

Estimating nectar and pollen Residues per Unit Dose (RUD) values for different pesticide application types based on a new global database

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Bee Exposure in Risk Assessment

Exposure

(what pesticide concentration is in pollen/nectar & how much is consumed)



- Crops that produce pollen and/or nectar
- The public literature is generally bee hive monitoring data (e.g., pollen, wax) with minimal to no link to a pesticide application
- Exposure assessment in bee RA :
 - Default estimates (lower tier)
 - If risk refinement is triggered, residue studies in pollen & nectar:
 - No standardized designs and regionally-specific context
 - Expensive and logistically difficult to conduct

Pesticide residues in the nectar & pollen depend on application method and use pattern



Foliar Spray



Soil Application



Seed Treatment



Tree trunk

Nectar & Pollen Residue Unit Dose (RUD) – PRTF Project Background



The current North America screening level assessments in BeeREX model (EPA 2014) rely upon default RUDs from non-bee relevant matrices



EPA pollen & nectar residue database recently exists for four NNI + sulfoxaflor



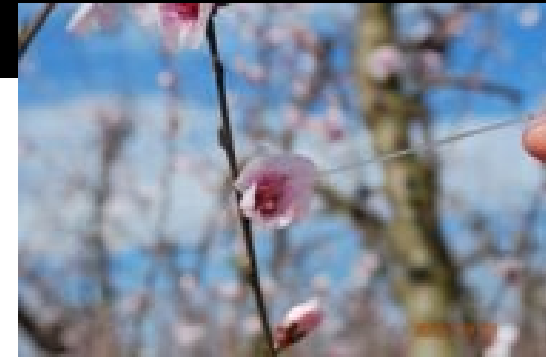
EFSA used a nectar & pollen residue database to derive RUDs for the EU risk assessment



ICPPR Residues WG identified need to compile global residue data to inform test designs/protocols when conducting residue trials



OECD also interested in global residue database



Current BeeREX default RUD values to calculate EECs in nectar & pollen

BeeREX model v.1

Table 1. User inputs (related to exposure)

Description	Value
Application rate	0.5
Units of app rate	lb a.i./A
Application method	foliar spray
Are empirical residue data available?	no

Table 2. Toxicity data

Description	Value ($\mu\text{g a.i./bee}$)
Adult contact LD50	12.9
Adult oral LD50	17.6
Adult oral NOAEL (NOEDD)	4.3
Larval LD50	1.2
Larval NOAEL (NOED)	0.7

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs ($\mu\text{g a.i./mg}$)
foliar spray	55	0.055
soil application	NA	NA
seed treatment	NA	NA
tree trunk	NA	NA

No distinction between pollen & nectar

Spray Application:

- 110 ppm for 1 lb ai/A (**98 mg/kg for 1 kg ai/ha**)
- Based on upper-bound pesticide residue value for 'tall grass' from USEPA T-REX model (EPA 2012)

Soil Application:

- **Briggs-Ryan plant-soil uptake model** based on application rate, log Kow and Koc

Seed Treatment:

- **1 mg ai/kg** regardless initial conc. on each seed

Project Goal 1: Compile nectar & pollen residue data across multiple a.i. & regions (US & EU)

- Pesticide residues data in nectar & pollen following a known application rate and use pattern
- Sources:
 - US EPA database: foliar, soil and ST, systemic insecticides (177 studies)
 - EFSA database (Kyriakopoulou et al., 2017) : Primarily foliar-applied insecticides, fungicides and herbicides (125 studies)
- Thorough standardization and data quality control to combine both databases
- A total of 12,773 unique bee-relevant values from 35 a.i.



