AQUATIC MACROPHYTES - IS THERE A NEED FOR ADDITIONAL TEST SPECIES?

Melanie Kroos, Naomi Blake & Dave Arnold
Cambridge Environmental Assessments, Battlegate Road, Boxworth, Cambridge, CB23 4NN, UK

Cambridge Environmental Assessments have conducted a survey of regulatory and research knowledge and practices concerning aquatic macrophyte studies in Europe in the context of the current approach to regulatory risk assessments under the Plant Protection Products Directive (91/414EEC), where *Lemna sp.* is used as a first tier indicator of potential herbicidal effects.

Introduction

Submerged vascular plants play an important ecological role in the littoral zones of lakes, estuaries and oceans and have the ability to absorb nutrients through their leaves as well as through their roots. A pesticide entering an aquatic system could either remain largely in the water column or partition into the sediment. Thus, the inclusion of rooted submerged macrophytes is advantageous as it would account for both routes of exposure. It may be necessary to develop standardised test procedures for one or more aquatic macrophyte species. Such tests may help to reduce the uncertainties associated with interspecies variability and also allow impacts of exposure through sediment to be addressed. The challenge is to identify species that are representative of relatively sensitive species, express toxicity associated with relevant exposure routes, can be maintained in laboratory conditions and have reliable endpoints with low inherent variability.

The main **objectives** of this project, which was funded by the UK Pesticides Safety Directorate, were:

1. Examination of current practices for aquatic macrophyte testing in the EU (and US) and identification of areas of concern with current methods.
2. Collection of information on the range and reliability of existing protocols and expertise and capabilities of different testing facilities in the EU

Methods

Questionnaires

• A detailed questionnaire was sent to 20 EU Member States, Switzerland, the US EPA and 18 European Research Institutes that conduct aquatic ecotoxicology tests. The aim of the questions was to cover the attitude and experiences of the individual Member States (MSs) on the existing risk assessment scheme for aquatic macrophytes as well as to collect proposals on an improved approach.

Literature search

• As a second tool, a literature search was conducted in order to get a complete overview on the whole spectrum of research and knowledge in this area.

Results: Questionnaire

• *Are Lemna tests considered as sufficient in PPP Annex III risk assessment?* Only 24% of the Member States and 8% of the research institutes feel that the *Lemna* test alone is sufficient in risk assessment although an additional 41% of MSs responded that it would be case dependent. Most believe it to be a morphologically reduced plant lacking a true stem and leaves and thus not representative of rooted macrophytes.

• *Would rooted macrophyte tests improve aquatic risk assessments?* 59% MSs see the submission of additional rooted macrophyte data as improving aquatic risk assessment *per se* and 29% would do so on a case by case basis. 83% research institutes also agree that additional macrophyte data would improve risk assessment.

• *Submission and request of data on additional macrophyte studies.* The majority of MSs (88%) state that data on additional macrophyte studies are not regularly submitted by notifiers. 71% MSs stated that they have never requested additional data.

• *What tests have been conducted and what endpoints are considered?* A range of study types is reported, from single species tests for determining species sensitivity distributions, to multispecies mesocosm studies evaluating longer-term effects and recovery potential. A variety of endpoints is reported from growth measurements to biochemical indicators such as oxygen production.

• *Quality of additional macrophyte study data.* MS experience with additional macrophyte data is limited (> 50%). A few (12%) have no experience at all and were not in a position to comment. 35% find the quality of the data received more or less acceptable.

• *Has a Member State reduced an assessment factor based on additional macrophyte data?* Very little experience is one of the key issues and a lack of guidance another. 71% of MSs would consider the use of additional macrophyte data to reduce the assessment factor. Responses infer, however, this has been the case in only a few instances (18%), representing three MSs.

• *Is there a need for improved methods, species etc.?* The majority of MSs (71%) are convinced that they would welcome additional guidance and action on this topic. Of those that recommended test species, *Myriophyllum spicatum* is the macrophyte most commonly referred to.

• *Endpoints for additional tests and any concerns over local species?* A range of views regarding endpoints was expressed from vegetative growth/ biomass measurements to measurements of photosynthetic activity and biochemical indicators. Few countries raise concern about country specific macrophytes.

Results: Literature Search

The information on macrophyte studies extracted from the literature search comprises a wide variety of different species, test methods and endpoints. In the reviewed papers more than 20 different test species were described. The most frequently tested species are summarised in the table below.

Macrophytes tested	Pesticide classes covered	Number of studies
Ceratophyllum demersum	Amides, aromatic acids, Phenoxy herbicides, Suflonylureas, Triazines, Triazinones, Ureas	9
Ceratophyllum submersum	Sulfonylureas, Triazines	2
Elodea canadensis	Amides, Aromatic fungicides, Pyridine herbicides, Sulfonylureas, Triazines, Triazinones	10
Hydrilla verticillata	Amides, Sulfonylureas, growth regulators	3
Myriophyllum aquaticum	Aromatic acids, Conazole fungicides, Drinitroanilines, Organophosphorus compounds, Phenoxy herbicides, Pyradizines, Sulfonylureas, Triazines, Ureas	18
Myriophyllum heterophyllum	Amides, Triazines, Triazinones	4
Myriophyllum spicatum	Amides, aromatic acids, growth regulators, Imidazolinones, Organophosphorus, Phenoxy herbicides, Pyridine fungicides, Pyridine herbicides, Sulfonylureas, Triazines, Triazinones, Ureas	20
Najas sp.	Amides, Triazines, Triazinones	4
Potamogeton crispus	Amides, Aromatic fungicides, Pyridine fungicides, Sulfonylureas, Triazines,	6
Ranunculus circinatus	Amides, Aromatic fungicides, Pyridine fungicides,	4
Sparganium emersum	Sulfonylureas, Triazines	2
Spirodela polyrrhiza	Aromatic acids, Phenoxy herbicides, Triazines, Ureas	4

Myriophyllum spicatum appears to be one of the most common species, probably due its suitability of being cultured in the lab. The reviewed studies included various different endpoints of which the most stated were growth, pigment content, photosynthetic activity and specific biochemical parameters. However, the interpretation of macrophyte studies is complicated by a very broad spectrum of tested species, test designs and endpoints. Macrophytes show a very wide variety in growth forms, bio-chemical pathways and morphological characteristics. In addition to the intraspecific variability macrophyte tests suffer from, this can result in interspecific variation in sensitivity to pesticide exposure.

Conclusions

• The current approach is considered by the majority to be inadequate to assess the impact of pesticides on non-target aquatic macrophytes.
• The majority of MSs and research institute responses indicate that effects data on additional species would improve aquatic risk assessments.
• There is considerable support for a workshop for regulatory experts and key researchers to debate the issue.

For further information on this project visit http://www2.defra.gov.uk/research/project_data/More.asp?I=PS2329.