Saving Your Urban Ash Requires Good Planning and Timing!

SREF Forest Health Webinars
March 2018

Cliff Sadof
Purdue Entomology

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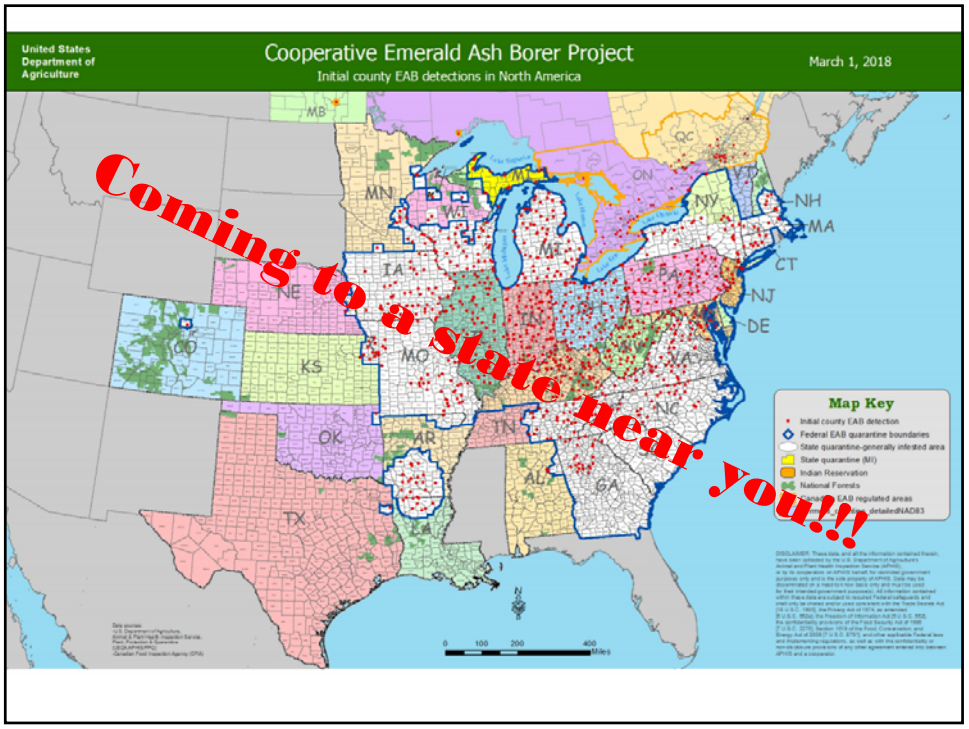
Emerald Ash Borer | Overview

- **EAB Primer**
- Insecticide options
- Invasion Management
- **Rallying Communities**
- Summary and Resources

EAB Basics

Learn about:

- How EAB Kills Ash Trees
- Why Ash Trees Are Valuable


United States Department of Agriculture
Cooperative Emerald Ash Borer Project
Initial county EAB detections in North America
March 1, 2018
Coming to a state near you!!!
Map Key
Initial county EAB detection
Federal EAB quarantine boundaries
State quarantine-generally infested area
State quarantine (MI)
Indian Reservation
National Forests
EAB regulated areas
MB
MN
WI
MI
ON
QC
NY
VT
NH
MA
CT
NJ
DE
PA
IA
NE
CO
KS
MO
OK
AR
TX
LA
TN
KY
VA
NC
SC
GA
AL
0 100 200 400
Miles

Emerald Ash Borer | Resource at Risk

for Master Gardeners

Healthy Trees Have Value!

National Tree Benefit Calculator

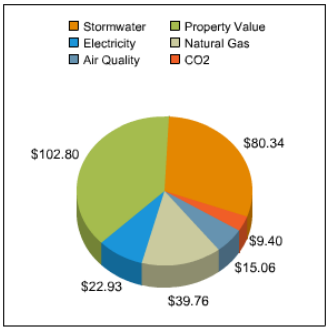
Beta

Thank you for choosing this site to calculate the economic and ecological benefits of your tree.

Want a useful tool for demonstrating the value of clients' trees? See for yourself!

www.treebenefits.com/calculator/

Example: What are the benefits of a 20" ash in Lafayette, IN?



