Monoterpane emission of pine seedlings and mature trees subjected to different environmental and biological treatments

Inka Lusebrink, Maya Evenden, Nadir Erbilgin, Jeremiah Bolstad, Andrew Ho, Christina Elliott, Matt Ferguson, Adrianne Rice, Brad Jones, Boyd Mori, Chris MacQuarrie

✉ lusebrin@ualberta.ca
One-year old lodgepole and jack pine seedlings (N=84 per species) were randomly assigned to environmental and wounding treatments.
Environmental and Biological Treatments

- Water regime:
  - Water deficit
  - Well watered

- Treatments:
  - Control
  - Mechanical wounding
  - Wounding plus inoculation

- Volatile collection:
  - Compounds such as β-Phellandrene, α-Pinenes, Myrcene, Limonene, β-Pinenes, β-Cymene, α-Phellandrene, Terpinene, Tepinone, Camphene

[Diagram showing different treatments and volatile compounds]
GC analyses

Lodgepole pine

- sealing caps
- high purity glass wool
- sorbent layer
- glass tube
- glass wool separators
- backup sorbent layer
- precision sealed tip

Other compounds:
- alpha-Pinene
- beta-Pinene
- 3-Carene
- Myrcene
- Limonene
- gamma-Terpinene
- Terpinolene

Retention times:
- 4.45 min
- 4.58 min
- 5.97 min
- 6.34 min
- 6.58 min
- 6.62 min
- 7.81 min
- 8.56 min
- 9.55 min
- 10.67 min

pA
Jack Pine

- α-Pinene
- 3-Carene

Lodgepole pine

- β-Phellandrene
- Myrcene
Myrcene emission

lodgepole pine

no water

water

Jack pine

no water

water

Mean Myrcene (ng/μL)

Error Bars: +/- 1. SE
3-Carene emission

lodgepole pine

no water

water

jack pine

no water

water

Mean 3-Carene (ng/µL)

Error Bars: +/- 1. SE
Overall monoterpene emission

**lodgepole pine**

**jack pine**

**Mean total amount of VOCs (ng/µL)**

- **Water regime**
  - No water
  - Water

- **Treatment**
  - Control
  - Fungus
  - Wounded

*Error Bars: +/- 1. SE*
Field 2009
Water regime field experiment

3.65 m

4.27 m
Watering
Biological Treatments
VOCs collection in the field
Chemical profile

<table>
<thead>
<tr>
<th>Species</th>
<th>alpha-Pinene</th>
<th>beta-Pinene</th>
<th>Limonene</th>
<th>beta-Phellandrene</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lodgepole pine</td>
<td>5%</td>
<td>16%</td>
<td>6%</td>
<td>50%</td>
<td>Pureswaran et al. 2004</td>
</tr>
<tr>
<td></td>
<td>17%</td>
<td>35%</td>
<td>6%</td>
<td>30%</td>
<td>Jost et al. 2008</td>
</tr>
<tr>
<td>Jack pine</td>
<td>91%</td>
<td>7%</td>
<td>1%</td>
<td>&lt;1%</td>
<td>Jost et al. 2008</td>
</tr>
<tr>
<td>Hybrids</td>
<td>80%</td>
<td>10%</td>
<td>5%</td>
<td>1%</td>
<td>Jost et al. 2008</td>
</tr>
<tr>
<td></td>
<td>45%</td>
<td>9%</td>
<td>3%</td>
<td>16%</td>
<td>Our study</td>
</tr>
</tbody>
</table>
Mean amount of VOCs

Error Bars: +/- 1. SE
Phloem moisture

![Bar chart showing mean phloem moisture (%)

- t=0
- t=8 weeks
- Water regime: no water, water
- Treatment: control, fungus, MPB mash, wounding

Error Bars: +/- 1 SE
Beetle mash vs. fungal lesions

![Image of tree stump with fungal and MPB lesions]

**Graph:**
- **X-axis:** Lesion type (fungal, beetle mash, fungal)
- **Y-axis:** Mean lesion length (cm)
- **Bars:** Representing different water regimes (no water, water)
- **Error Bars:** +/- 1 SD

**Legend:**
- Green: no water
- Blue: water
Outlook

Bolts were inoculated with 4 pairs of MPB per bolt

The offspring of these beetles will be used in beetle condition studies (size, fat content, dispersal capability)
Outlook

The field experiment in summer 2010 should be conducted on pure pine species stands (lodgepole pine or/and jack pine)

Biological treatments:
  only control and fungal inoculation

Environmental treatments:
  water deficit, ambient and well watered