. The Assessment suggested that follow-up studies would increase EPA's confidence with regard to risk conclusions. Therefore, in its Interim Registration Review Decision for methoxyfenozide (March 2018), the EPA stated that it was currently determining whether additional data were needed.

Clearly, the results from Fisher and colleagues warrant consideration by the EPA. These are exactly the type of data they're looking for! And similar data were requested for pyriproxyfen and bifenazate. Thus, Fisher and colleagues' study is very timely in terms of informing regulatory considerations that have the po-

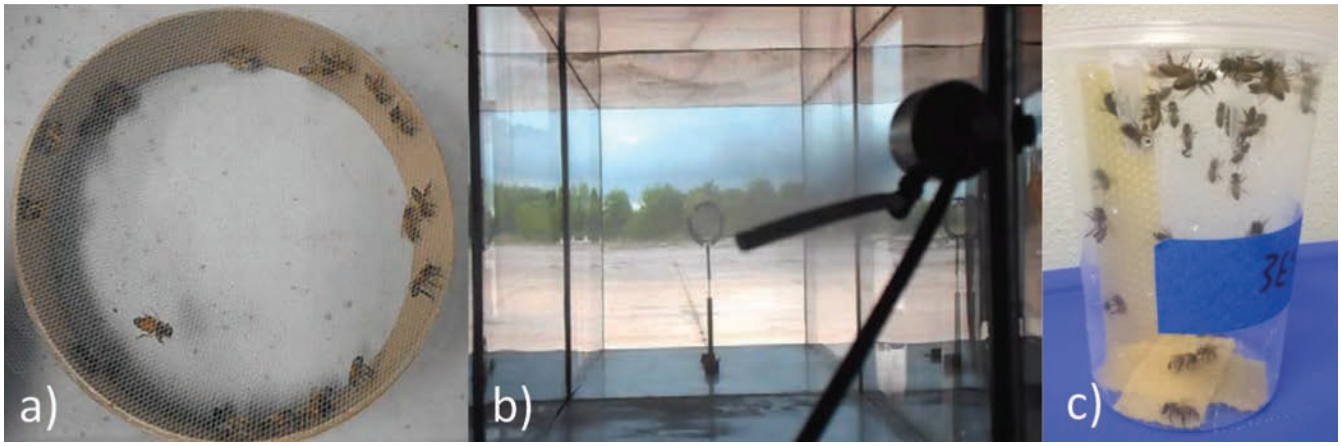

Fig. 1. *Experimental set up used to test the effects of pesticides on honey bee forager survival. First, a) 30-40 bees were loaded into clean bioassay cages. Then, b) cages were placed in a wind tunnel and exposed to either a pesticide-free control or pesticide-laden atomized liquid treatment in increasing concentrations. Once treated, the caged bees were transferred into c) plastic holding units with feeders containing 50:50 sucrose solution ad libitum and placed in an incubator held at 34° C to measure worker mortality every 24 h for 10 days.*

tential to reduce pesticide risk to bees on a broad scale.

Fantastic! So, who's paying attention? Hopefully the EPA. But in addition, grower organizations such as the Almond Board of California could greatly benefit from knowing about the results of this work. After all, if they don't have healthy honey bees to pollinate their almonds, they don't have almonds! Luckily, the Almond Board is perhaps one of the most proactive grower organizations in the country in terms of bee health (see, for example: **http://www.almonds.com/pollination#BeeBMPs**).

Perhaps it's time for additional grower organizations to move beyond adolescence, carefully consider their hormones (such as IGRs), and develop proactive pollinator BMPs that utilize the latest cutting-edge science.

Until next time, bee well and do good work,

Scott McArt

Reference:

Fisher II, A., C. Colman, C. Hoffmann, B. Fritz and J. Rangel. 2018. The effects of the insect growth regulators methoxyfenozide and pyriproxyfen and the acaricide bifenazate on honey bee (Hymenoptera: Apidae) forager survival. *Journal of Economic Entomology* 111: 510-516.

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Fig. 2. *Same as above, just a different view of the bioassay cages (a); the experimental flight tunnel (b); and the incubator set up housing the bees after exposure (c).*