Project Goal 2: Create a User Interactive tool to calculate Nectar & Pollen Residue Unit Doses (NPRUD)

- Method RUD Calc – All appl., last application
- *Days After Last Application (DALA): 0 to 365 days
- Application type: Seed T., Foliar, Soil, Seed+others
- Matrix: All, Nectar (all), Pollen (all), Bee Nectar, Bee Pollen, Extrafloral Nectar, Floral Nectar, Flower, Pollen Floral, Processed Nectar, Processed Pollen
- Systemicity: All, Systemic, Non-systemic
- Crop: 39 crops grouped by IR-4 index
- Bloom Status at App: All, pre-, during, post-

Method for RUD Calculation: All Applications

Days After Last Application	
≥ Begin	≤ End
0	365

Note: To select a single value for days after application, type in the same value for Begin/End

Application Type: Foliar

Matrix: All

Systemic/Non-systemic: Both

Crop Group: All

Note: After selecting a Crop Group, please open up the pull down window for Crop to 'reset' the options

Crop: [Empty]

Bloom Status: During Bloom

**Only data up to 365 DALA are included in the tool*

Example NPRUD Interactive Tool – Foliar spray, bloom

v.55

Method for RUD Calculation All Applications

Days After Last Application

≥ Begin	≤ End
0	365

Note: To select a single value for days after application, type in the same value for Begin/End

Application Type Foliar

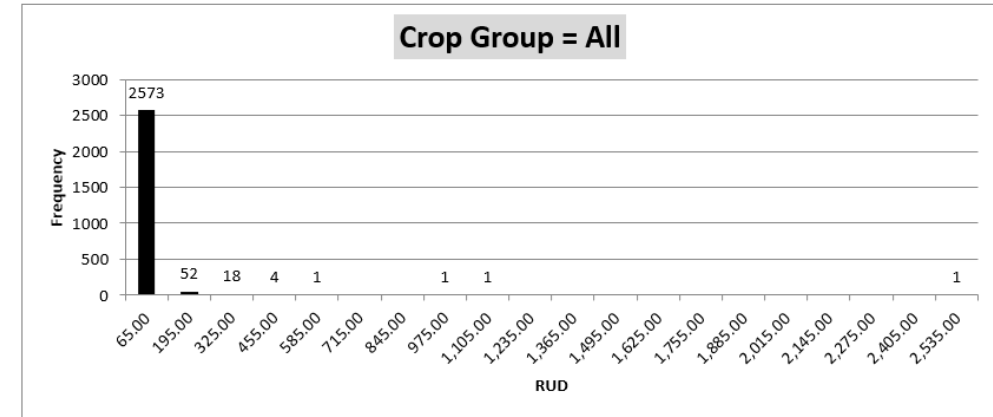
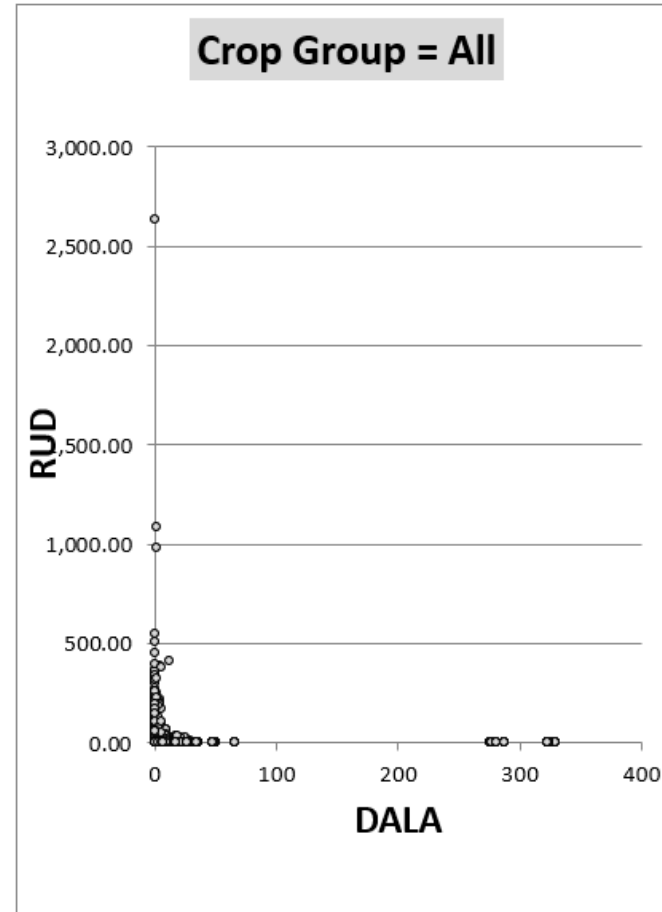
Matrix All

