Compilation and statistical analysis of pollen and nectar pesticide residue concentrations: Applications to Tier 1 and refined Residue Unit Doses (RUDs) for pesticide bee risk assessment

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POLLINATOR RESEARCH TASK FORCE

INTRODUCTION

Honey bee dietary risk assessment of pesticides requires knowledge of the residue levels in nectar and pollen following foliar application to crops, trunk/stem injection application, soil application or seed treatment applications. Current Tier 1 bee risk assessment in the U.S. relies on an exposure estimation and risk assessment model called BeeREX. This model uses a Residue Unit Dose (RUD) approach to estimate residues in nectar and pollen based on the upper-bound pesticide residue values from US Environmental Protection Agency's (US EPA) T-REX model (Version 1.5) of residues measured on a variety of plant matrices (Kenaga Nomogram) assembled for the purpose of dietary risk assessment in birds and mammals. Specifically, the RUD for 'long grass' residues are used in BeeREX as a surrogate for residues in nectar and pollen. In comparison, European Union (EU) Tier 1 risk assessment uses a database of nectar and pollen residue data. The US EPA has recently received residue study data, primarily for systemic chemicals, from pesticide registrants that can be used to adequately describe the post-application distribution of pesticide residues occurring in various plant tissue, including nectar, pollen, leaves, flowers and whole plant, relative to application rate, method of application, and crop. By combining the EU and US EPA plant tissue residue databases, especially nectar and pollen residue data, a statistically refined estimation of RUD values can be calculated. The resulting nectar and pollen RUD values will then inform the Bee REX model with exposure data relevant to the bee risk assessment for modern pesticides.

DATABASE DEVELOPMENT

Data from numerous GLP field and semi-field residue studies, conducted by pesticide registrants, were provided by the U.S. EPA for use in this project. Data from all studies conducted with a specific pesticide were combined into single data files and quality assurance evaluations were conducted by the U.S. EPA and contract research organizations (CROs). Authorization from the European Food Safety Authority (EFSA) to include the European RUD Database has been requested. When granted, this authorization will facilitate expansion of the database to include non-systemic pesticide products.

The resulting U.S. data files have been merged into a single comprehensive data base that can be queried by users across multiple variables to acquire RUD values or to make statistical comparisons. The database column variables are presented in Table 1. Each line of the database contains information from a single sample collected during a study. The database currently contains just those studies conducted in the U.S. which have produced residue concentrations for approximately 20,300 samples of nectar, pollen, leaves, whole plant, and soil.

Chemical names will be coded in the database for all users except for regulatory agencies to whom decoding information will be provided.

Table 1: Database column variables.

Chemical code	1st Application type	Sample DALA
Formulation	(foliar, drip, drench, etc.)	Total residues
Treatment #	1st application date	RUD
MRID #	1st application rate	Brix
Study I.D.	1st application seed trt rate	Total residues
Study type	1st application BBCH	Total Mol. Equivalents
Trial ID	Interval since last application	
Agency submitted to	(repeat for 12 applications)	
Site history	Parent concentration	
Study location	Deg 1 concentration	
Study Code	Deg 2 concentration	
Study tracking code	Deg 3 concentration	
Soil type	Concentration units	
% organic matter	Parent LOD LOQ	
pH	Deg 1 LOD LOQ	
% sand	Deg 2 LOD LOQ	
% silt	Deg 3 LOD LOQ	
% clay	Sampling technique	
Crop group	Sample I.D.	
Crop type	Matrix	
Variety	Date sampled	

RUD DEFINITION

(Mg a.i./kg food item) per 1 lb a.i. application/acre

RUD DATABASE APPLICATIONS

The primary intent of the RUD database is to provide dependable estimates of residue concentrations in pollinator food resources following various application scenarios across numerous crops. The residue data will be used to facilitate RUD calculations for use in modeling post-application pollinator pesticide exposure and effects. However, the database user will be able to conduct additional useful analyses such as those examples listed below.

EXAMPLES of RUD DATABASE ANALYSES

1) Nectar and pollen residue concentration in light vs. heavy soils.

2) Mean RUD difference between hand-collected nectar and pollen vs bee collected nectar and pollen.

3) Comparison of residue levels and RUD in nectar, pollen and plant foliage among crop types or crop groups.

4) Residue decline rate in plant matrices and soil.

5) Plant tissue residue concentrations by application method.

6) RUD in pollen and nectar – Substance related difference.

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