Glyphosate exposure assessments among amenity horticulturists
Amenity horticulture
Glyphosate

- 2A Probably carcinogenic to humans (IARC)

  International Agency for Research on Cancer
  World Health Organization

- Classification refuted

  ECHA
  European Chemicals Agency
  EFSA
  European Food Safety Authority

- Highest volume herbicide used worldwide, >750 products
Aims & Objectives

- Quantify occupational exposure to glyphosate
- Evaluate the possible routes of exposure
- Improved sampling strategies
Similar Exposure Groups (SEGs)

1\textsuperscript{st} SEG
- Manual knapsack

2\textsuperscript{nd} SEG
- Pressurised handheld lance

3\textsuperscript{rd} SEG
- Controlled droplet applicator
Urine Sampling

- Collection of full void urine samples in a 24 hr period
  - Pre-exposure sample (before task begins)
  - Post-exposure sample (within one hour of task completion)
  - Following morning void

Participants also had an option to give samples for each void in a 24 hr period.
Dermal sampling

- Hands (two wipes/hand)
- Perioral region (one wipe)
- Collection of gloves
- Potential contaminated work surfaces (one wipe)
  - Mobile phones
  - Steering wheels of vehicles
  - Product containers
Sample Collection

- 125 urine samples collected
- 351 samples of dermal/glove/surface contamination
  - 76 gloves
  - 140 hand samples
  - 52 perioral region
  - 27 product containers
  - 9 steering wheel
  - 18 mobile phones

Additional blank samples were taken to ensure sampling integrity
Glyphosate (µg/L) - urine

![Graph showing peak urinary concentration of glyphosate for different application methods.]

- Manual knapsack: n=12
- Pressurised lance: n=10
- Controlled droplet applicator: n=7
Individual spot urine samples over 48 hours for two work tasks
Estimated the half-life of glyphosate

5 ½ - 10 hours

**Elimination rate**

- **Urine glyphosate concentrations (µg L⁻¹)**

  - Time passed from peak glyphosate concentration sample (hrs)

  - **Equation:** 
    
    \[ y = -0.0642x + 0.6693 \]
    
    \[ R^2 = 0.99 \]
Glove, hand & perioral sampling
Results - glove, hand & perioral

- Both gloves
- Both hands
- Perioral region

n=17
n=29
n=29
Surface contamination
Potentially contaminated surfaces

![Box plot showing glyphosate concentrations (µg/cm²) for product container, steering wheel, and mobile phone, with sample sizes n=21, n=10, and n=18 respectively.](image)
Urinary vs Perioral

![Graph showing the relationship between peak glyphosate urinary concentrations and perioral region ug/cm². The correlation coefficient r is 0.60.](image)
Hand vs. Perioral

* $p < 0.01$

$r = 0.64$
Results

Determinants of perioral region exposure:
- Hand contamination
- Sampling time
- Frequency of hand contact to contaminated surfaces
- Type of glove

Determinants of dermal exposure:
- Sampling time
- Quantity of pesticide concentration used
- Age of participant
Discussion

- New data on glyphosate
  - Biomonitoring
  - Dermal
  - Inadvertent ingestion
  - Amenity horticulturists

- Potentially contaminated work surfaces
  - Potential exposure for non-pesticide users
  - Para-occupational exposures
Conclusions

- Exposures among this occupational group
- Evaluated dermal and inadvertent ingestion exposure routes
  - What about inhalation?
- Estimated the human biological half-life of glyphosate
We would like to thank all the workers who participated in the study.
References
Questions?