Protecting individual pines from bark beetles: systemic insecticides & semiochemicals

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Treatments that consistently protect individual high value pine trees from bark beetles are currently limited to insecticides sprayed onto tree boles; however, situations exist where this application method is not possible.

- rust resistant sugar pines
- high elevation pines like whitebark or foxtail
To increase treatment options available to land managers, we are evaluating semiochemicals and systemic insecticides for effectiveness in single tree protection against bark beetles.
Louisiana:

Stem-injected emamectin benzoate (EB) is being evaluated in laboratory bioassays with pine bolts to determine its effects, movement patterns, effective dosages and durability in loblolly pine against the southern pine beetle.

California:

Stem-injected EB is being tested as a tree protectant against mountain pine beetle in sugar and western white pines. We are also assessing the ability of semiochemicals to inhibit Jeffrey pine beetle response to baited traps.
Emamectin benzoate (EB)

EB is touted as an effective prophylactic treatment of pines against bark beetles. Data gathered in the western U.S. have not supported this claim; however, the lack of residual chemistry data causes some difficulties in interpretation.

- Submitted for EPA registration as TREE-äge™.
- Active ingredient: emamectin benzoate which is a glycoside insecticide.
- “Warning” label.
- Primary route of toxicity is through ingestion, but may also have some contact toxicity.
- Formulated to translocate in the tree’s vascular system when injected.
TREE-äge™ appears to be effective against both larval and adult stages of Emerald Ash Borer.

- being evaluated in Hawaii against erythrina gall wasp.
- being evaluated in the south against seed and cone insects
- will evaluate in 2009 against GSOF in So Cal with Tom
Evaluations (bioassays) were completed using the southern pine beetle and a small-bolt laboratory assay, which exposed 75 beetles to individual bolts (11 cm long) in polystyrene containers for 48 hours.

Southern pine beetle produced significantly shorter galleries in EB treated bolts, particularly in the highest dosage treatment.
<table>
<thead>
<tr>
<th>Location</th>
<th>Species</th>
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<th>Treatment period</th>
<th>Evaluate</th>
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<tr>
<td>Tahoe NF</td>
<td>Sugar pine</td>
<td>30</td>
<td>Spring 2007</td>
<td>Summer 2008</td>
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<tr>
<td>Tahoe NF</td>
<td>Sugar pine</td>
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<td>Modoc NF</td>
<td>Western white pine</td>
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EB injection treatments using ARBORjet Tree I.V.
EB injection treatments using ARBORjet Tree I.V.
Challenge by mountain pine beetle was promoted by attaching attractive lures to tree boles at breast height. Treatments are being evaluated by a combination of biological and chemical assays.

Trees will be checked for pitch tubes, crown fading and ultimately, mortality. Amount of gallery formation and adult emergence will also be determined. In addition, phloem tissue was collected from injected trees for chemical analysis.
California

Injected tree evaluations

- **Spring-injected 2007, sugar pines:** none of the treated trees died; 4 control trees died. Control tree mortality was insufficient to meet the treatment evaluation standard.

- **Fall-injected 2007, sugar pines:** trees were baited 31 July through 10 October 2008. As of October 10, most trees have high numbers of MPB attacks. Several trees sustained fire injuries in 2008. Tree status will be evaluated again in 2009.

- **Fall-injected 2007, western white pines:** trees were baited from 1 July through 4 Sept. 2008. As of October, all of the control trees and all but two of the injected trees have high numbers of MPB attacks. Tree status will be evaluated again in 2009.
Both trees are heavily attacked by mountain pine beetle: treated tree will likely die due to numerous attacks, however, there is a difference in degree of fading between treated and untreated trees. May indicate some level of toxicity of EB to mountain pine beetle.

Higher doses of EB may be effective and a new study may be initiated in 2009 after we have determined EB residue levels in the phloem.
Disruptant Semiochemicals

- have been used for decades to manipulate the behavior of a wide range of bark beetle species.

- Verbenone has been used to aid in the management of many western bark beetle species.

- More recently there have been additions from a class of chemicals known as green leaf or non-host volatiles.

- There is some evidence that these compounds synergize with verbenone to improve disruption effects toward bark beetles.

- Large reductions in the number of beetles caught in traps might indicate that the application of disruptant semiochemicals to individual Jeffrey pine trees could be a useful management tool for tree protection.
Jeffrey pine beetle
verbenone/ GLVs
2007

- Location: Luther Pass (LTBMU and Toiyabe NF), elevation 7,735 ft.
- Trapping period: 19 July 07 - 16 Aug 07
- Replicates: 12 / treatment
- Traps - 12 unit funnel
- Collections: weekly

Photo by Erich Vallery
Treatments

- Blend of 95% n-heptane and 5% 1-heptanol in 250 ml bottle with hole drilled in cap (no wick).

- Blend of 95% n-heptane and 5% 1-heptanol in bottle, with verbenone (Synergy) and GLV (Synergy).
- **verbenone**: disruptant pheromone that is an oxidized terpene; important in the chemical communication system of several economically important bark beetle species.

- **green leaf volatiles (GLV, Synergy Semiochemicals Corp.):** 1:1 mix of Z-3-hexenol (aka cis-3-hexenol, or leaf alcohol) and 1-hexanol.
Jeffrey Pine Beetle 2007
Luther Pass, CA

Total JPB caught = 1,024

Mean Catch (JPB / trap)

Lure

Lure + Verbenone + GLV

~ 80% reduction in trap catch
Jeffrey pine beetle
Verbenone/ GLV/ Frontalin
2008

- Location: Luther Pass (LTBMU and Toiyabe NF), elevation 7,735 ft.
- Trapping period: 24 June 08 – 6 Aug 08
- Replicates: 5 / treatment
- Traps - 12 unit funnel
- Collections: weekly
Treatments

- Blend of 95% n-heptane and 5% 1-heptanol in 250 ml bottle with hole drilled in cap (no wick)

- Blend of 95% n-heptane and 5% 1-heptanol in bottle, with verbenone (Synergy), glv (Synergy) and frontal in (Synergy).
2008 treatments added frontalin

frontalin: a Jeffrey pine beetle (and other Scolytids) pheromone component produced by males (Paine et al. 1999; Hall et al. 2002); Paine reported inhibition of female J PBs to traps baited with frontalin
Only first two weeks of collection counted and displayed in graph.

Jeffrey Pine Beetle 2008
Luther Pass, CA

Total JPB caught = 1,744

~ 60% reduction in trap catch for verbenone and GLV; the addition of frontalin to the disruptant blend reduces trap catch to nearly zero.
2009

we plan to test the disruptant combination of verbenone, green leaf volatiles and frontalain for protection of individual Jeffrey pine trees.
Thanks

Tree injections:

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Semiochemical work:

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Danny Cluck for presenting.