Quantifying insect pollinator exposure and effects from pesticides for risk and impact assessment

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chemical on Days 3-6 with mortality recorded on Days 4-8 during the larval phase, on Day 15 during the pupae phase, and on Day 22 during adult emergence. Given the 22-day larval study design covers all phases of honey bee brood development up to adult emergence and the larval endpoints LD_{50}/LC_{50} can be calculated, the European Food Safety Authority (EFSA) only requires the 22-day larval study to derive larval endpoints for their bee risk assessments. However, USEPA requires the acute, single exposure study to calculate a dose-based endpoint (i.e., LD_{50}) that can be incorporated into the current screening-level risk assessment model (i.e., BeeREX). In 2018, a preliminary review of LD_{50}/LC_{50} endpoints from both study designs indicated that similar endpoints (< 2x difference) are derived based on dose (i.e., LD_{50}s) for both study types but lower endpoints (greater sensitivity) are typically derived in the repeat exposure design when based on concentration (LC_{50}s). Likewise, converted daily dose (e.g., LDD_{50}s) endpoints from the repeat exposure designs are often lower (40% where >2x lower) than single exposure endpoints. Additional data (approximately 50 studies total) have been incorporated into this most recent evaluation to further corroborate or refute our previous finding. If confirmed, we propose that the acute, single exposure study design should not be required considering the 22-day larval study provides the necessary larval endpoints required for Tier 1 bee risk assessments.

TP274 The utility of a weight-at-emergence endpoint in the 22-day larval assay for a pollinator risk assessment

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USEPA has identified the 22-day honey bee larval assay as a Tier 1, screening-level toxicity study for assessing pesticide risk to bees. This repeat-dose larval study is based on the Organization for Economic Co-operation and Development Guidance Document 239, and methodology provided by Schmehl et al.(2016). During this study, first instar larvae are transferred from healthy colonies to grafting cells (day 1) and treated diet is administered between days 3 and 6. Survival is assessed at multiple stages of the test: daily between days 4 and 8 for larvae; day 15 for pupae; and day 22 (emergence time) for adults. However, at the request of the USEPA, adult weight at emergence has also been included as a study endpoint. The Pollinator Research Task Force (PRTF) is conducting an endpoint evaluation to compare the sensitivity of adult weight at emergence to that of the survival endpoint in this study design. A database was developed based on anonymized study data from PRTF member companies, as well as applicable studies from the open literature. The compiled data were evaluated both empirically and statistically with regard to endpoint sensitivity. Statistically significant effects based on survival and adult weight at emergence were compared. No- and Lowest-Observed-Effect Dose (NOED and LOED) values, as well as 50% lethal and effect dose (LD_{50} and ED_{50}) values were also compared between the endpoints. Coefficients of variation (CVs) were compared graphically and statistically to quantify the variability in each metric and determine significant differences. A pairing structure was also used to assess correlation, which could be graphed and statistically analyzed. This presentation outlines the methods used during this project, the results of the endpoint analyses, and concluding findings on the endpoint sensitivity comparison between survival and adult weight at emergence.

TP275 Comparisons of Neonicotinoid Residue Data When Considering Potential Exposures to Pollinators

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Historically, data has been sparsely available to quantify the concentrations ("residues") of pesticides in food matrices relevant to honey bees, (i.e., pollen and nectar). As part of the registration review of the nitroguanidine-substituted neonicotinoid insecticides (imidacloprid, clothianidin, thiamethoxam, and dinotefuran), registrants submitted data to the U.S. Environmental Protection Agency (EPA) on neonicotinoid concentrations in pollen and nectar for a variety of crops and application methods. Registrants also submitted data for other matrices that could potentially be used as surrogates for pollen and nectar (e.g., anthers, flowers). Each neonicotinoid active ingredient has its own set of registered crops and corresponding rates and methods, leading to many possible chemical-crop-application scenarios to consider when assessing potential honey bee exposures. To understand potential influences of geographic location on residues, studies for the same crop and application scenario were carried out at multiple locations. Since residue data were not available for every crop and application scenario registered for a single neonicotinoid, EPA analyzed residues for the same chemical and application method to determine potential bridging among crops (i.e.., whether residues in floral matrices of one or more crops are suitable surrogates for an entire crop group). In addition, EPA analyzed residues for the same crop and application method (e.g., foliar applications to cotton) among different neonicotinoids to determine the potential for bridging across neonicotinoids. We summarize the available residue data, provide comparisons across chemicals and crops, and describe the scientific justification for extrapolating residue data among neonicotinoids, crops, and plant matrices when assessing risks to bees.

TP276 Quantifying insect pollinator exposure and effects from pesticides for risk and impact assessment

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Pollinator populations are suffering significant declines worldwide. The use of agricultural pesticides has been identified as one of the main contributing causes. The impact pathway associated with pollinators' exposure to pesticides, however, is currently missing in various assessment frameworks, including comparative risk screening and life cycle impact assessment (LCIA) to characterize various impacts contributing to damages on humans, ecosystems and natural resources associated with product and service life cycles. To address this gap, we developed a model to quantify field exposure of honey bees--chosen as most relevant pollinator species--to pesticides and related potential ecotoxicity impacts. As exposure metrics, we defined bee intake and dermal contact fractions for oral and dermal exposure, respectively. We tested our model to characterize bee impacts of two pesticides, namely lambda-cyhalothrin (insecticide) and boscalid (fungicide) applied to oilseed rape. We observed that dermal contact and oral intake fractions vary according to the specific type of forager honey bees, with the highest dermal contact fraction of 1.27x10-5 kgdermal contact/kgapplied found in pollen foragers for the fungicide boscalid, and the highest intake fractions of 3.21x10^-5 and 1.90 x10^-5 kg_oral intake/kg_applied found in nectar foragers for both boscalid and lambda-cyhalothrin respectively. Hive oral exposure fraction is higher than forager oral exposure fractions in both pesticides. For boscalid it is 7.4 to more than 100 times higher, while for lambda cyhalothrin, it is 2.1 to 32.4 times higher than the intake fraction of foragers. We observed a higher impact of the insecticide, being the impact score two orders of magnitude higher compared with the fungicide, and the impact per unit application three orders of magnitude higher. Overall, nectar foragers are the most affected forager type for both pesticides, emphasizing the oral pathway dominating overall bee exposure.Considering the in-hive exposure, CFs for hive bees are up to two orders of magnitude higher than CFs of foragers for boscalid, and at least twice the CF of foragers for lambda-cyhalothrin. This is based on the assumption of the same toxicity between adults and larvae. This model and the calculation of bee intake fraction constitutes an important first step toward integrating pollinator impacts in risk screening and LCIA, whereas we also identified areas of further model refinement to fully operationalize our approach in comparative frameworks where quantifying impacts on pollinators is relevant.