4.10 A review of available bumble bee colony end-points and identification of current knowledge gaps

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Abstract

Bumble bee adult chronic toxicity studies and bioassays to assess larval development in the laboratory are currently undergoing method validation and standardization through ring-testing. These test designs will contribute valuable data required for Tier 1 risk assessments for this significant and commercially valuable pollinator. While laboratory assays allow for a conservative, highly controlled, and standardized evaluation of the relationship between test item dose and organism response, they do not reflect field-realistic exposure scenarios and cannot adequately address potential impacts on whole colony development.

Semi-field, landscape-level field, or feeding studies are more suitable to describe whole- colony health and development and potential impacts from pesticide exposure in an agricultural setting. However, evaluation end-points need to be clearly characterized and the associated assessment methodology should minimize variation across studies. This is especially true for field studies, where genetic and environmental variability will cause significant impacts on study results.

Here, we seek to provide a comprehensive review of available bumble bee colony end-points, assess their relevance and suitability for higher tier studies examining field-realistic exposure scenarios, and identify data, method, and knowledge gaps that may guide future research activity.

4.11 Non-Apis (*Bombus terrestris*) versus honeybee (*Apis mellifera*) acute oral and contact sensitivity – Preliminary results of ECPA company data evaluation

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Abstract

A preliminary data evaluation was conducted by ECPA companies to compare the sensitivity of bumblebees (*Bombus terrestris*) with the sensitivity of honeybees (*Apis mellifera*). For the evaluation about 70 data sets were available for contact exposure and about 50 data sets for oral exposure. The data sets comprised insecticides, fungicides, herbicides in about equal numbers plus a few other substances. The preliminary ECPA company data evaluation of LD_{50} values indicates lower or similar contact sensitivity of bumblebees vs. honeybees. Similarly, lower or similar oral sensitivity of bumblebees vs. honeybees was determined with one exception for an insecticide that indicated higher acute oral bumblebee sensitivity compared to honeybees. For this insecticide, higher tier data indicates no negative impact on bumblebees at the maximum intended use rate. Overall, the ECPA company data evaluation indicates that bumblebees are not more sensitive than honeybees based on acute toxicity assessment.

Keywords: Honeybee, bumblebee, acute oral and contact sensitivity

Introduction

The knowledge regarding the honeybee sensitivity versus the sensitivity of other bee species to plant protection products is currently limited[1, 2, 3]. A preliminary data evaluation was conducted by ECPA companies to compare the sensitivity of bumblebees (*Bombus terrestris*) with the sensitivity of honeybees (*Apis mellifera*).

Material and methods

For the evaluation 75 data sets were available for acute contact exposure and 52 data sets for acute oral exposure. The data sets for adult worker bee toxicity of *B. terrestris* and *A. mellifera* comprised fungicides, herbicides, insecticides in about equal numbers plus a few other substances. The data evaluation used all available contact and oral LD_{50} values (in terms of a.s./bee), including LD_{50} endpoints higher (">") than the tested dose. To analyze the sensitivity of bumblebees versus honeybees the ratio of the honeybee LD_{50} value divided by the bumblebee LD_{50} value for each substance was calculated and plotted.

Results and discussion

The ratios of the honeybee LD_{50} values divided by the bumblebee LD_{50} values are given for the acute contact and oral toxicity tests in Figure 1 and 2, respectively.

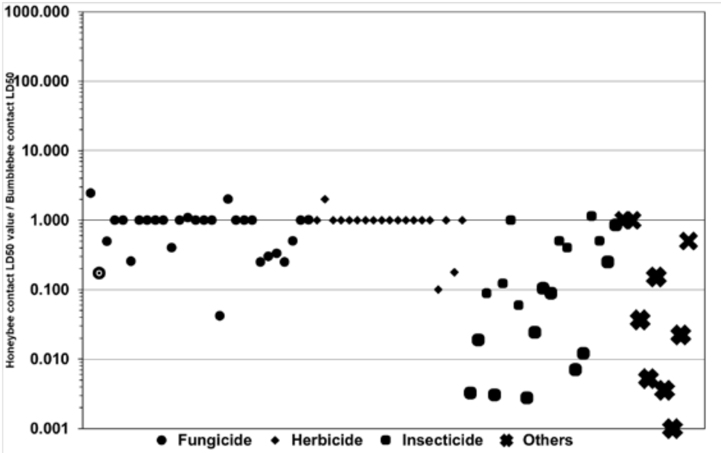

Figure 1 Ratio of honeybee contact LD_{50} divided by bumblebee contact LD_{50} value (Large bullet points represent ratios based on discrete LD_{50} values for both honeybees and bumblebees)

