Worker re-entry exposure within the framework of the BROWSE project

Kim Doan Ngoc

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The main aim was to develop an improved worker exposure model for PPPs.

- Available data
- EFSA guidance
- Regulation 1107/2009
- Gender and regional differences
- Transparent
A worker exposure scenario is a combination of a crop group and a task.

**OUTDOOR**
- Harvesting orchard fruit
- Harvesting grapes

**INDOOR**
- Harvesting fruiting vegetables
- Harvesting ornamentals
Introduction

Modelling approach

Output
The conceptual model starts from the application of a substance.

- **Application**
  - Initial deposit on crop
  - Deposit on crop at re-entry
  - Contact with crop
  - Dermal exposure
  - Concentration in air at re-entry
  - Inhalation exposure
  - Inhalation exposure
  - Absorbed amount

- **Volatilisation and dispersion**

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- **Hand-to-mouth contact**
  - Oral exposure

- **Modelled by PEARL-OPS**
Dermal exposure is the result of contact with PPP residue on the crop.
Dermal exposure is the result of contact with PPP residue on the crop

Expressed by transfer coefficient
• EFSA guidance
• User input
• (Defaults based on literature)

Expressed by DFR
• Modelled by PEARL-OPS
• User input
Dermal exposure is the result of contact with PPP residue on the crop.

Two options available:
- Default based on survey data
- User input

Predefined options available:
- Coverage factors
- Migration factors

Contact  Residue  Duration  Clothing/PPE
Inhalation exposure is the result of the inhalation of air with PPP residues. Modelled by PEARL-OPS, which takes into account:

- Substance properties
- Application rate
- Crop properties
- Meteorological data

The factors affecting concentration air include:

- Breathing rate
- Duration

These factors are derived from the Exposure Factors Handbook, considering:

- Intensity activity
- Gender
- User input
Hand-to-mouth contact leads to oral exposure

Modelled by dermal exposure module

Exposure hands  Contact  Duration

Defined by:
Fraction of hand in contact with mouth
Hand-to-mouth transfer efficiency
Number of contacts
Pearl provides an estimate of the DFR and the concentration in the air.

Meteorological data over 5 year time period
5 locations in 3 EU zones
Simulates one application every week in period April-September

Distribution across 120 data points
Acute exposure: averaged over a single day
Longer term exposure: averaged over longer period
Introduction

Modelling approach

Outputs
Level of conservatism

Defaults provided for many parameters
  – aimed at overall realistic worst-case

Many parameters allow user input
  – drop-down menu
  – within given range
**Example inputs:**

**harvesting of grapes**

**Minimum input parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration a.s. in product</td>
<td>500</td>
<td>g/l</td>
</tr>
<tr>
<td>Product dose</td>
<td>1.2</td>
<td>l/ha</td>
</tr>
<tr>
<td>Molar mass</td>
<td>248</td>
<td>g/mol</td>
</tr>
<tr>
<td>Saturated vapour pressure</td>
<td>0.001</td>
<td>Pa</td>
</tr>
<tr>
<td>Water solubility</td>
<td>1800</td>
<td>mg/L</td>
</tr>
<tr>
<td>Log10 $K_{om}$</td>
<td>1.3</td>
<td>-</td>
</tr>
<tr>
<td>AOEL</td>
<td>0.02</td>
<td>mg/kg BW/day</td>
</tr>
<tr>
<td>Dermal absorption of product</td>
<td>2</td>
<td>%</td>
</tr>
<tr>
<td>Dermal absorption of in use dilution</td>
<td>10</td>
<td>%</td>
</tr>
<tr>
<td>Oral absorption</td>
<td>100</td>
<td>%</td>
</tr>
</tbody>
</table>

**realistic application of medium volatile substance**
Example inputs: harvesting of grapes

Other parameters:
defaults provided in software

Gender: Male
Clothing: Trousers, t-shirt and cap
Re-entry interval: 1 day
Duration: 8 hours/day
Application type: Single
EU zone: Southern - Italy

→ realistic worker exposure scenario
Example output: **acute** exposure harvesting of grapes