Systemic/Non-systemic Both

Crop Group All

Note: After selecting a Crop Group, please open up the pull down window for Crop to 'reset' the options

Bloom Status During Bloom



Note: data labels > 0 are shown above each column (e.g. the number of values in that column)

Crop Group = All	
Number of Observations	2651
Using Individual RUD values	
90th percentile	28.53
Mean	14.61
Median	0.28461

Example NPRUD Interactive Tool – Foliar spray, pre-bloom

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Method for RUD Calculation: All Applications

Days After Last Application

≥ Begin	≤ End
0	365

Note: To select a single value for days after application, type in the same value for Begin/End

Application Type: Foliar

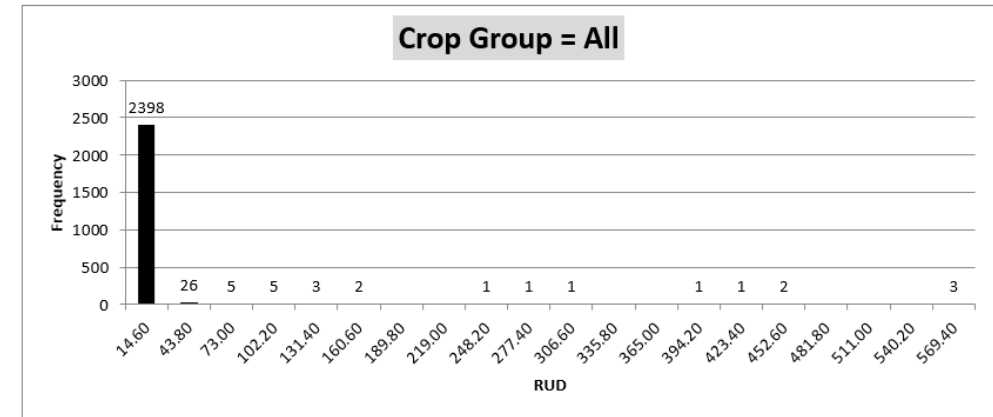
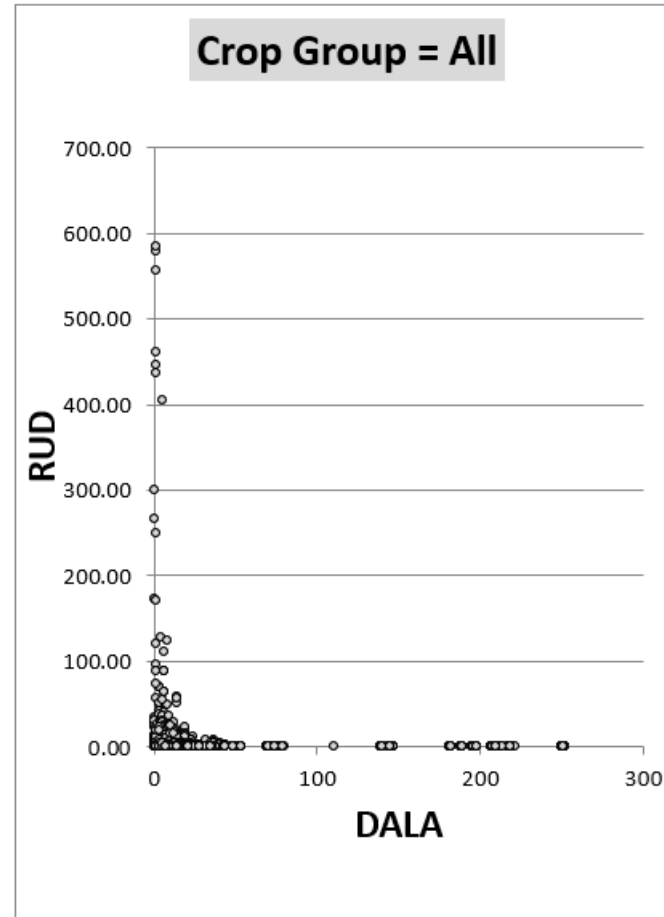
Matrix: All

