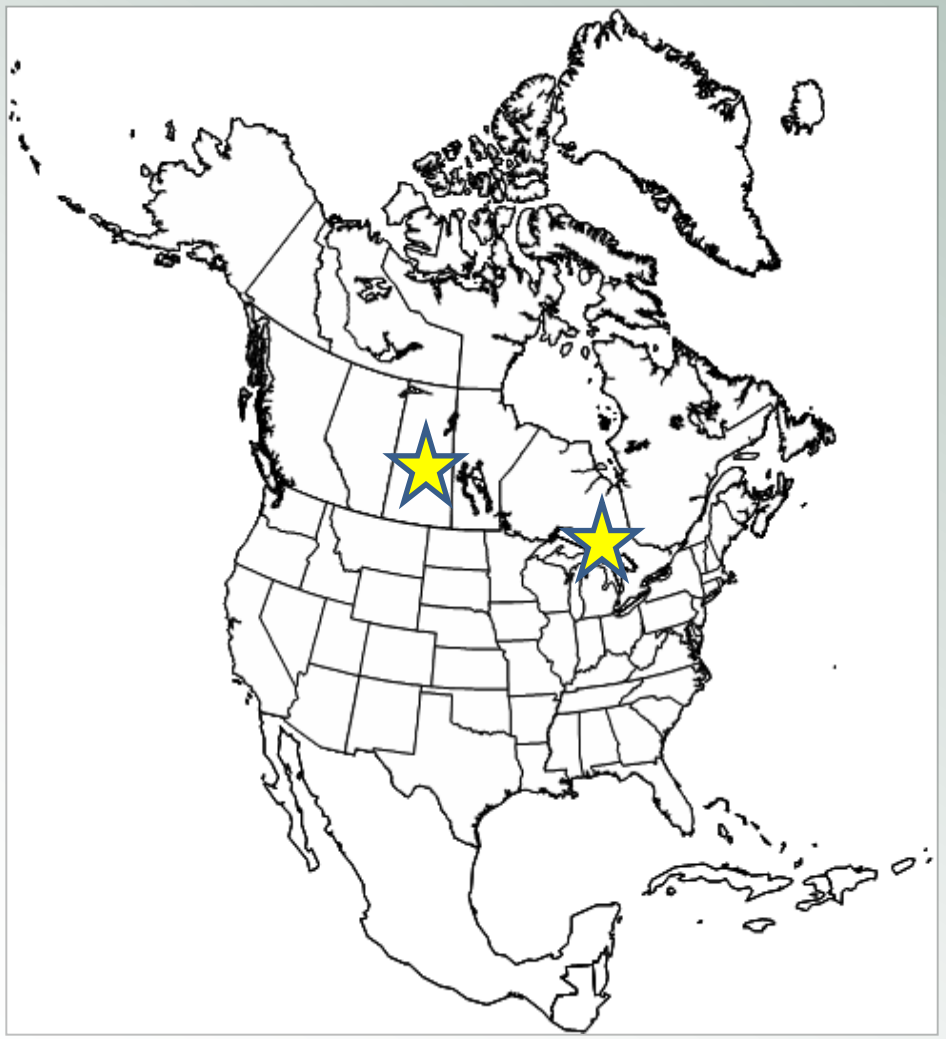
Emerald Ash Borer and TreeAzin® Systemic Insecticide

Paul Bolan

BioForest Technologies Inc.

BioForest Office Locations



Head Office - Sault Ste. Marie, ON

Regional Office – Prince Albert, SK

Staff – 11 SSM, 2 PA

Who is BioForest?

- Born in 1995 from Canadian Forest Service downsizing
- BioForest principals (Joe Meating & Paul Bolan) were members of the Forest Insect & Disease Survey Unit – Canadian Forest Service

Expertise:

- Commercial & Urban forest surveys
- Commercial & Urban forest pest management
- Tree care product development & distribution - 2008-14

  TreeAzin®

  Arbotect 20-S

  EcoJect System®

Emerald Ash Borer

Management Options:

1. **Treat all ash trees with an insecticide(s)**
2. **Let EAB kill all the ash trees**
3. **Treat high value ash trees that provide significant benefit, remove low quality ash trees and replant non-ash species**

