NEW DEVELOPMENTS IN SPECIES SELECTION FOR MESOCOSM TESTING WITH HERBICIDES: RECENT EXPERIENCE AND RECOMMENDATIONS

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Introduction

A number of new developments in mesocosm testing have taken place since the most recent revisions to guidance for these complex studies (e.g. HARAP, 1998 & CLASSIC, 2001). Much of the progress in this area has been in the design and conduct of freshwater mesocosm studies to evaluate the toxicity of herbicides. We will show how we have implemented this research using examples drawn from recent state of the art regulatory tests. We will also provide recommendations for macrophyte species selection for different functional groups and embryonic classes. Finally, we will provide examples of assessment methods for evaluating the effects of pesticide exposure to macrophytes for regulatory assessment. It is hoped that this information will advance mesocosm design for herbicide studies and offer advice to those considering conducting these studies, whilst stimulating discussion in this developing area of higher tier aquatic ecotoxicology.

Macrophyte species selection

Edge of field water bodies are host to a wide range of macrophyte communities, which in turn support algal, zooplankton and macroinvertebrate populations (Heegard et al, 2001). Guidelines for testing terrestrial plants require a range of species giving representation across the plant kingdom (OECD208, 2006) however, there are no similar requirements for aquatic macrophyte testing. We have identified eight macrophyte species suitable for use in mesocosm testing that represent a range of functional groups and morphological traits along with their recommended planting depths as presented in Table 1.

Example species	Embryonic class	Morphological characteristics	Planting depth (cm)
Potamogeton natans (Broad leaved pondweed)	Monocot	Rooted, floating leaved	50
Elodea canadensis (Canadian pondweed)	Monocot	Rooted, submerged	50
Sparganium erectum (Bur-reed)	Monocot	Rooted, emergent	50
Glyceria maxima (Reed sweet grass)	Monocot	Rooted, emergent	20 – 30
Myriophyllum spicatum (Eurasian watermilfoil)	Dicot	Rooted, submerged	30 – 50
Hippuris vulgaris (Common mare's tail)	Dicot	Rooted, emergent	20 – 30
Callitriche stagnalis (Water starwort)	Dicot	Rooted, floating leaved	10 – 20
Veronica beccabunga (Brooklime)	Dicot	Rooted, emergent	0 - 10

Table 1. Macrophyte taxa and recommended planting depths

Health assessments

For a robust assessment of macrophyte health we identified a need to collect quantitative as well as qualitative data. In order to do this we have developed a range of assessment criteria that can be applied to different macrophyte species, based on their morphological characteristics and ecological functions. The criteria we have identified for being appropriate for different species are presented in *Table 2*.

Species	Assessment Characteristic							
	Percentage Chlorosis	Percentage Necrosis	Stem number	Stem length	Flower spikes	Leaf number	Nodes on 5 cm	Nodes on 10 cm
Potomogeton natans	✓	✓			✓	✓		
Elodea canadensis	✓	✓					✓	
Sparganium erectum	✓	✓	✓	✓	✓			
Glyceria maxima	✓	✓	✓	✓				
Myriophyllum spicatum	✓	✓						✓
Hippuris vulgaris	✓	✓	✓	✓				
Callitriche stagnalis	✓	✓						
Veronica beccabunga	✓	✓			✓			✓

Table 2. Recommended health assessments

Meeting the requirements of functional groups

Previous work conducted at CEA has shown that mesocosms should incorporate natural margins to more accurately resemble natural ponds (Williams et al 2002) and to create optimal growing conditions for individual species. As a result, it is recommended that shallow water and marginal macrophytes are planted at depths that more accurately reflect macrophyte assemblages in natural edge of field water-bodies. Examples of recommended depths for different species are presented in Table 1. Previously this has been done using raised baskets or steps however, these options create discrete populations of plant species rather than true communities. In order to avoid the segregation of populations we have developed sloping mesocosms (*Figure 1.*) that allow community end points to be obtained whilst also providing suitable niches for different functional groups.

Figure 1. Sloped mesocosms for macrophyte communities

Conclusions

To ensure that freshwater mesocosm studies to evaluate the toxicity of herbicides, most accurately represent natural edge of field water-bodies, whilst also providing robust community endpoints, the following recommendations are made:

- The macrophyte species used should cover a range of functional groups and morphological traits
- The methods used to assess macrophyte health should provide quantitative and qualitative data from numerous measurements
- Macrophytes should be planted at depths that most accurately reflect assemblages in natural edge of field water-bodies, whilst still allowing community interactions

References

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