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INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

PROTECTING POLLINATORS

EPA RESEARCH ON NON-*APIS* BEES

OVERVIEW

Pollinators help 90% of the world's flowering plants reproduce, and include insects such as bees, wasps, sawflies, butterflies, moths, beetles, flies, and some vertebrates (e.g. birds and bats). Populations of honey bees (*Apis mellifera*), the most recognized pollinators, have declined in the U.S. and many other countries.

Bee health can be impacted by a myriad of environmental stressors, including pesticides, pests and pathogens, poor nutrition, and habitat loss. Diminished immunity may be a central factor in population declines, but little research has been done on the effects of exposure to environmental stressors on immunocompetence in bees. An incomplete understanding of the relationship between pesticide exposure and susceptibility to disease means that new pesticide risk assessment does not include direct effects on immunity.

Currently, the honey bee is used as the model organism for new pesticide risk assessment, with effects observed in honey bees being extrapolated to other species of non-*Apis* bees. A 2017 workshop (see references) concluded that honey bee pesticide risk assessments may not always protect non-*Apis* bees.

RESEARCH GOAL

EPA's Office of Research and Development is working in laboratory-based research collaborations to evaluate the effects of pesticides on overall health and condition of non-*Apis* bees, including immunocompetence. This research also will assess the suitability of honey bees as a model organism for new pesticide risk assessment performed on non-*Apis* bees, such as bumble bees.

Case Study

EPA scientists are investigating the effects of pesticides on overall bumble bee health in a research case study taking place in New England plant nurseries. This case study will determine the types of pollen that bees collect and consume, and identify and quantify the pesticide content of that bee-collected pollen. The study will also assess the effect of pesticides applied to plant nursery crops on bumble bee colony condition and health.

Microcolony Model

EPA and external collaborators (see references) are investigating the utility of a bumble bee brood development microcolony model optimized for use in pesticide exposure-effect studies, and promoting standardization of this model, which will increase ability to make comparisons between studies and to establish baseline measurements needed for study interpretation.

Installing bee nucleus colonies in the EPA apiary. Scientists collect pollen from the bees for use in the studies.

U.S. Environmental Protection Agency
Office of Research and Development

Methods

Ring tests are the first, critical step to developing standardized methods for evaluating the toxicity of pesticides to bees. EPA's Office of Research and Development is one of only three U.S. laboratories contributing to international ring tests organized by the International Commission for Plant-Pollinator Relationships (ICPPR) to develop methods for non-*Apis* bees. EPA maintains an apiary as part of these studies. The tests follow specified protocol for acute oral or contact toxicity testing to determine which pesticides are expected to pose a minimal risk to bees. Standardized methods are essential in order to complete studies designed to make cross-species comparisons between *Apis* and non-*Apis* bees, to allow comparisons between studies, and to establish baseline measurements needed for study interpretation.

Solitary bees in lab for acute oral toxicity ring test.

CITATIONS

Klinger EG, Camp AA, Strange JP, Cox-Foster D, Lehmann DM. *Bombus Microcolonies as a Tool for Biological Understanding and Pesticide Risk Assessment*. Environ Entomol. 2019 (In press).

EPA ORD and USDA ARS Bee Research Laboratory (Logan, UT) recommendations for standardizing bumble bee microcolony studies to support use of a standardized model in pesticide risk assessment.

Kruger A, Schmehl D, Lehmann DM. *Expanding beyond the honey bee: novel approaches for advancing risk assessment for non-Apis* bees using what we have learned from the honey bee. Globe. February 2018. http://setac.sclivelearningcenter.com/index.aspx

Proceedings from an EPA and Bayer CropSciences-organized symposium Expanding Beyond the Honey Bee: Novel Approaches for Advancing Risk Assessment for non-*Apis* Bees Using What We Have Learned from the Honey Bee at the annual Society of Environmental Toxicology and Chemistry (SETAC) meeting in 2017. The symposium brought together academic, agrochemical industry and government scientists to discuss efforts to develop methodologies to assess potential adverse effects of pesticides on non-*Apis* bees.

Boyle NK, Alix A, Lehmann DM, O'Neill B, Thomson H, Morandin L, Raine NE, Pitts-Singer TL, Hinarejos S, Steeger T. *Workshop on pesticide exposure assessment paradigm for non-Apis bees: Foundation and summaries*. Environ Entomol. 2018.V48(1):411. https://doi.org/10.1093/ee/nvy103

A 2017 EPA-hosted workshop that brought together experts representing regulatory agencies, academia, and agrochemical industries to discuss pesticide exposure to non-*Apis* bees and to determine how likely honey bee exposure estimates are to protect non-*Apis* bees.

Gradish AE, van der Steen S, Scott-Dupree CD, Cabrera AR, Cutler GC, Goulson D, Klein O, Lehmann DM, Lückmann J, O'Neill B, Raine NE, Sharma B, Thompson H. *Comparison of pesticide exposure in honey bees (Hymenoptera: Apidae) and bumble bees (Hymenoptera: Apidae): Implications for risk assessments*. Environ Entomol. 2019.V48(1):12-21. https://doi.org/10.1093/ee/nvy168

Participants in this 2017 pesticide exposure workshop concluded that honey bee pesticide risk assessments may not always protect bumble bees, and identified critical data gaps to be addressed before incorporating bumble bee exposure into the pesticide risk assessment process.

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