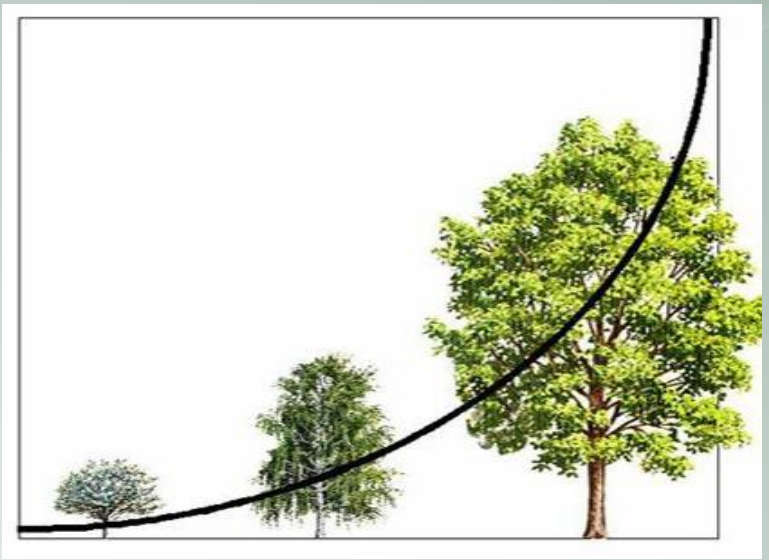
This is not an option

Emerald Ash Borer

Why Treat?

Benefits of Trees:

- **Air quality**
- **Carbon sinks**
- **Rainwater interception**
- **Energy conservation**
- **Aesthetics**
- **Property values**
- **Environmental/ecological benefits**



Dr. A. Kenney

Emerald Ash Borer

Insecticides Registered in Canada

- AceCap® 97 - Acephate
- Confidor® 200SL - Imidacloprid
- TreeAzin® - Azadirachtin

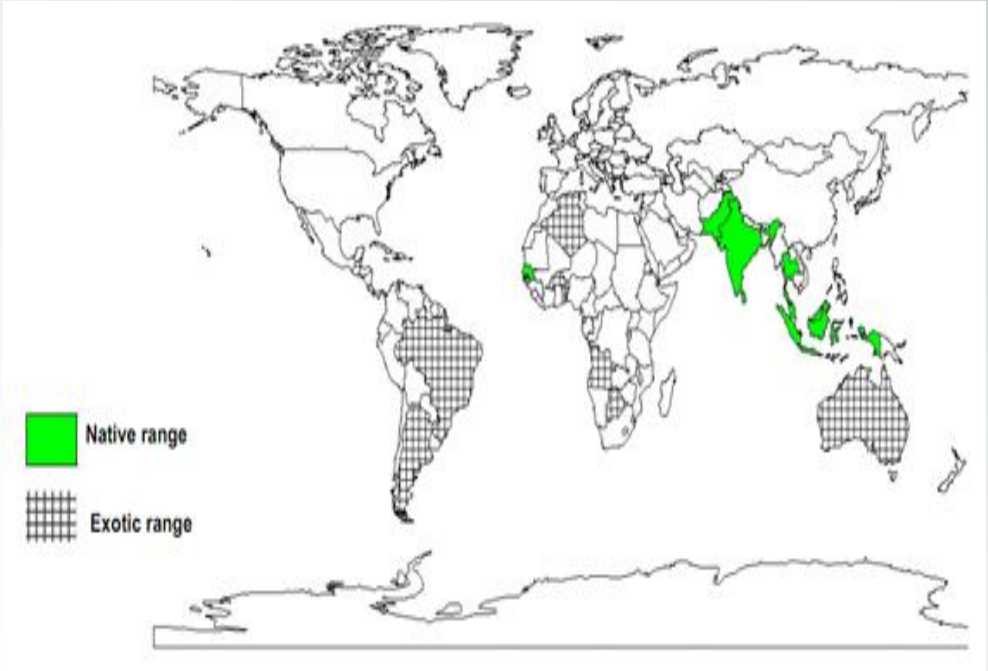
TreeAzin®

- 5% Azadirachtin systemic formulation
- For deciduous and coniferous species
- Intellectual property of Canadian Forest Service
- Developed in collaboration with BioForest (worldwide license holder)

TREEAZIN® SYSTEMIC INSECTICIDE

Azadirachtin

- Extract from Neem tree seed kernels
- Toxic to a wide range of insect pests
- Very low mammalian and bird toxicity



