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Sorption of three pesticides to the seaweeds *Ulva lactuca* and *Sargassum muticum*

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Background

- Seaweed receives global attention as a driver of a blue economy.
- In production systems exposure to contaminants, such as pesticides, is likely.
- Depending on hydrophobicity, association with pesticides can occur.
- Potentially problematic for some commercial uses but also presents the possibility for phycoremediation of effluent water from pond- or tank-based aquaculture systems.
- To assess seaweed-pesticide interactions, so-called sorption coefficients are required.
- However, there is a general lack of sorption, uptake, bioaccumulation, and effects studies under laboratory conditions for seaweed species.
- Such information is necessary to be able to predict associated (environmental) risks.

Objective

- Determine the sorption of three pesticides (Thiamethoxam, Diazinon, Chlorpyrifos), selected to cover a representative range of expected sorption behaviour, to the seaweeds *U. lactuca* and *S. muticum* (Fig. 1 and 2).

Figure 1. *Ulva lactuca.*

Figure 2. *Sargassum muticum.*

Methods

- Sorption study was performed using a batch method (Fig. 3) according to OECD-106 at one concentration level; 10 µg/L (Thiamethoxam, Diazinon) and 100 µg/L (Chlorpyrifos).
- Sorption coefficients for soil organic carbon (K_{oc}) used as indicator for sorption range. K_{oc} values of Thiamethoxam, Diazinon and Chlorpyrifos are 56, 643, and 3954 L/kg, respectively.

Figure 3. Set-up of batch sorption carousel inside incubator.

Results

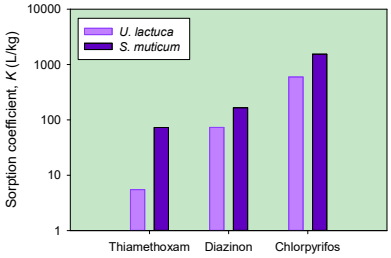

Figure 4. Sorption coefficients of Thiamethoxam, Diazinon and Chlorpyrifos for the seaweeds *U. lactuca* and *S. muticum.*

- Sorption coefficients increase with increasing K_{oc} value (Fig. 4).
- Sorption coefficients for *U. lactuca* are lower than for *S. muticum* (~factor 2-3 for Diazinon and Chlorpyrifos).
- Sorption coefficient Thiamethoxam differs strongly between the two seaweeds.

Conclusions

- Sorption coefficients can be determined using a batch method based on OECD-106.
- Sorption of pesticides to seaweeds occurs and K_{oc} value can be used as indicator for sorption range of pesticides for seaweeds.
- To assess potential associated (environmental) risks, we recommend extending existing models (e.g. the ERA-AQUA model) with a seaweed compartment (Fig. 5).

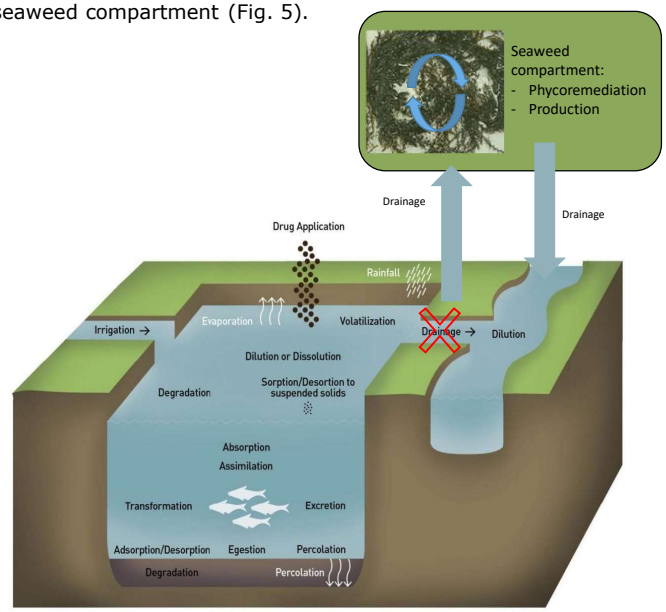

Figure 5. Processes describing drug transfer and dissipation included in the ERA-AQUA model and shows where a seaweed compartment would be placed in the overall system. Adapted from: Rico et al., (2013).

Acknowledgements & More info

This work is part of the overarching Aquatic systems project (left QR). A report investigating the need for environmental risk assessment of chemical crop protection practices in seaweed was published (right QR).

References

- Rico, A., Y. Geng, A. Focks, and P. J. Van den Brink. 2013. Modeling environmental and human health risks of veterinary medicinal products applied in pond aquaculture. Environmental Toxicology and Chemistry 32:1196-1207.
- OECD (2000), Test No. 106: Adsorption -- Desorption Using a Batch Equilibrium Method, OECD Guidelines for the Testing of Chemicals, Section 1, OECD Publishing, Paris, https://doi.org/10.1787/9789264069602-en.

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