

## Pesticide Buildup Could Lead to Poor Honey Bee Health

Honey bees industriously bring pollen and nectar to the hive, but along with the bounty comes a wide variety of pesticides, according to researchers in the College of Agricultural Sciences. Add the outside assault to the pesticides already in the waxy structure of the hive, and bee researchers see a problem difficult to evaluate and correct. However, an innovative approach may mitigate at least some beeswax contamination.

The researchers presented their analysis of pollen, brood, adult bees, and wax samples recently at the 236th national American Chemical Society meeting in Philadelphia. Those results show unprecedented levels of fluralinate and coumaphos—pesticides used in the hives to combat parasitic varroa mites—in all comb and foundation wax samples. They also found lower levels of seventy other pesticides and metabolites of those pesticides in pollen and bees.

“Everyone figured that the acaricides [anti-varroa-mite chemicals] would be present in the wax because the wax is reprocessed to form the structure of the hives,” says Maryann Frazier, senior extension associate in entomology. “It was a bit of a shock to see the levels and the widespread presence of these pesticides.”

While the researchers expected the presence of the chemicals available to treat varroa mites in the hives, the other pesticides’ levels were also surprising. All of the bees tested showed at least one pesticide, and pollen averaged six pesticides with as many as thirty-one in a sample.

“We already had in place ways to test for viruses, bacteria, and fungi, but it was difficult to find an analytical laboratory that could analyze for unknown pesticides,” says Christopher Mullin, professor of



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entomology. “We needed to take a comprehensive look at all pesticides, not just those associated with beekeeping.”

They eventually turned to the National Science Laboratory of the U.S. Department of Agriculture’s Agricultural Marketing Service. That lab tests commodities such as milk, fruits, and vegetables to ensure that they meet national and international standards.

“When we began doing this work, honey was not regularly analyzed, and bee pollen was not a commodity and so was not analyzed,” says Mullin. “We decided to go with the types of screening the lab does for milk and apples—these tests look at over 170 pesticides. Now, honey is included in the commodities to be analyzed.”

While beekeepers will have a difficult time controlling pesticide exposure outside the hive, the researchers tested a method for reducing the acaricide load in beeswax. Using gamma radiation from

a cobalt 60 source housed at Penn State’s Breazeale Reactor, they irradiated the sheets of beeswax that beekeepers use as the structural foundation for the bees to build their combs. Applying radiation levels at the high end of the range used to irradiate foods, the team was able to break down about 50 percent of the acaricides in the wax.

“Gamma radiation is often used to kill viruses and other disease-causing agents,” says James Frazier, professor of entomology. “Commercial irradiation firms usually decontaminate medical instruments or foods.” Some beekeepers already irradiate their equipment to eliminate disease-causing agents, the researchers note.

Beekeepers cannot manage the environmental pesticide contamination as easily as the wax contamination. The U.S. Environmental Protection Agency does regulate and monitor pesticides but does not have the ability to monitor the interaction of these chemicals.

With the large number of pesticides found in bees and pollen, interactions are likely.

“We are finding fungicides that function by inhibiting the steroid metabolism in the fungal diseases they target, but these chemicals also affect similar enzymes in other organisms,” says James Frazier. “These fungicides, in combination with pyrethroids and/or neonicotinoids, can sometimes have a synergistic effect hundreds of times more toxic than any of the pesticides individually.”

It’s not clear what implications these findings have for Colony Collapse Disorder (CCD), the syndrome that has decimated honey bee colonies across the country. Bees affected by CCD are not dying in their hives but are not returning to their hives. James Frazier notes it is difficult to observe bees outside the hive, and chronic exposure to pesticides may cause behavioral changes that are unmonitored.

“We do not know that these chemicals have anything to do with Colony Collapse Disorder, but they are definitely stressors in the home and in the food sources,” he says. “Pesticides alone have not shown they are the cause of CCD. We believe that it is a combination of a variety of factors, possibly including mites, viruses, and pesticides.”

The researchers, who also include research assistant Sara Ashcraft, form a team uniquely suited to examine the honey bee pesticide problem because they combine a toxicologist (Mullin), a physiologist (James Frazier), and an extension specialist with connections to beekeepers across the country (Maryann Frazier).

“We now want to look at small versus large operations and organic versus nonorganic operations to see if there are differences,” says Maryann Frazier.

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—Andrea Messer