Modes of Action

- **Immature stages:**
  - **Interrupts growth and development (IGR)**
- **Mature stages:**
  - **Reduced fecundity & egg viability**

TreeAzin® Efficacy

- **"Given the inhibition of larval development, reduction of adult emergence, and the occurrence of foliar residues at biologically active concentrations, we conclude that azadirachtin is effective in protecting ash trees from EAB"**

FOREST ENTOMOLOGY

Azadirachtin: An Effective Systemic Insecticide for Control of *Agrilus planipennis* (Coleoptera: Buprestidae)

NICOLE McKENZIE,[1,2] BLAIR HELSON,[3] DEAN THOMPSON,[3] GARD OTIS,[1] JOHN McFARLANE,[3] TERESA BUSCARINI,[3] AND JOE MEATING[4]

J. Econ. Entomol. 103(3): 708–717 (2010); DOI: 10.1603/EC09305

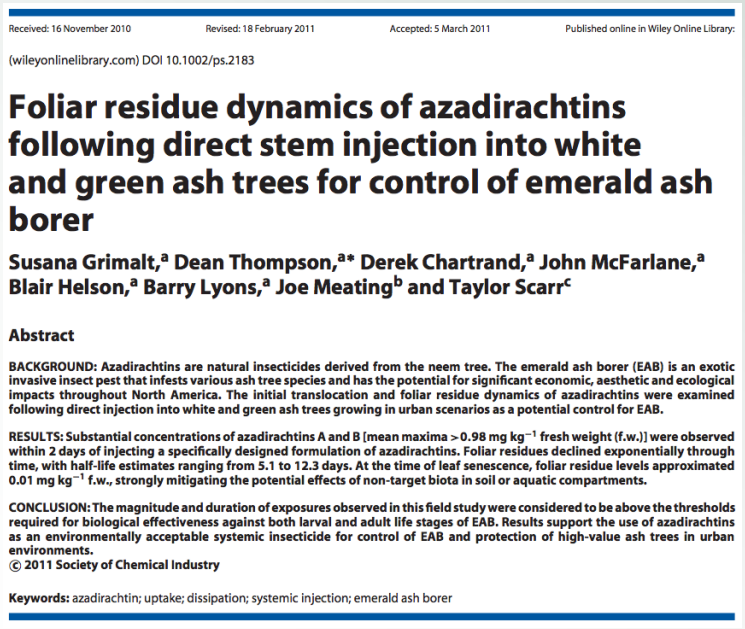
ABSTRACT The emerald ash borer, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae), an invasive pest discovered in North America in 2002, is now well established and threatens ash (*Fraxinus* spp.) trees throughout the continent. Experiments were conducted to 1) examine the efficacy of an alternative natural pesticide, azadirachtin, to control emerald ash borer, and 2) determine foliar uptake and dissipation patterns after systemic injections of azadirachtin into trunks of small (2.2 cm diameter at breast height [dbh]), uninfested green ash trees. We found no evidence of mortality of adult beetles. In contrast, fewer larvae completed their development at dose levels ≥1.7 mg (AI)/cm dbh and development ceased beyond the second instar at dose levels ≥13.6 mg (AI)/cm dbh. Substantial concentrations (11.2 μg/g dry mass [SD = 7.55]) of azadirachtin were present in leaves within 7 d of treatment. After rapid initial uptake, concentrations in leaves declined logarithmically during the 55 d after injection. A similar pattern was observed in a separate experiment that examined the uptake and translocation of azadirachtin in larger green ash trees (22 cm dbh) treated with 250 mg (AI)/cm dbh with the EcoJect injection system. In another experiment, recently infested plantation green ash trees treated with doses ≥40 mg (AI)/cm dbh had significant reductions in adult emergence ≈1 yr postinjection. Given the inhibition of larval development, reduction of adult emergence, and the occurrence of foliar residues at biologically active concentrations, we conclude that azadirachtin is effective in protecting ash trees from emerald ash borer.

McKenzie *et all.* 2010.

