Research Shows Imidacloprid Depresses Honey Bee Feeding and Communication

(*Beyond Pesticides*, May 25, 2012) Biologists at the University of California at San Diego (UCSD) have discovered that a small dose of the commonly used neonicotinoid crop pesticide **imidacloprid** turns honey bees into "picky eaters" and affects their ability to recruit their nestmates to otherwise good sources of food. The results of the experiments, detailed in this week's issue of the *Journal of Experimental Biology* (**abstract**), shed light on one of the main culprits suspected to be behind the recent declines in honey bee colonies and detail the particular ways that the substance impedes the functions of the colony.

Since 2006, beekeepers in North America and Europe have lost about one-third of their managed bee colonies each year due to "colony collapse disorder." While the exact cause is unknown, researchers believe pesticides have contributed to this decline. One group of crop pesticides, called "neonicotinoids," has received particular attention from beekeepers and researchers. **Neonicotinoids**, including **clothianidin** and **thiamethoxam**, in addition to imidacloprid, are highly toxic to a range of insects, including honey bees and other pollinators. They are taken up by a plant's vascular system and expressed through pollen, nectar and gutation droplets from which bees forage and drink. They are particularly dangerous because, in addition to being acutely toxic in high doses, they also result in serious sublethal effects when insects are exposed to chronic low doses, as they are through pollen and water droplets laced with the chemical as well as dust that is released into the air when treated seeds that have been coated with the chemicals are planted. **Previous research has shown** that these effects cause significant problems for the health of individual honey bees as well as the overall health of honey bee colonies, including disruptions in mobility, navigation, feeding behavior, foraging activity, memory and learning, and overall hive activity.

The UCSD biologists focused this particular study on imidacloprid, which has been banned for use in certain crops in some European countries and is being increasingly scrutinized in the United States. "In 2006, it was the sixth most commonly used pesticide in California and is sold for agricultural and home garden use," said James Nieh, PhD, a professor of biology at UCSD who headed the research project with graduate student Daren Eiri, the first author of the study. "It is known to affect bee learning and memory."

The two biologists found in their experiments that honey bees treated with a small, single dose of imidacloprid, comparable to what they would receive in nectar, became "picky eaters." "In other words, the bees preferred to only feed on sweeter nectar and refused nectars of lower sweetness that they would normally feed on and that would have provided important sustenance for the colony," said Mr. Eiri. "In addition, bees typically recruit their nestmates to good food with waggle dances, and we discovered that the treated bees also danced less."

The two researchers point out that honey bees that prefer only very sweet foods can dramatically reduce the amount of resources brought back to the colony. Further reductions in their food stores can occur when bees no longer communicate to their kin the location of the food source. "Exposure to amounts of pesticide formerly considered safe may negatively affect the health of honey bee colonies," said Dr. Nieh.

To test how the preference of sugary sources changed due to imidacloprid, the scientists individually harnessed the bees so only their heads could move. By stimulating the bees' antennae with sugar water, the researchers were able to determine at what concentrations the sugar water was rewarding enough to feed on. Using an ascending range of sugar water from 0 to 50 percent, the researchers touched the antennae of each bee to see if it extended its mouthparts. Bees treated with imidacloprid are less willing to feed on low concentrations of sugar water than those that were not treated. A video showing the experiments can be found on **UCSD's YouTube page**:

The biologists also observed how the pesticide affected the bees' communication system. Bees communicate to each other the location of a food source by performing waggle dances. The number of waggle dances performed indicates the attractiveness of the reward and corresponds to the number of nestmates recruited to good food. "Remarkably, bees that fed on the pesticide reduced the number of their waggle dances between fourfold and tenfold," said Mr. Eiri. "And in some cases, the affected bees stopped dancing completely."

On March 21, 2012, commercial beekeepers and environmental organizations **filed an emergency legal petition** with the U.S. Environmental Protection Agency (EPA) to suspend use of **clothianidin**, another neonicotinoid pesticide which affects bees, urging the agency to adopt safeguards. The legal petition, supported by over one million citizen petition signatures, targets the pesticide for its harmful impacts on honey bees. The petition points to the fact that EPA failed to follow its own regulations. EPA granted a conditional, or temporary, registration to clothianidin in 2003 without a required field study establishing that the pesticide would have no "unreasonable adverse effects" on pollinators. Granting conditional registration was contingent upon the subsequent submission of an acceptable field study, but this requirement has not been met. EPA continues to allow the use of clothianidin nine years after acknowledging that it had an insufficient legal basis for initially allowing its use. Additionally, the product labels on pesticides containing clothianidin are inadequate to prevent excessive damage to non-target organisms, which is a second violation of the requirements for using a pesticide and further warrants removing all such misbranded pesticides from use.

For more information on how pesticides affect pollinators and what you can do to help, see Beyond Pesticides' **pollinators program page**.

Source: ***UCSD press release***

Image Credit: Dr. James Nieh

All unattributed positions and opinions in this piece are those of Beyond Pesticides.