Case Study:
Battling the Polyphagous Shot Hole Borer

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Street Tree Seminar
Pomona, CA
Known distribution of Fusarium dieback/ Polyphagous shot hole borer in southern California 12/17/2012

Data source: Eskalen lab., Dept. of Plant Pathology and Microbiology, University of California, Riverside. www.eskalenlab.ucr.edu
Control Options

Cultural / Sanitation -
Tree removal, branch pruning, chipping, wound painting, solarization, restrict firewood movement

Biological - Native shift or introduction of natural enemies, biocontrol of fungal symbionts

Trapping/Pheromones (attractants/repellents) -
Nothing available at this time

Chemical -
Contact sprays create barrier (bifenthrin)
Systemics - soil injection/drench, trunk injection
Potential Advantages of Systemic Insecticide/Fungicide Injections

- Reduce potential pesticide load in area
- No need for bucket trucks to treat large trees
- Little or no worker exposure
- No drift or nontarget effects
- No leaching into ground water
- Longer treatment duration (2 or more years)
- Wider treatment window - better time management
- No impact from wind and rain - better results
## Systemic Pesticide Projects ('97-'13)

### Conifer Insect/Disease
- Pine Seed Orchards (12)
- Bark Beetles (16)
  - Ips (EB, Aba, Fip)
  - WPB (EB)
  - SPB (EB + P; Allee Effect *)
  - MPB (EB, Aba)
  - BTB (EB rate and inj height *)
  - SB (EB timing and spacing) **
- Chalcid Wasp on Afghan Pine (1)
- Leaf Beetle on Athel (1)
- Pine Tip Moth (1)*
- Conifer Mites (1)*
- Pinewood Nematode (1)**

### Hardwood Insect/Disease
- Oak Pests (3)
- Soapberry Borer on Western Soapberry (2)
- WTB/TCD (2)*
- Polyphagous Shot Hole Borer/Fusarium sp. (1)**

### Injection System Evaluation
- Oak Wilt (1)*
- Hypoxylon Canker (1)*

* Current trial; ** planned trial
Registered Systemic Insecticides

- **Abamectin** *(Abicide 2, Greyhound, Vivid)*
- **Acephate** *(ACECAP 97, ACE-jet, Dendrex, Lepitect)*
- **Azadirachtin** *(AzaSol, TreeAzin)*
- **Bidrin** *(Inject-a-cide B*)
- **Chlorantraniliprole** *(Acelopryn)*
- **Dinotefuran** *(Transtect, Safari)*
- **Emamectin benzoate** *(TREE-äge*)
- **Fipronil** *(PTM)*
- **Imidacloprid** *(IMA-jet, Imicide, Pointer, Xytect)*
- **Metasystox-R** *(Inject-a-cide, Harpoon)*
- **Thiamethoxam** *(Actara)*

* Restricted Use Product
TREE-äge® is Approved Against Many Difficult Tree Pests

- Pine Wood Nematode
- Pine Coneworm
- Bagworm
- Fall Webworm
- Tent Caterpillars
- Clearwing Borers
- Leafminers
- Oakworm Caterpillar

Hymenoptera
- Sawfly (elm, pine)

Lepidoptera

Coleoptera
- Emerald Ash Borer
- Bronze Birch Borer
- Longhorned Borers
- Bark Beetles (SPB, Ips, etc)

Hemiptera
- Pine Seed Bug
- Plant Bugs
- Pine Needle Scale

Mites
- Mites (red palm, conifer)
Systemic Injection for Bark Beetles: 2004 - 2012

Objective

- Evaluate and register alternative to bole sprays for protection of trees against bark beetles in seed orchards and residential sites.
Methodology

- Treatments:
  1) EB @ 0.2-0.4g/" DBH
  2) Fipronil @ 0.2-0.4g/" DBH
  3) Untreated check

- Applied to 35 loblolly pine trees in areas with recent beetle activity, spaced >100 m apart, and 23-52 cm DBH. Used Arborjet’s Tree IV system.
**Methodology**

- Study trees baited with frontalin, alpha-pinene and endo-brevicomin for two 6 week periods.