Systemic/Non-systemic: Both

Crop Group: All

Note: After selecting a Crop Group, please open up the pull down window for Crop to 'reset' the options

Bloom Status: Pre-Bloom



Note, data labels > 0 are shown above each column (e.g. the number of values in that column)

Crop Group = All	
Number of Observations	2449
Using Individual RUD values	
90th percentile	4.66
Mean	4.26
Median	0.16071

Example NPRUD Interactive Tool – Seed Treatment

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Method for RUD Calculation: All Applications

Days After Last Application

≥ Begin	< End
0	365

Note: To select a single value for days after application, type in the same value for Begin/End

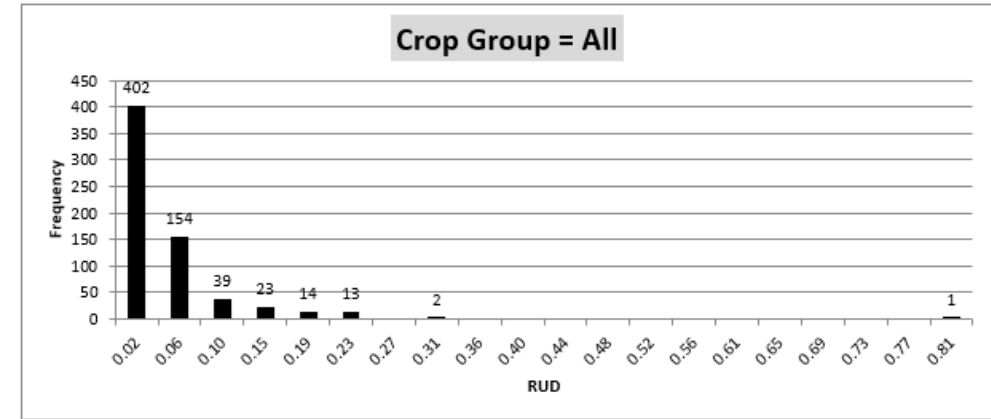
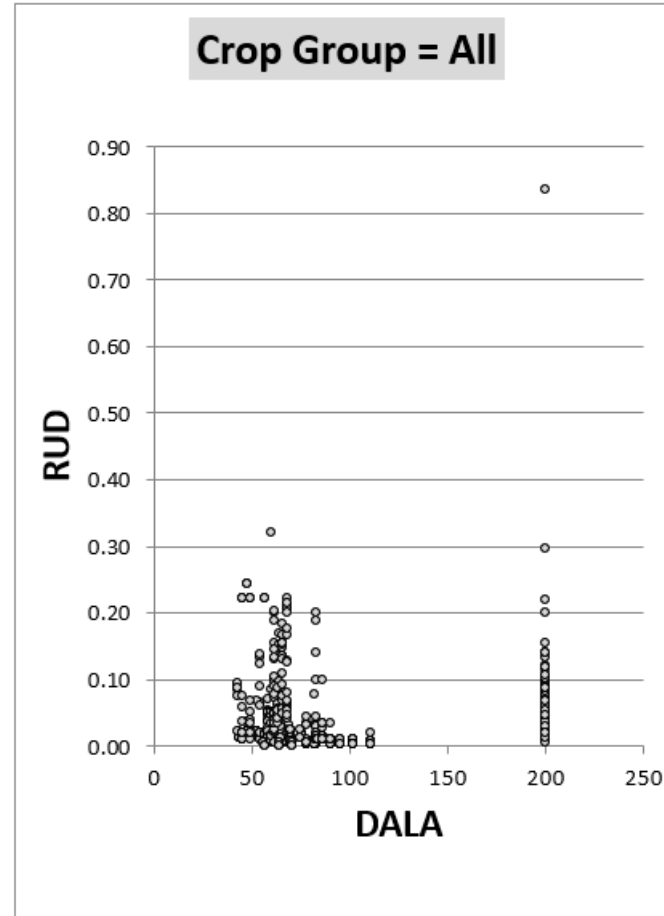
Application Type: Seed

Matrix: All

Systemic/Non-systemic: Both

Crop Group: All

Note: After selecting a Crop Group, please open up the pull down window for Crop to 'reset' the options

