Update on ambrosia beetle biology and potential applications for management

Monique Rivera, Lukasz Stelinski, Xavier Martini, and Kirsten Pelz-Stelinski

University of Florida, Entomology and Nematology
Recent research topics

- Flight capacity of ambrosia beetles
- Transmission of the pathogen by the vectors
- Use of repellents and attractants against ambrosia beetles for management
The ambrosia symbiosis is specific in some species and promiscuous in others.

Figure 1: Digital cross-sections of *Xyleborus ferrugineus* and *Xylosandrus crassiusculus* showing the two different types of mycangia, mandibular and mesonotal, respectively.

Kostovcik, Bateman, Kolarik, Stelinski, Jordal, Hulcr, 2014
Investigating the flight capability of the Redbay ambrosia beetle
Flight capacity of *Xyleborus glabratus*

Distribution of distance covered by *Xyleborus glabratus* during 2 h of recorded flight (n=60)
**Monarthrum mali**

Wood boring insects
Widespread in eastern North America

*Monarthrum mali 24 hr. flight mill*

<table>
<thead>
<tr>
<th>Total flight distance (m)</th>
<th>Percentage of beetles (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>5</td>
</tr>
<tr>
<td>10-50</td>
<td>30</td>
</tr>
<tr>
<td>50-100</td>
<td>15</td>
</tr>
<tr>
<td>100-200</td>
<td>20</td>
</tr>
<tr>
<td>200-500</td>
<td>25</td>
</tr>
<tr>
<td>500-700</td>
<td>10</td>
</tr>
<tr>
<td>700-1,000</td>
<td>5</td>
</tr>
<tr>
<td>&lt;1,000</td>
<td>0</td>
</tr>
</tbody>
</table>
Various species investigated have similar flight capabilities and behaviors.
$R.\ lauricola$ transmission

• Propagative mechanical transmission

• Possible factors affecting transmission:
  – Background fungal community in beetle mycangia may facilitate or inhibit transmission
  – Beetle species
  – $R.\ lauricola$ titer in mycangia

• Disruption of fungal communities may alter transmissibility of $R.\ lauricola$
Identify fungal symbionts that reduce transmission of *R. lauricola*

Cross section of beetle head:

Myccangia

- fungal symbiont 1
- *R. lauricola*

---

**Practical Outcome**: Identification of specific combinations of symbiont communities that PREVENT efficient inoculation of *R. lauricola* for each ambrosia beetle species.
CHEMICAL ECOLOGY

1. Identification of new attractants for *Xyleborus* sp.
   1. Fungal symbiont-based attractants (Part 1)
   2. Host plant-based attractants (Part 2)

2. Development of synthetic lure attracts for Ambrosia beetles

3. Effects of host odors on gallery formation by ambrosia beetles
Fungal symbiont odors
Synthetic Raffaelea Blend (by volume)

36.5 parts ethyl acetate
29 parts ethanol
22 parts isoamyl alcohol
12.5 parts isoamyl acetate

1 mL of blend in polyethylene BEEM vial
Prototype Lure Designs by Alpha Scents

Lure A
Lure B
Lure C
Lure D

www.alphascents.com
FIELD TRAPPING METHODS

½ Elm beetle sticky traps on 6’ stakes.

5-6 Replicates for each lure.

>20’ between traps.

*X. glabratus* counted for 2 weeks.

Non-target Scolytinae also counted.
X. glabratus was abundant at Wekiwa Springs State Park.

Manuka lures work fairly well for locations like this.
More *X. glabratus* caught on Raffaelea odors when paired with manuka.
1. Odors of *Raffaelea lauricola* synergize with manuka lures for increased trap capture of *X. glabratus*.

2. Constituents of *R. lauricola* odor are cheap and smell like banana.

3. Formulations can be very long lasting; however, they outlast manuka lures.

4. Therefore, Raffaelea lures should be combined with a longer lasting attractant than the current commercial manuka lures.
Host odors

Redbay wood odors
ODOR ANALYSIS

1. Cut branches from redbay and three avocado varieties:
   1. Peterson
   2. Lula
   3. Booth

2. 1.5” wood disks were cut from replicated samples and placed in glass beaker with tin foil lid

3. Odors adsorbed with solid-phase microextraction (SPME). Analysis/ID- GC-MS
Presence of eucalyptol is correlated with capture of *X. glabratus*.
α-copaene mimic used for medfly.
Raffaelea; rather than Redbay, odors drive beetle boring
Host odors—wood volatiles

1. Beetles are attracted to eucalyptol

2. Removal of eucalyptol decreases attraction considerably

3. Eucalyptol is not abundant in the avocado varieties tested.
   - This may explain why avocado is not preferred compared with redbay
   - Potential predictor of susceptibility
   - May be important to examine eucalyptol content in resistant/tolerant plants/varieties

Boring behavior appears to be affected by the presence of Raffaelea rather than Redbay odors.
Applications

SPLAT® with high concentration of Methyl salicylate to apply directly on the trunk of redbay trees
Trap Design:

A) healthy redbay bolt (*attractant*), B) SPLAT repellent, C) sticky cards (on bolt front and back) and D) metal support pole.
Results
It actually works in the field!
Results

It actually works in the field!
Results

It actually works in the field!

Verbenone pricing is $523 per Kg

MeSA pricing is $85 per Kg

42% Saving! (for a 50%/50% MeSA Verb vs 100% verb formulation)