- Only criteria used to determine efficacy of insecticide treatment was whether or not individual trees succumb to attack by SPB (Shea et al 1984).

Pct. Tree Mortality

- Untreated
- Fipronil
- Emamectin

CY 2006:
- Untreated: 24/35
- Fipronil: 12/35
- Emamectin: 7/35

CY 2007:
- Untreated: 26/30
- Fipronil: 11/28
- Emamectin: 10/22

CY 2008:
- Untreated: 3/18
- Fipronil: 3/12
- Emamectin: 1/17

Cumulative:
- Untreated: 53/68
- Fipronil: 25/34
- Emamectin: 19/35
SPB Methodology

- **Treatments:**
  1) EB @ 0.4g/” DBH
  2) Thiabendazole + Propiconazole (1:1)
  3) EB + T + P (2:1:1)
  4) Untreated check

- Applied in April 2009 to 30 loblolly pine trees in areas with recent beetle activity, spaced >10m from other host trees, and 23-52 cm DBH. Used Arborjet’s Tree IV system.

Effect of injection treatments on mortality of loblolly pine by southern pine beetle; Talladega N.F., AL: 2009 - 2012

Untrt = Untreated Control, EB = Emamectin benzoate, PT = Propiconazole + Thiabendazole
Insect/Disease Management Focus Should Be Based on Fungal Virulence

- Fungicide
- Insecticide

SPB MPB TCD PSHB
LWD
Inhibition of *Fusarium* sp. nov *in vitro*

Growth of three *Fusarium* inoculates were evaluated in the presence of 23 different fungicides and 8 insecticides at 10 ppm.

Freeman et al. 2012. *Screening for inhibition of the fungal symbiont Fusarium* sp. nov. in *Israel*. Invasive Ambrosia Beetle Conference.
Inhibition of *Fusarium* sp. nov *in vitro*

Based on Freeman et al. 2012. *Screening for inhibition of the fungal symbiont Fusarium sp.nov. in Israel*. Invasive Ambrosia Beetle Conference.
Inhibition of *Fusarium* sp. nov *in vitro*

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PSHB/Fusarium Trial #1 - 2013

- **Justification:** Polyphagous shot hole borer (PSHB) was recently discovered in So. CA attacking 200+ tree species. Systemic insecticides and fungicides may be effective against the PSHB and *Fusarium* associated fungi, respectively.

- **Objective:** Evaluate the efficacy of emamectin benzoate (TREE-äge™) alone or combined with one of two fungicides for protecting individual trees from attack by PSHB.

- **Treatments:**
  - Emamectin benzoate (EB)
  - EB + Propiconazole (P)
  - EB + Thiabendazole (TH)
  - Untreated control
Positive finding *Fusarium* sp./Polyphagous Shot Hole Borer

Negative-*Fusarium* sp./Polyphagous Shot Hole Borer

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Research Parameters

Tree Species: coastal live oak, sweetgum, Japanese maple

Chemical: emamectin benzoate (EB, TREE-age™ with 4% EB), propiconazole (P, Alamo™ with 14.3% P), or thiabendazole (TH, 26.6% TH)

Rates: EB = 5 ml per inch DBH; P and TH = 6 ml per inch DBH

Injection spacing: DBH/1.25 (~1 pt every 4” circ).

Treatment Time: January 2013.

Health Condition: Healthy: (no PSHB infestation of Fusarium infection at Descanso Garden) or Light - Moderate: (PSHB infestation and Fusarium infection at Huntington Garden)
**Objective:**
1) Evaluate the efficacy and duration of several pesticide treatments for protecting individual trees from attack by PSHB.
2) Determine attack threshold for therapeutic treatments.

**Treatments:**
- Emamectin benzoate (trunk injection).
- Bifenthrin (bole spray)
- Imidacloprid (soil injection)
- Dinotefuran (trunk spray)
- Untreated control
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Questions?