Entomological Society of America

TreeAzin® Uptake and Translocation

- Rapid uptake and translocation within 48 hrs
- Essentially complete dissipation of foliar residues prior to leaf fall
- No quantifiable levels in next year's foliage



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Foliar residue dynamics of azadirachtins following direct stem injection into white and green ash trees for control of emerald ash borer

Susana Grimalt,[a] Dean Thompson,[a]* Derek Chartrand,[a] John McFarlane,[a] Blair Helson,[a] Barry Lyons,[a] Joe Meating[b] and Taylor Scarr[c]

Abstract

BACKGROUND: Azadirachtins are natural insecticides derived from the neem tree. The emerald ash borer (EAB) is an exotic invasive insect pest that infests various ash tree species and has the potential for significant economic, aesthetic and ecological impacts throughout North America. The initial translocation and foliar residue dynamics of azadirachtins were examined following direct injection into white and green ash trees growing in urban scenarios as a potential control for EAB.

RESULTS: Substantial concentrations of azadirachtins A and B [mean maxima > 0.98 mg kg^{-1} fresh weight (f.w.)] were observed within 2 days of injecting a specifically designed formulation of azadirachtins. Foliar residues declined exponentially through time, with half-life estimates ranging from 5.1 to 12.3 days. At the time of leaf senescence, foliar residue levels approximated 0.01 mg kg^{-1} f.w., strongly mitigating the potential effects of non-target biota in soil or aquatic compartments.

CONCLUSION: The magnitude and duration of exposures observed in this field study were considered to be above the thresholds required for biological effectiveness against both larval and adult life stages of EAB. Results support the use of azadirachtins as an environmentally acceptable systemic insecticide for control of EAB and protection of high-value ash trees in urban environments.

Keywords: azadirachtin; uptake; dissipation; systemic injection; emerald ash borer

Grimalt *et al.* 2011.
Pest Management Science

TreeAzin® Environmental Impacts

- **"foliar concentrations in senescent leaf material are likely to pose little risk of harm to decomposer invertebrates"**

Contents lists available at ScienceDirect

Ecotoxicology and Environmental Safety

journal homepage: www.elsevier.com/locate/ecoenv

Environmental safety to decomposer invertebrates of azadirachtin (neem) as a systemic insecticide in trees to control emerald ash borer

David Kreutzweiser [a,*], Dean Thompson [a], Susana Grimalt [a], Derek Chartrand [a], Kevin Good [a], Taylor Scarr [b]

[a] Canadian Forest Service, Natural Resources Canada, 1219 Queen St. East, Sault Ste. Marie, Ontario, Canada P6A 2E5
[b] Ontario Ministry of Natural Resources, Forest Resources Group, Suite 400, 70 Foster Drive, Sault Ste. Marie, Ontario, Canada P6A 6V5

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ABSTRACT

The non-target effects of an azadirachtin-based systemic insecticide used for control of wood-boring insect pests in trees were assessed on litter-dwelling earthworms, leaf-shredding aquatic insects, and microbial communities in terrestrial and aquatic microcosms. The insecticide was injected into the trunks of ash trees at a rate of 0.2 g azadirachtin cm^{-1} tree diameter in early summer. At the time of senescence, foliar concentrations in most (65%) leaves where at or below detection (< 0.01 mg kg^{-1} total azadirachtin) and the average concentration among leaves overall at senescence was 0.19 mg kg^{-1}. Leaves from the azadirachtin-treated trees at senescence were added to microcosms and responses by test organisms were compared to those in microcosms containing leaves from non-treated ash trees (controls). No significant reductions were detected among earthworm survival, leaf consumption rates, growth rates, or cocoon production, aquatic insect survival and leaf consumption rates, and among terrestrial and aquatic microbial decomposition of leaf material in comparison to controls. In a further set of microcosm tests containing leaves from intentional high-dose trees, the only significant, adverse effect detected was a reduction in microbial decomposition of leaf material, and only at the highest test concentration (~ 6 mg kg^{-1}). Results indicated no significant adverse effects on litter-dwelling earthworms or leaf-shredding aquatic insects at concentrations up to at least 30 × the expected field concentrations at operational rates, and at 6 × expected field concentrations for adverse effects on microbial decomposition. We conclude that when azadirachtin is used as a systemic insecticide in trees for control of insect pests such as the invasive wood-boring beetle, emerald ash borer, resultant foliar concentrations in senescent leaf material are likely to pose little risk of harm to decomposer invertebrates.

