Long-term monitoring of pesticides in air and atmospheric deposition in Sweden

Jenny Kreuger & Bodil Lindström

Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden

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Background

• Long-term monitoring of environmental fate of pesticides in Sweden since 2002
  • Main focus on surface water*
  • To a lesser extent, also monitoring of pesticides in atmospheric deposition and in air

Sampling sites

- Sampling sites located jointly with other international/national atmospheric monitoring programs (e.g. EMEP & ICOS)
- Located in rural background areas, surrounded by forests, >1 km from treated fields
Methods - precipitation

- Event related sampling using a bulk sampler (a stainless steel funnel, area 0.5 m², above a fridge)
- Ca 12-15 samples/season
- Ca 140 pesticides analysed today
- Sampling during main growing season
  - From 2009 April-October
  - Previously May-June + October
- Started in 2002 at Vavihill & in 2009 at Aspvreten (further north)
Methods - air

Air samples collected
• At fixed, weekly, intervals using a high-volume pump (ca 400 m³/day)
• Using pre-cleaned cartridges with quartz fiber filter and PUF/XAD/PUF
• Ca 10-12 samples/season
• Ca 100 pesticides analysed today
• Started in 2009 at Vavilhill
Max total concentration 3.9 µg/l in a sample from October 2015, with prosulfocarb constituting the major part (3.8 µg/l)
• During later years (2012-2015) 65 a.i. & 6 TP:s were detected.
• Most detects at the low ng/l-level, though some were occasionally detected above 0.1 µg/l, mainly:
  • prosulfocarb, protioconazole-destio, MCPA, pendimethalin, and terbutyhazine-desethyl.

Max total concentration 3.9 µg/l in a sample from October 2015, with prosulfocarb constituting the major part (3.8 µg/l).
Detection frequency in rainwater at Vavihill (south) during recent years 2012-2015

Of those pesticides detected in ≥ 20 % of the samples – ca 50 % were not used in Sweden during the investigation period (e.g. lindane, endosulfan, chlorpyrifos, terbuthylazinle, metolachlor, epoxiconazole, flufenacet)
Atmospheric deposition at Vavihill in southern Sweden 2012-2015 (April-October)

- Herbicides dominate, followed by fungicides
- Also pesticides not registered for use in Sweden (red bars) contribute to the total load
Yearly $\sum$ 3-month deposition ($\mu g/m^2$) 2002-2017 for pesticides not used in Sweden
Banned within the EU (left) and approved within EU (right)
Long-term trends - deposition

Yearly $\sum$ 3-month deposition (µg/m²) 2002-2017
Pesticides used in Sweden (left) and for pesticides banned during the period (right)
Air samples - distribution between filter, PUF and XAD for 26 pesticides detected in >20% of the air samples (n = 34)

- PUF breakthrough (> 30%) for dichlobenil, HCH-a, HCB and trifluralin.
- However, only 4% of total pesticide concentration found in XAD and PUF-2

* Substances not approved for use within EU at the time of sampling
Pesticides in air
April 2017 – March 2018

- Some were primarily detected on filter
- Seasonal occurrence
Pesticides in air
April 2017 – March 2018

- Others were detected on PUF
- Year round
• A total of 31 a.i. and 5 TP:s
• Majority of pesticides detected in the gas phase are not approved for use within Sweden, many not even within the EU
• Most concentrations at low levels (< 0.1 µg/m³ air), mainly prosulfocarb detected above this level (max. 30 µg/m³ air)
Detection frequency in air (filter) 2012-2015

- Majority of pesticides detected in the particulate phase are approved for use within Sweden.
- Most concentrations at low levels (< 0.1 µg/m³ air), mainly fenpropimorph detected above this level (max. 0.8 µg/m³ air).
Conclusions

- Currently used pesticides are regularly detected at ng/l-levels in rainwater, with occasional µg/l-level findings.
- A larger number of pesticide detected during spring/early summer, however higher concentrations were detected during fall (mainly prosulfocarb).
- Deposited amount corresponds to ca 0.1 - 0.0001% of the applied dose in the field.
- A significant contribution to atmospheric deposition in southern Sweden from pesticides not used within Sweden, i.e. a transboundary atmospheric transport of pesticides.
Thank you! Questions?

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• Information about the pesticide monitoring program at
  • Department of Aquatic Sciences and Assessment or
  • Centre for Chemical Pesticides