What's Bugging Our Bees?

by Elina L. Niño

There are approximately 20,000 bee species in the world and 1,600 species in California. Despite this diversity, honey bees are still arguably the most important managed pollinator, and this brief overview will focus on issues plaguing this charismatic insect. However, many of the same stressors are certainly affecting other pollinator populations. In agriculture, honey bees are used for pollinating numerous food plants that make our diets more exciting and nutritious, including many fruits, vegetables and nuts, and they are a crucial contributor to healthy ecosystems. However, beekeepers in the past decade have been reporting annual honey bee colony losses that have reached 45%, which is more than double the acceptable loss deemed by beekeepers.

Unless you do not own a TV or a smart phone, or for some reason you do not follow the news, you probably have heard about colony collapse disorder (CCD). This phenomenon was reported by a Pennsylvania beekeeper in 2006 and caused widespread die-offs of honey bees in the United States. CCD was characterized by a complete loss of the colony's adult bee population, although the queen and the developing bees (brood) were still present in the hive. Beekeepers also noted that pests and bees from neighboring hives were reluctant to enter the affected hives. What caused the death of the colony's adult bees was a mystery due to the complete absence of dead bees around the hives—as if these bees simply disappeared. However, researchers and beekeepers now mostly agree that CCD was likely caused by a combination of environmental and biological factors.

While CCD specifically is not causing large-scale colony death in the United States any longer, beekeepers still have a tremendous number of issues to contend with and are still losing a high percentage of colonies each year. Beekeepers can usually recoup at least part of their losses by splitting colonies to create new ones, but the operational costs of maintaining a sufficient honey bee supply are on the rise, predominantly due to addressing these issues. This has also caused an increase in hive rental prices for growers who use the hives to pollinate their crops.

One key issue is whether neonicotinoids, a class of insecticides that affect insects' nervous systems, are negatively affecting bees *(editor's note: see Randy Oliver's feature article for details)*. While pesticides tend to be a focus of media attention and often rightfully so, perhaps the biggest challenge for U.S. beekeepers today is *Varroa destructor*. This aptly named parasitic mite feeds on bee hemolymph ("blood"), simultaneously transmitting pathogens and suppressing bee immunity. Often, several mites feed on a single bee.

Beekeepers use a variety of integrated pest management (IPM) techniques, including miticides designed to specifically target the bee parasitic mites. However, some of the miticides have been found to cause negative effects in bees such as deformities, behavioral issues and increased mortality. Additionally, some of the commercial miticides have lost their efficacy against *Varroa* due to the development of resistance. This is the reason why our laboratory is currently developing and evaluating several novel biomiticides to be used as part of an IPM plan. Prevention is usually better then intervention, so another strategy for dealing with mites is

breeding *Varroa*-resistant bee stock. Supporting breeding efforts through our research in improving honey bee queen reproduction is also a part of our lab's efforts.

In addition to parasites, honey bees are also exposed to many pathogens including viruses, bacteria and fungi. Viruses have been implicated as an important factor in honey bee health declines, but we are just starting to understand how bees deal with this type of infection. The *Varroa*-virus complex (fig. 1) is a particularly prominent challenge for honey bees, often preventing bees from performing normal work functions and leading to increased mortality.

Fig. 1. Bee carrying *Varroa* mites (*upper left corner*), next to two bees with deformed wings due to an infection with deformed wing virus. A third bee (*lower right corner*) also shows symptoms of the virus. *Photo*: Bernardo D. Niño.

Furthermore, potential negative effects of pesticide use on bee health have prompted a passionate public debate and have spurred concern among amateur and professional gardeners alike. But providing diverse forage to pollinators may help mitigate some of these issues. Horticulturists and nursery growers producing ornamental and native plants are under increasing pressure to provide pollinator-supportive plants that are free of harmful pesticide residues. However, not much is known about the attractiveness of specific nursery plants to the variety of bees and other pollinators, as well as how much of commonly used systemic pesticides is translocated into nectar and pollen.

To fill some of those gaps, our lab is a part of a large multistate USDA grant project led by Rutgers University to specifically tackle these questions, as well as develop pollinator-safe IPM programs for growers. (*Editor's note: Randy Oliver comments in his feature article that he and Jim Bethke are also working on this grant, which was awarded to the IR-4 Project's Ornamental Horticulture Program based at Rutgers.*) The project has already identified common garden plants preferred by different bee species, preferred flower structure, and even preferred cultivars of specific plants. These interesting results have been extended at the Häagen-Dazs Honey Bee Haven demonstration garden and at the UC Davis campus annual pollinator workshops. Future research at the Häagen-Dazs Honey Bee Haven will include studying various irrigation schemes on plant attractiveness, likely of particular interest to nursery customers. Furthermore, the Bee Biology research labs at the UC Davis Harry H. Laidlaw Jr. Honey Bee Research Facility, and research labs at other universities (see lab links listed at "Links to Others" on the Williams lab web page) are analyzing what types of flowering plants provide the best supplemental forage for bees in agricultural setting.

Nursery growers can help protect honey bees by implementing pollinator-safe pest management techniques. They can also help shield pollinator health by providing information to their retail customers about the best pollinator-supportive plants and safe pest management techniques. For an idea of great pollinator-supportive plants particularly suited for the California environment, see our Häagen-Dazs Honey Bee Haven plant list (fig.2). And don't forget to support your local beekeeper by buying their honey. You can learn more about honey and locate California beekeepers by visiting the National Honey Board website.

Fig. 2. Honey bee foraging on *Ceanothus* 'Julia Phelps' in the Häagen-Dazs Honey Bee Haven garden at UC Davis. 'Julia Phelps' is one of seven ceanothus cultivars currently on the Häagen-Dazs Honey Bee Haven plant list. *Photo*: Bernardo D. Niño.

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