TreeAzin is NOT persistent in the environment

Leaves from TreeAzin treated trees can be composted and used in gardens

Kreutzweiser et al. 2011.
Ecotoxicology and Environmental Safety

TreeAzin® Toxicity

Skin Sensitization	Not a dermal sensitizer of male Guinea pigs following repeated exposures
Acute Oral Toxicity	Single oral dose in male and female rats **LD50 > 2000 mg/kg**
Acute Nose Inhalation	4-hour acute inhalation in male and female rats **LC50 > 2.070 mg/L**
Acute Dermal Irritation	No dermal irritation following a single application in rabbits
Acute Dermal Toxicity	In male and female rabbits **LD50 >2000 mg/kg**

Labeled Insect Pests

Pest	Application Rate
Emerald Ash Borer	2-5 mL /cm DBH
Gypsy Moth Tent Caterpillars Spruce Budworm Jack Pine Budworm Cedar Leafminers	3 mL /cm DBH
Sawfiles: including Birch Leafminer and Pine False Webworm	2 mL /cm DBH

US TreeAzin® Research

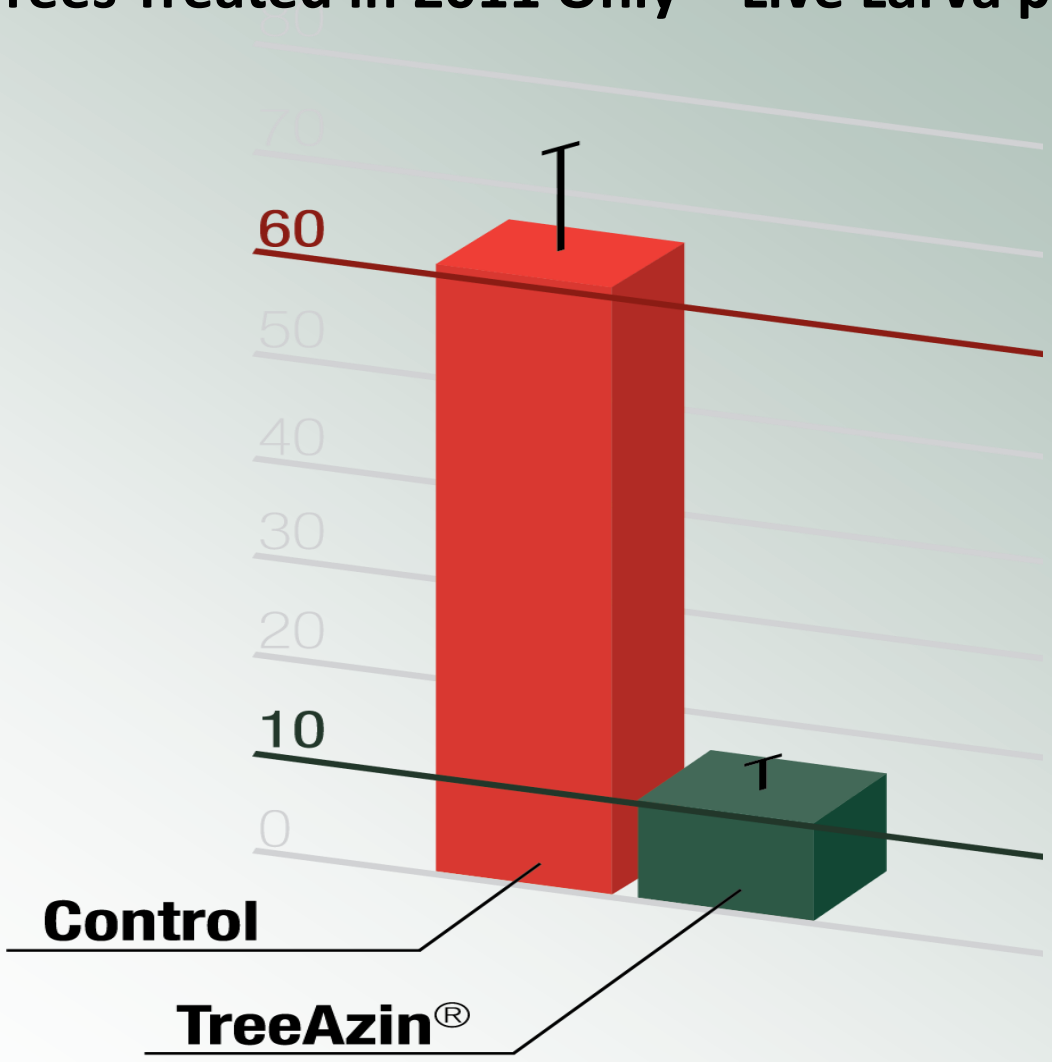
- Michigan State University – 2011 - EAB – Dr. Deb McCullough
- Ohio State University – 2012 - EAB – Dr. Dan Herms
- University of Minnesota - 2013 – EAB - Dr. Brian Aukema
- University of Massachusetts - 2009 – Hemlock Woolly Adelgid – Dr. David Mausel
- Virginia Technical University – 2010 - Hemlock Woolly Adelgid – Dr. Scott Salom

