Evaluation of algaecides to eliminate *Phytophthora* spp. from naturally-infested streams in South Carolina

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Introduction/Problem

• Spread of \textit{P. ramorum} continues
  • Infested plant nurseries in SE -> risk of spread to forests

• Need mitigation strategies to prevent escape from infested nurseries—particularly in water

• Can registered algaecides be used as a mitigation strategy to treat waterways infested with species of \textit{Phytophthora}?

• Previous studies (G.C. Colburn):
  • \textit{K-Tea}^{	ext{TM}} [Cu(OH)\textsubscript{2}] & \textit{Captain}^{	ext{TM}} [CuCO\textsubscript{3}]
    • Zoospores: not detected 0.5-1 h after exposure
    • Sporangia: not detected 4 h after exposure
    • Chlamydomospores: not detected 8 h after exposure
Objectives

- Determine efficacy of four algaecides to propagules of *Phytophthora* in naturally-infested water
  - K-Tea – A.I. = copper hydroxide
  - Captain – A.I. = copper carbonate
  - Algimycin – A.I. = copper citrate
  - GreenClean Liquid – A.I. = hydrogen dioxide

- Seasonal temperature changes in water

- Seasonal variation in *Phytophthora* spp. present

- Lowest effective treatment application rate
Algaecides

• For use in slow moving or quiescent bodies of water—including:
  • Golf course, ornamental, fish, irrigation and fire ponds
  • Fresh water lakes and fish hatcheries;
  • Potable water reservoirs and associated waters (rivers, streams, bays and coves)
  • Crop and non-crop irrigation conveyance systems (canals, laterals and ditches)
Methods – Streams, Treatments

- 2 suburban streams:
  - Six Mile Creek, Seneca Creek
- Sampling months:
  - Six Mile Creek: Jan – Dec 2010
  - Seneca Creek: Feb – Dec 2010
- Treatments:
  - 5 treatments (@ highest label rate):
    - K-Tea 1 ppm Cu
    - Captain 0.8 ppm Cu
    - Algimycin 1 ppm Cu
    - GreenClean 25 ppm H₂O₂
    - Non-treated control
- Experimental units:
  - 15 20-L containers - 3 per algaecide
  - 10 L stream water per container
Methods - Rates

- Each algaecide tested at each stream
- 3 containers per rate
- Treatments:
  - **Copper-based algaecides:**
    - Non / Control
    - Low = 0.25x
    - Med = 0.5x
    - Maximum = x
  - **Hydrogen dioxide:**
    - Non / Control
    - Low = 0.04x
    - Med = 0.4x
    - Maximum = x
Methods - Filtering

- 3 – 200 ml aliquots water per container
- 0h, 2h, 4h, (8h) after treatment
- Millipore Durapore filters
  - 5 µm pores, 47 mm diam.
- Filters inverted onto PARPH-V8 selective medium
- 20°C for 3-7 d
- Count no. CFU/200 ml
Methods - Stream Locations
Results – Monthly Means by Stream Density of *Phytophthora* spp. & Temperature
Results: Six Mile Creek – March

CFU / 200 ml stream water

Treatment

Control | GreenClean | Algimycin | Captain | K-Tea

0 hours | 2 hours | 4 hours | 8 hours
Results: Seneca Creek – July

CFU / 200 ml stream water

<table>
<thead>
<tr>
<th>Treatment</th>
<th>0 hours</th>
<th>2 hours</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>18.0</td>
<td>12.0</td>
<td>10.0</td>
</tr>
<tr>
<td>GreenClean</td>
<td>22.0</td>
<td>13.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Algimycin</td>
<td>28.0</td>
<td>27.0</td>
<td>26.0</td>
</tr>
<tr>
<td>Captain</td>
<td>30.0</td>
<td>30.0</td>
<td>30.0</td>
</tr>
<tr>
<td>K-Tea</td>
<td>30.0</td>
<td>30.0</td>
<td>30.0</td>
</tr>
</tbody>
</table>
Results – Treatment Rates

CFU / 200 ml stream water

Application rate
Treatment

Con | Low | Med | High | Low | Med | High | Low | Med | High | Low | Med | High

Algimycin | Captain | K-Tea | GreenClean

0 hours | 2 hours | 4 hours
Conclusions

• Copper-based algaecides eliminated propagules of *Phytophthora* spp. from water throughout the year
  • Range of temperatures
  • *Phytophthora* spp. present – *P. cinnamomi, P. citricola, P. gonapodyides, & others*)
• Hydrogen-dioxide (GreenClean) not consistently effective at max label rate
• Rates:
  • Cu-based algaecides: lowest label rate effective
  • H$_2$O$_2$ algaecide: not effective
• Population density of *Phytophthora* spp. varied
  • Between the two streams
  • Among months in each stream
• Copper-based algaecides may be an effective management strategy for species of *Phytophthora* in infested waterways

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