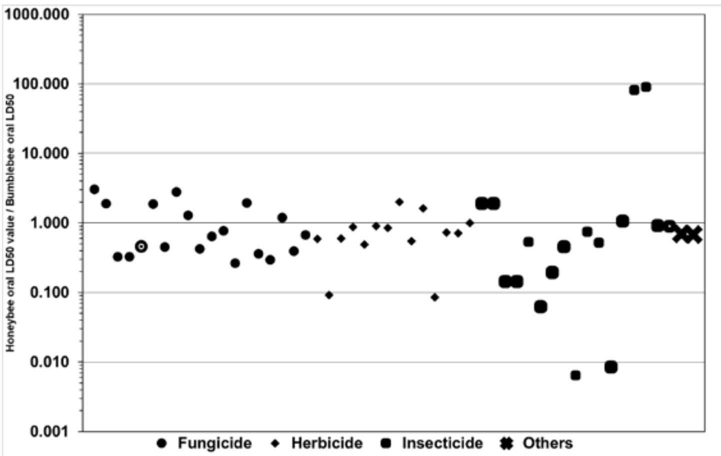

Figure 2 Ratio of honeybee oral LD_{50} divided by bumblebee oral LD_{50} value (Large bullet points represent ratios based on discrete LD_{50} values for both honeybees and bumblebees)

The data evaluation of acute contact LD_{50} values indicates lower or similar contact sensitivity of bumblebees vs. honeybees (Figure 1). Where there was no toxicity observed and the endpoint was the same maximum dose tested in both cases, the ratio was 1:1. For 18 of the 75 acute contact

LD_{50} data sets (of which 11 were insecticides), discrete LD_{50} values were determined for both honeybees and bumblebees. For all of those 18 data sets the ratio of honeybee contact LD_{50} values divided by bumblebee contact LD_{50} value was lower than one, demonstrating that honeybees were more sensitive to the test substances than bumblebees.

Similarly, lower or similar oral sensitivity of bumblebees vs. honeybees was determined (Figure 2). Where the endpoint was the maximum dose tested, a ratio of 1:1 was rare because the endpoint is adjusted according to actual dose consumption. For 12 (and 11 of those were insecticides) of the 52 acute oral LD_{50} data sets, discrete acute oral LD_{50} values were determined for both honeybees and bumblebees. Only for one insecticide a higher acute oral bumblebee sensitivity compared to honeybees was determined (for two different formulations). For this insecticide, higher tier semi-field data with *B. terrestris* is available and results do not indicate any negative impact on bumblebees or their colony development at the maximum intended use rate.

B. terrestris worker bees are about 3-times heavier in terms of body weight than *A. mellifera* worker bees. Therefore, lower or similar contact and oral sensitivity of the bumblebee species vs. the honeybee was also found in terms of body weight.

Conclusions

Overall, the ECPA company data evaluation indicates for a wide range of plant protection products that bumblebees are not more sensitive than honeybees based on acute toxicity assessment supporting similar previous findings[2, 3].

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4.12 Impact of pesticide residue on Japanese Orchard Bees (Osmia cornifrons) development and mortality

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Keywords: Japanese orchard bee, *Osmia cornifrons*, pesticide residue, integrated pest and pollinator management, IPPM, toxicity, contact toxicity, pestiside residue

Introduction

Pollinators are crucial to high value crop production such as apples. Pesticide use in these crops can sometimes reduce pollinator populations. Some pesticide use is necessary to control insects and disease which threaten farm profitability and sustainability. A new approach to this problem is Integrated Pest and Pollinator Management (IPPM) which maintains adequate pest management while protecting pollinator health. Several pieces of information are needed in order to construct an IPPM program. An important piece of information is the toxicity of pesticides to various pollinator species, including wild solitary bees. To better understand the effects of pesticide application on the wild pollinators, we will evaluate the impacts of pesticide residue on the Japanese Orchard Bee (JOB), *Osmia cornifrons*, a promising alternative pollinator for the fruit industry.

Our previous work has shown that a shift in application timing to 10 days before apple bloom can reduce the pesticide levels that moves into the nectar and pollen, but still effectively control pre-