MSU Study of 2-Year Control 2011-2013

- Trial Location – East Lansing, MI
- 3 forested sites; 8 blocks per site; 5 ash trees per block
- Total of 24 blocks (120 trees), DBH - 5 to 13 inches
- 4 treatments (TreeAzin, Safari, Treeage & Azazol) plus control trees
- All trees treated in 2011 (24 trees per treatment)
- 12 blocks re-treated in 2012 (12 trees per treatment)
- All trees felled in winter 2012-2013 & debarked from the base to the upper canopy to determine larval density

MSU Study of 2-Year Control 2011-2013

Trees Treated in 2011 Only – Live Larva per m2



MSU Study of 2-Year Control 2011-2013

“There was an average of 10-12 larvae per m^2 in the 2012 winter on TreeAzin trees treated only in 2011. That’s pretty low – you would not see canopies declining on trees with that density of larvae”

“On TreeAzin trees treated in both 2011 and 2012, there were nearly no live larvae.”

Dr. Deb McCullough – Michigan State University

MSU Study of 2-Year Control 2011-2013

“TreeAzin reduced production of fertile eggs & egg hatch. Effects most pronounced when trees treated in 2011 & 2012”

Average egg hatch rates in 2012:

- **Controls – 67%**
- **TreeAzin 2011 – 34%**
- **TreeAzin 2011 + 2012 – 9%**

Emerald Ash Borer

“TreeAzin has been approved by EPA to provide up to 2 years control of EAB”

Emerald Ash Borer

0%

10%

20%

30%

40%

50%

60%

70%

80%

90%

100%

When treating any tree with
≥30% canopy thinning and/or dieback
tree condition may compromise treatment effectiveness

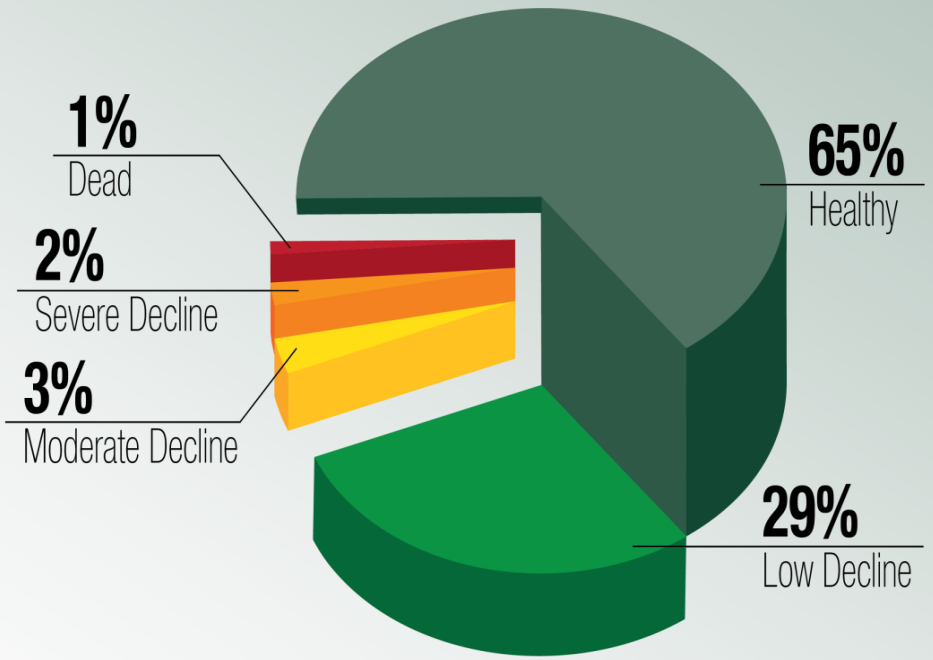
Photos by: Dave Smitley, Michigan State University

