FIELD-STUDIES FIND NO IMPACT OF NEONICOTINOIDS ON HONEYBEES

CLAIM: Studies demonstrate that "sublethal" levels of neonicotinoid pesticides impact hive health.

REALITY: Studies of honeybee exposures to chemicals in real-life settings have not found any such effects, and studies that find effects at unrealistically high exposure levels are not particularly relevant.

Some environmentalists suggest that relatively low exposures that do not immediately kill the bees (sublethal exposures) make them too weak to survive other stresses. The Pesticide Action Network in the United Kingdom, for example, maintains: "Sub-lethal effects on individual bees can build up to colony-level harm, especially if exposure continues for several weeks."

However, much of the research to date has not proven particularly relevant to real-life exposure to chemicals in the field. In fact, the Pesticide Action Network plays down the fact that field-relevant studies show no such effects, and that real-world scenarios tell us more about how these chemicals actually impact wildlife. Several studies, notes Kim Kaplan of the USDA's Agricultural Research Service, "relied on large, unrealistic doses and gave bees no other choice for pollen, and therefore did not reflect risk to honey bees under real world conditions. Nor have the studies demonstrated a direct connection or correlation to CCD."

Over-reliance on studies that feed or otherwise dose bees with chemicals in a lab and then measure hive losses after the bees are allowed to forage in the field creates a misleading impression about the risks for many reasons. First, they ignore the fact that regular feeding or dosing of bees every day for a period of time is completely different than intermittent exposures from pollen in the field. As a result, even what some researchers maintain to be "field relevant" exposures in the lab are not relevant real-life exposures.

In fact, when researchers actually measure the chemicals in pollen, nectar, and bee products like wax and honey, the levels reported are largely insignificant. For example, Tjeerd Blacquière, of Wageningen University in The Netherlands, and his colleagues summarize the research on such exposures in an article for *Ecotoxicology*, published in 2012. They explain that the current research indicates that the exposures in pollen, nectar, and bee products are below levels that would pose acute or chronic toxicity. They point out that no field-relevant studies to date have demonstrated any adverse sublethal effects from neonicotinoids.

In February 2014, other researchers reported similar findings. They measured neonicotinoids in several crops grown from seeds treated with the chemicals. They could not find any traces of the chemicals on soybean flowers or in cotton nectar. They found one neonicotinoid chemical in corn, but only in an insignificant amount. University of Arkansas entomologist Gus Lorenz, who participated in this study concluded, "It's not being expressed in the reproductive parts of the plants."

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A Pan-European Epidemiological Study on Honeybee Health, European Union Reference Laboratory on Honeybee Health, April 2014.

Effects of Neonicotinoid Seed Treatments on Bumble Bee Colonies under Field Conditions, The Food and Environment Research Agency, UK Government's Department for Environment, Food and Rural Affairs, March 2013.

British Beekeeper Association Response to the EAC Report on Pollinators and Pesticides, April 5, 2013.

What Happened To The Bees This Spring? Part 1: Environmental and Biotic Factors, by

Nonetheless, researchers at Harvard University produced a 2014 study that some say finally proved that neonicotinoids are to blame for colony collapse disorder (CCD). In this study, the researchers fed a handful of honeybee hives a diet of high fructose corn syrup containing pesticides and then waited to see how many would survive winter compared to control groups fed the syrup without pesticides. When the bees fed the neonicotinoids suffered more losses than did the control groups, the authors concluded: "[T]he findings in this study reinforce the conclusion that sub-lethal exposure to neonicotinoids is likely the main culprit for the occurrence of CCD."

The Harvard researchers maintained that the exposure levels they used in their study were similar to those that honeybees experience in the field and that the neonicotinoid-treated bees suffered losses that resembled CCD. But both claims were not compelling to other researchers who reviewed the study.

A statement released by Bayer CropScience maintained that the bees were fed a diet of neonicotinoids for 13 weeks that exposed them to a pesticide level 10 times higher than what bees encounter in real-life scenarios, a practice Bayer described as "unrealistic" and "deceptive." Activists and others dismiss Bayer's analysis because of the company's financial interest in the issue, but they have not been able to dispute the data. In fact, Dennis vanEngelsdorp basically agreed with Bayer CropScience's position. He remarked to the press that the study was of limited value because all it shows is that "high doses of 'neonics' kill bees—which is not surprising."

Entomologist Joe Ballenger, in an analysis of the Harvard study on the blog Biofortified, explains that the exposure in this study was likely five times what bees would experience in the field and 33 times higher than what is typically found in the hives of honeybee colonies. "Bottom line," says Ballenger, the study "appears to have overdosed the colonies compared to what they are encountering in the real world."

Ballenger points to another problem: The honeybee losses the Harvard study describes do not constitute CCD. While some honeybees abandoned the hive, there were lots of dead bees present and some hives lost queens as well as their brood. This does not resemble CCD, which involves disappearance of nearly all worker bees with few dead bees present, with live queens and brood left behind.

A couple of other studies, led by USDA entomologist Jeff Pettis, raised concerns about neonicotinoids similar to those in the Harvard study, but these too have important limitations that have been largely overlooked by the press. In one study, Pettis et al., dosed young worker bees with neonicotinoids as they emerged from the hive for the first time. These bees had very little time to develop immunity and died in large numbers. Pettis concluded that the pesticides appear to have weakened the bees and made them more susceptible to the Nosema parasites. While that may be true for this lab experiment, it appears to have little relevance to real world scenarios.