<table>
<thead>
<tr>
<th>Statistic</th>
<th>AOEL = 0.02 mg/kg BW/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute DFR</td>
<td>0.890 µg/cm² (90th percentile *)</td>
</tr>
<tr>
<td>Longer term DFR</td>
<td>0.538 µg/cm² (90th percentile *)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acute/Longer term</th>
<th>Exposure route</th>
<th>Exposure (mg/kg bodyweight/day)</th>
<th>Absorbed amount (mg/kg bodyweight/day)</th>
<th>Proportion of AOEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>Dermal (hands)</td>
<td>0.701</td>
<td>0.0701</td>
<td>3.50</td>
</tr>
<tr>
<td></td>
<td>Dermal (body bare)</td>
<td>0.222</td>
<td>0.0222</td>
<td>1.110</td>
</tr>
<tr>
<td></td>
<td>Dermal (body clothed)</td>
<td>0.399</td>
<td>0.0399</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Dermal (total)</td>
<td>1.32</td>
<td>0.132</td>
<td>6.61</td>
</tr>
<tr>
<td></td>
<td>Ingestion</td>
<td>0.00231</td>
<td>0.00231</td>
<td>0.0023</td>
</tr>
<tr>
<td></td>
<td>Inhalation</td>
<td>0.000212</td>
<td>0.000212</td>
<td>0.01062</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>1.32</strong></td>
<td><strong>0.135</strong></td>
<td><strong>6.74</strong></td>
</tr>
</tbody>
</table>

\[
\text{absorbed amount} \div \text{AOEL} \\
> 1 \quad \text{potential risk} \\
< 1 \quad \text{no potential risk}
\]
Example output: **longer term exposure harvesting of grapes**

AOEL = 0.02 mg/kg BW/day

<table>
<thead>
<tr>
<th>Acute/Longer term</th>
<th>Exposure route</th>
<th>Exposure (mg/kg bodyweight/day)</th>
<th>Absorbed amount (mg/kg bodyweight/day)</th>
<th>Proportion of AOEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longer term</td>
<td>Dermal (hands)</td>
<td>0.424</td>
<td>0.0424</td>
<td>2.12</td>
</tr>
<tr>
<td></td>
<td>Dermal (body bare)</td>
<td>0.134</td>
<td>0.0134</td>
<td>0.671</td>
</tr>
<tr>
<td></td>
<td>Dermal (body clothed)</td>
<td>0.241</td>
<td>0.0241</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td>Dermal (total)</td>
<td>0.799</td>
<td>0.0799</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Ingestion</td>
<td>0.00139</td>
<td>0.00139</td>
<td>0.0697</td>
</tr>
<tr>
<td></td>
<td>Inhalation</td>
<td>0.0001157</td>
<td>0.0001157</td>
<td>0.000000231</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>0.801</strong></td>
<td><strong>0.0814</strong></td>
<td><strong>4.07</strong></td>
</tr>
</tbody>
</table>

\[
\frac{\text{absorbed amount}}{\text{AOEL}} > 1 \quad \text{potential risk}
\]

\[
\frac{\text{absorbed amount}}{\text{AOEL}} < 1 \quad \text{no potential risk}
\]
Example output: harvesting of grapes

- **Dermal exposure:** ± 98%
- **Oral exposure:** ± 2%
- **Inhalation exposure:** < 1%

Absorbed amount (mg/kg BW/d)

0.081

0.135
Comparison with existing models: harvesting of grapes

EUROPOEM
- EUROPOEM default of 3 µg/cm² per kg a.s./ha
- U.S. EPA transfer coefficient for harvesting of grapes

BROWSE: user input DFR
- EUROPOEM default of 3 µg/cm² per kg a.s./ha

BROWSE: DFR calculated by PEARL-OPS
- Estimates with different vapour pressures/volatility
- Central EU zone
Comparison with existing models: harvesting of grapes

- EUROPOEM
- BROWSE: EUROPOEM DFR
  - high Vp
  - medium Vp
  - low Vp
- PEARL-OPS

Absorbed amount (mg/kg BW/d)

- longer term
- acute
Advantages of the BROWSE model

BROWSE... has a user-friendly software?

provides an estimate of DFR

includes inhalation and oral exposure

estimates acute and longer term exposure

takes account of regional and gender differences

provides defaults but also allows user input
Next steps

Add TC distributions

Extend range of scenarios

Implement indoor volatilisation model

Further testing and validation
Questions?