

USE OF MESOCOSM STUDIES TO TEST THE EFFECTS OF PLANT PROTECTION PRODUCTS (PPP'S) ON SEDIMENT AND BENTHIC ORGANISMS

Marie Brown[#], Hanna Schuster, Zoe Jones, Jamie Smith, Nadine Taylor, Amy Brooks, Abdul Abu
Cambridge Environmental Assessments, Boxworth, UK; [#]Corresponding author: marie.brown@cea-res.co.uk

INTRODUCTION

Current data requirements relating to impacts on sediment organisms comprise of tier 1 studies (*Chironomus* sp. or *Myriophyllum* sp.). Concern has been raised that these tests may not be fully representative of the risks of PPPs to the community of sediment organisms and plants, and that sediment is currently under-represented in environmental risk assessment. In addition, in the repaired FOCUS surface water scenarios, accumulation in sediment is expected to occur which could cause an increase in the number of sediment toxicity tests that are triggered. In response to such concerns, in 2015, the EFSA Panel on Plant Protections Products and their Residues (PPR) published an opinion on the risk assessment for benthic organisms and in 2016, the European Chemicals Agency (ECHA) updated the sediment section of the “Guidance on Information Requirements & Chemical Safety Assessment”. These publications advocate the use of sediment-spiked toxicity data and micro/mesocosm tests in a tiered approach in order to improve the link between exposure and effects in sediment risk assessments.

Sediment Mesocosm Design Technical Methods

Here we present different methods for sampling sediment organisms in mesocosm studies that we intend to trial at the CEA mesocosms, using seeded bioassay containers, sediment colonisers and direct sediment sampling. Whilst each method has its own advantages and disadvantages, the methods should be carefully considered to ensure the study meets the specific regulatory requirements and by focussing sampling effort in a targeted and informed manner depending on the type of effects expected and the most sensitive critical taxa.

Seeded Bioassay Container

Container set up with sediment and a known number of target organisms, submerged within the mesocosm.

Advantages

- ✓ Target organisms can be sampled in a controlled way within the mesocosm.

Disadvantages

- x If the bioassay containers are closed systems it is not possible to observe long term effects on the population.
- x If the bioassay containers are open the organisms could migrate out of the container.

Sediment Coloniser

Coloniser designed to attract sediment dwelling organisms.

Advantages

- ✓ Conditions are maintained in order to achieve high abundances of organisms.

Disadvantages

- x Abundance data could be variable between replicates.

In addition to sediment sampling, the emergent insects can also be monitored during a mesocosm study to determine the effects of a PPP on the emergence of the larval sediment dwellers.

Direct Sediment Sampling

Samples taken directly from the sediment layer of the mesocosm.

Advantages

- ✓ Samples representative of natural populations.

Disadvantages

- x Sampling could cause adverse effects through disturbance of the sediment.
- x Sediment could be exhausted over time.



Using Mesocosm Studies to Assess Sediment Organisms

Benefits

- ✓ Opportunity to assess long-term effects at the population or community level under more realistic exposure conditions.
- ✓ Increased realism in a system replicating the natural environment in an edge-of-field waterbody.

Disadvantages

- x Studies are rarely used to investigate sediment organisms due to the lack of guidance on how to design, conduct and interpret such studies.
- x Studies with poor study design can lead to a lack of acceptance by regulators.

✓ The benefits could outweigh the disadvantages if an appropriate study design is used, ideally designed in collaboration with target regulatory authorities



Sediment Mesocosm Study Design Considerations

- What is the realistic worst-case exposure scenario?
- How will the concentrations in the sediment be measured?
- Sediment properties - sediment characteristics vary across Europe, what is the organic matter content?
- Sediment community – e.g. how does this vary depending on water body type and climatic conditions?
- What is the mode of action of the chemical? Is it persistent, hydrophobic? Is it expected that there will be an effect of accumulation in the sediment?

RECOMMENDATIONS

Mesocosm study designs need to be optimised to specifically target sediment organisms using targeted sampling techniques in order to obtain reliable data and regulatory acceptability.

References:

- 1 “Scientific Opinion on the effect assessment for pesticides on sediment organisms in edge-of-field surface water” EFSA, 2015
- 2 “Guidance on Information Requirements & Chemical Safety Assessment” ECHA, 2016