In an article reviewing this and other research on neonicotinoids, several researchers explain:

> Honeybees harbor a characteristic bacterial complex in the gut that plays an important role in nutrient processing, degradation of toxic compounds, and defending against pathogens. …The establishment of a normal microbiota requires contact with the colony and food exchange with older nestmates. The isolation of newly emerged workers in cages for testing may lead to increased susceptibility to pesticides and pathogens because of an impoverished gut microbiota. Differences in physiology, stress levels, and the bacterial complex of the gut may explain why the standard practice of collecting newly emerged workers from brood frames placed in incubators for use in laboratory pesticide tests may lead to misleading and/or inaccurate results.

In another study Pettis et al., found that honeybees exposed to the same neonicotinoid, Imidacloprid, had a lower number of Nosema spores present in the hive than the honeybees without such exposure. Rather than acknowledge that this study conflicts with earlier findings, the authors downplay the disparity noting: "Specific results vary, and may depend on the pesticide or dose used." More appropriately, in their review of this literature, Fairbrother et al., point out: "The studies by Pettis et al. illustrate the difficulty in extrapolating laboratory effects to field conditions when investigating susceptibility to gut pathogens."

In yet another study, researchers dosed bumblebees in the lab with neonicotinoids and inserted tiny devices that allowed researchers to track the bees' behavior after the insects were set free to forage. Not surprisingly, these lab exposures were relatively high and led to disoriented bees, affecting their

Randy Oliver, ScientificBeekeeping.com.

Agricultural Research Service, United STates Department of Agriculture, Colony Collapse Disorder: An Incomplete Puzzle.

Robert Arnason, "Ontario Field Study Finds no Link Between Seed Treatments, Bee Deaths," The Western Producer, February 21st, 2013.

United States Department of Agriculture, *Report on the National Stakeholders Conference on Honey Bee Health National Honey Bee Health Stakeholder Conference Steering Committee,* Sheraton Suites Old Town Alexandria Hotel Alexandria, Virginia, October 15–17, 2012.

Helen M Thompson, *EXTERNAL SCIENTIFIC REPORT: Interaction Between Pesticides and other Factors in Effects on Bees,* Food and Environment Research Agency, Sand Hutton, York YO41 1LZ.

Annual reports on honey production and number of colonies in U.S., National Agricultural Statistics Service.

ability to forage and find their way back to the hive. The authors called their dosing "field realistic," but the doses were still done in a lab and those feeding conditions and type of diet—sugar water rather than a diverse diet in the field—can also affect results.

Such studies may well show that at some level and given limited diets, pesticides can place additional stresses on bees. But these studies do not show that pesticide risks cannot be managed and kept low enough to have insignificant impact on hive survival, which is the goal. Several other studies that dosed bees with "environmentally relevant" levels of neonicotinoids found no adverse effects.

Perhaps most importantly, studies of bees in the field where neonicotinoids are used show no measurable effects. For example, one study conducted by researchers in the United Kingdom's Department for Environment, Food and Rural Affairs found no difference between bumble bees that visited areas treated with neonicotinoids and control bees. It reported:

> This study was not a formal statistical test of the hypothesis that neonicotinoid insecticides reduce the health of bumble bee colonies. Nevertheless, were neonicotinoids in pollen and nectar from treated oilseed rape to be a major source of field mortality and morbidity to bumblebee colonies, we would have expected to find a greater contribution of insecticide residues from nearby treated crops and for there to have been a clear relationship between observed neonicotinoid levels and measures of colony success. The absence of these effects is reassuring but not definitive. The study underlines the importance of taking care in extrapolating laboratory toxicology studies to the field, as well as the great need of further studies under natural conditions.

More recently, a study that relies on data from actual field conditions confirms that farmers can protect their crops using these chemicals without harming honeybee hives. The study, published in the online journal *PeerJ*, assessed the impact of neonicotinoid-treated canola crops on hives that foraged among these crops in 2012 in Ontario Canada. The researchers found no adverse impacts and very low exposure to the chemicals. The authors report:

> Overall, colonies were vigorous during and after the exposure period, and we found no effects of exposure to clothianidin seed-treated canola on any endpoint measures. Bees foraged heavily on the test fields during peak bloom and residue analysis indicated that honey bees were exposed to low levels (0.5–2 ppb) of clothianidin in pollen. Low levels of clothianidin were detected in a few pollen samples collected toward the end of the bloom from control hives, illustrating the difficulty of conducting a perfectly controlled field study with free-ranging honey bees in agricultural landscapes. Overwintering success did not differ significantly between treatment and control hives, and was similar to overwintering colony loss rates reported for the winter of 2012–2013 for beekeepers in Ontario and Canada. Our results suggest that exposure to canola grown from seed treated with clothianidin poses low risk to honey bees.

No one can completely dismiss the fact that agrochemicals can have an impact at some level to honeybees and non-target insects. The key is finding a level where risk is low-to-negligible in real-life settings, to allow beneficial uses of products necessary to grow food. That way we can have both effective pollination and agricultural productivity.

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