The Relative Sensitivity of Macrophyte and Algal Species to Herbicides and Fungicides: An Analysis Using Species Sensitivity Distributions

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Overview of Project

• Objective: Evaluate the sensitivity of *Lemna* species, *Myriophyllum* species, and standard algal test species to herbicides and fungicides, relative to other macrophyte species.

• Approach:
  – Obtain, review, evaluate publications and reports on pesticide toxicity to macrophytes.
  – Compile macrophyte toxicity database.
  – Construct SSDs for chemicals with 6+ species.
  – Examine SSDs, quantify relative sensitivity of *Lemna, Myriophyllum*, and algae.
Variety of endpoints!

- **Plant part:** Shoot, root, leaf, whole plant
- **Measurement:**
  - Standing crop (biomass, shoot length, leaf area, frond number, chlorophyll, etc.)
  - Growth rate (change in standing crop over time)
  - Function (photosynthesis, transpiration, etc.)
- **Exposure duration:** < 1 day to 77 days
- **Statistical result:** EC50, EC10, NOEC...

Data selection was challenging. The analysis was based on lowest EC50 for each species, regardless of measurement endpoint.
SSD for Chemical F4

<table>
<thead>
<tr>
<th></th>
<th>Lemna gibba</th>
<th>Myriophyllum spicatum</th>
<th>Most sensitive algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction Affected</td>
<td>9.1%</td>
<td>36.4%</td>
<td>0.43%</td>
</tr>
<tr>
<td>EC50/HC5</td>
<td>1.5</td>
<td>5.3</td>
<td>0.3</td>
</tr>
<tr>
<td>EC50/lowest EC50</td>
<td>1.0</td>
<td>3.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>
SSD for Chemical B

<table>
<thead>
<tr>
<th>Algae</th>
<th>Fraction Affected</th>
<th>EC50/HC5</th>
<th>EC50/lowest EC50</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Lemna gibba</em></td>
<td>81.3%</td>
<td>90</td>
<td>54</td>
</tr>
<tr>
<td><em>Myriophyllum spicatum</em></td>
<td>12.5%</td>
<td>1.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Most sensitive algae</td>
<td>90.9%</td>
<td>261</td>
<td>155</td>
</tr>
</tbody>
</table>
Position of standard species on SSD

- Chemicals: F4, E4, F5, D1, C, E2, A, E3, B, E1, D2, F3, F1, F2
- Y-axis: Rank or Estimated Fraction Affected (%)
EC50 of standard species vs HC5

The graph shows the EC50/HC5 ratio for various chemicals labeled from E1 to F1. The ratios are indicated by green bars with labels such as A, L, M, and A,L,M. The no SSD (No Standard) ratio is the lowest among the chemicals tested.
EC50 of standard species vs most sensitive macrophyte
Conclusions

• While no single species consistently represents the most sensitive macrophyte species, the combination of *L. gibba* and the 4 FIFRA algae almost always includes a data point that is near or below the most sensitive macrophyte data point and the macrophyte HC5.

• For the exceptional chemicals for which the EC50s of *L. gibba* and the FIFRA algae are not near or below the most sensitive macrophyte EC50, *M. spicatum* is among the most sensitive species.
Next Steps

• Report has been submitted to EFSA for consideration.

• Report will be posted on CSI’s website (www.complianceservices.com).

• A manuscript will be submitted to IEAM early in 2012.

• Future: add more data as they become available, refine conclusions.