Multi-Drug Resistance Transporters and a Mechanism-Based Strategy for Assessing Risks of Pesticide Combinations to Honey Bees

Feb 03, 2016
Author:
Guseman, A. J., Miller, K., Kunkle, G., Dively, G. P., Pettis, J. S., Evans, J. D., et al.

Abstract

Annual losses of honey bee colonies remain high and pesticide exposure is one possible cause. Dangerous combinations of pesticides, plant-produced compounds and antibiotics added to hives may cause or contribute to losses, but it is very difficult to test the many combinations of those compounds that bees encounter. We propose a mechanism-based strategy for simplifying the assessment of combinations of compounds, focusing here on compounds that interact with xenobiotic handling ABC transporters. We evaluate the use of ivermectin as a model substrate for these transporters. Compounds that increase sensitivity of bees to ivermectin may be inhibiting key transporters. We show that several compounds commonly encountered by honey bees (fumagillin, Pristine, quercetin) significantly increased honey bee mortality due to ivermectin and significantly reduced the LC50 of ivermectin suggesting that they may interfere with transporter function. These inhibitors also significantly increased honey bees sensitivity to the neonicotinoid insecticide acetamiprid. This mechanism-based strategy may dramatically reduce the number of tests needed to assess the possibility of adverse combinations among pesticides. We also demonstrate an in vivo transporter assay that provides physical evidence of transporter inhibition by tracking the dynamics of a fluorescent substrate of these transporters (Rhodamine B) in bee tissues. Significantly more Rhodamine B remains in the head and hemolymph of bees pretreated with higher concentrations of the transporter inhibitor verapamil. Mechanism-based strategies for simplifying the assessment of adverse chemical interactions such as described here could improve our ability to identify those combinations that pose significantly greater risk to bees and perhaps improve the risk assessment protocols for honey bees and similar sensitive species.

Read the full article in *PLoS ONE.* [1]

Associated SESYNC Researcher(s):
dhawthorne [2]
DOI for citing:
https://doi.org/10.1371/journal.pone.0148242

Links
[1] http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148242
[2] https://www.sesync.org/users/dhawthorne