Long Term TreeAzin® EAB Efficacy

Oakville, ON (suburb of Toronto)

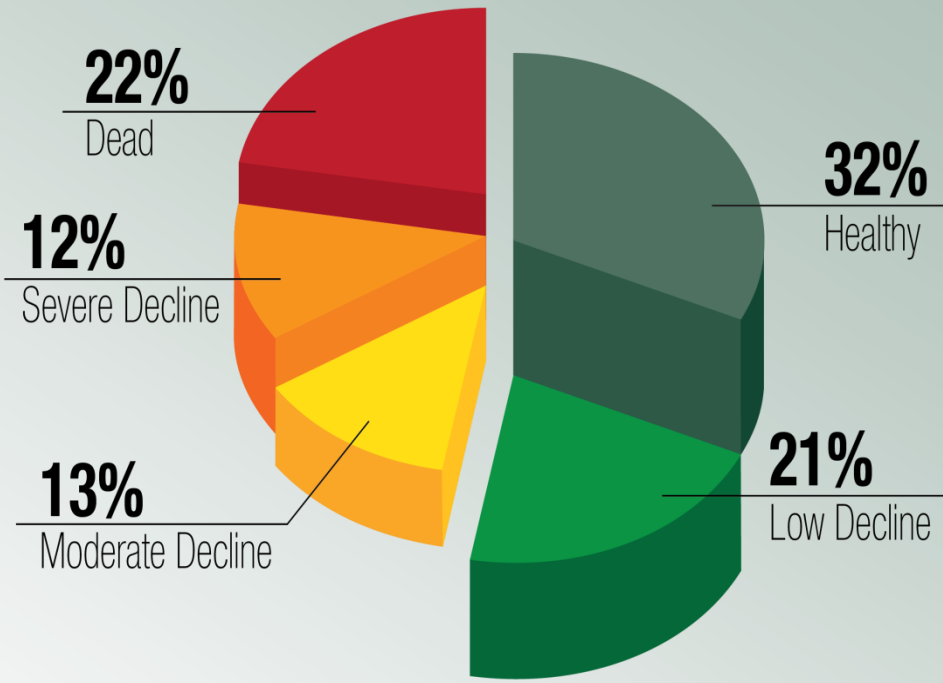
- EAB detected in 2008 (arrived in 03/04)
- In 2013, 727 randomly selected treated and untreated ash trees were surveyed for EAB signs and symptoms
- Average tree diameter – 30 cm Dbh
- TreeAzin treatments commenced in 2008
- Approx. 5700 trees currently under treatment (biennial treatment strategy)

Long Term TreeAzin® EAB Efficacy



Treated ash trees

Untreated ash trees



Emerald Ash Borer

Sault Ste. Marie, ON – June 17, 2013 – Untreated ash trees

Emerald Ash Borer

Sault Ste. Marie, ON – June 17, 2013 – TreeAzin treated in 2011 & 2013

EcoJect® System Kits

3L Kit

- 3L Pump
- 48 20 mL Canisters
- 18 8 mL Canisters
- 72 Nozzles
- 1 Loading Gun
- Drill bits, DBH tape, PPE, and more…

3XL Kit

- 3L Pump
- 144 20 mL Canisters
- 48 8 mL Canisters
- 204 Nozzles
- 1 Loading Gun
- Drill bits, DBH tape, PPE, and more…

6L Kit

- 6L Pump
- 264 20 mL Canisters
- 96 8 mL Canisters
- 372 Nozzles
- 2 Loading Gun
- Multi-loader attachment
- Drill bits, DBH tape, PPE, and more...

EcoJect® System

Important Questions

- Is the product effective against EAB – “show me the data”
- Multi-year control – “show me the data”
- Be knowledgeable - read the product label
- Adverse impact to the environment - “show me the data”
- Formulation translocation – “show me the data”
- Be knowledgeable - Pesticides Act and Ontario Regulation 63/09-Landscape Licensed Exterminators
- Cost
- Licencing requirements

Thank You


Don't move firewood,
it BUGS me!
Cooperative Emerald Ash Borer Project
www.emeraldashborer.info
5394680