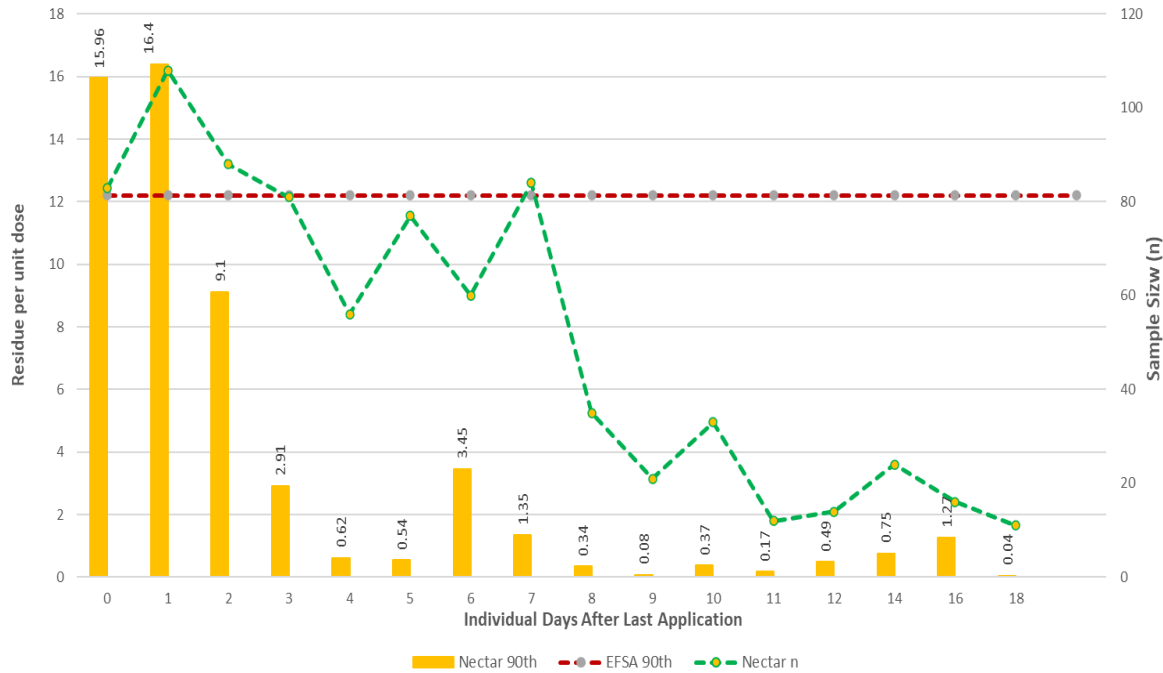


Note, data labels > 0 are shown above each column (e.g. the number of values in that column)

Crop Group = All	
Number of Observations	648
Using Individual RUD values	
90th percentile	0.10232
Mean	0.04441
Median	0.02365

Calculated Nectar & Pollen RUDs for different short DALAs – Foliar spray

v.55



- BeeREX default nectar RUD value could be changed from 98 mg/kg to 16.4 mg/kg (or adopt the current EFSA 90th percentile nectar RUD value of 12.2 mg/kg)
- BeeREX default pollen RUD value could be increased from the current value of 98 to 239.4 mg /kg.

Summary

- The global database and user interface can provide refined exposure estimates for pollinator Risk Assessment in North America, also in other regions
- Empirically based default RUD values for pollen & nectar, separately
- Reduce the overall uncertainty of using non-relevant matrices while maintaining sufficiently protective dietary exposure assumptions in Tier 1 bee risk assessments
- Current database can be kept populated with new data when available
- User interface and data analyses have been shared with the US EPA for review
- A manuscript to be submitted for publication in a peer-review journal

Potential to...

- Leverage existing data in bee risk assessment
 - ↓ residue studies needed
 - More uniformed and predictive screening assessments
 - Means to target areas for refined data needs (by crop, timing, app. type, matrix type, etc)
- Better evaluate potential exposure estimates for research studies
- Use data to inform Integrated Pest Management (IPM) decisions



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