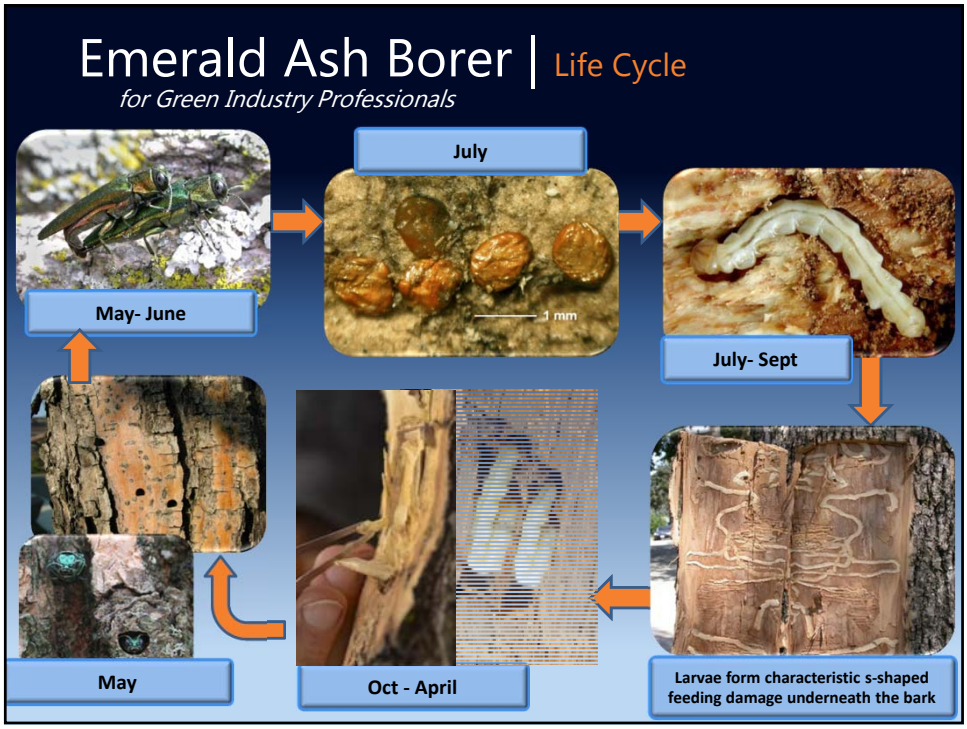
Measuring Tree Size

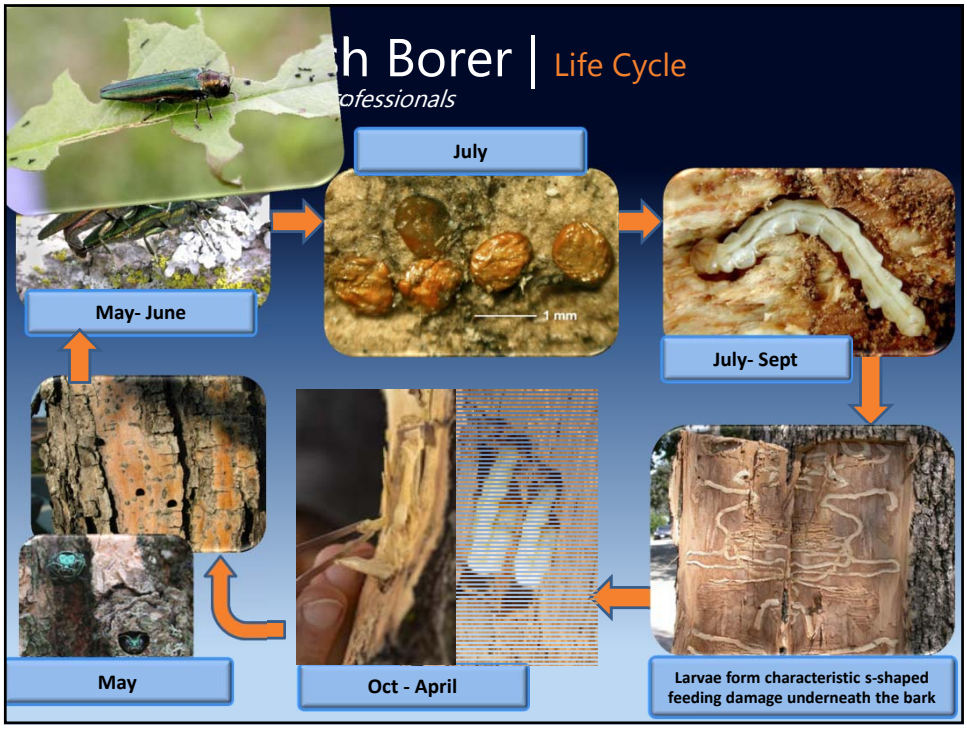
Treatment recommendations are based on the tree's DBH, or Diameter at Breast Height.

To get DBH:

1. Measure the distance around the trunk (circumference) at breast height (4.5 ft from the ground).
2. Divide that number by 3 to estimate diameter.

Example: If the distance around the trunk is 30 inches, the DBH is roughly 10 inches (actual diameter I 30 inches divided by pi (3.14))


Emerald Ash Borer | Life Cycle
for Green Industry Professionals
July
May- June
1 mm
July- Sept
May
Oct - April
Larvae form characteristic s-shaped feeding damage underneath the bark

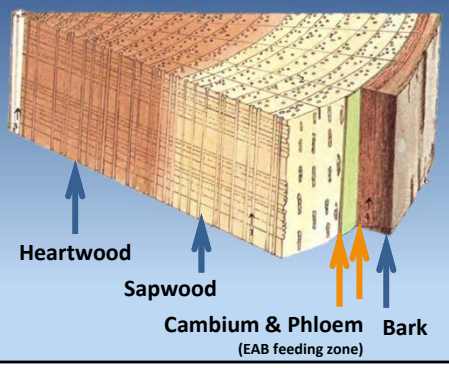

h Borer | Life Cycle
ofessionals
July
May- June
1 mm
July- Sept
May
Oct - April
Larvae form characteristic s-shaped feeding damage underneath the bark

Emerald Ash Borer | How EAB Kills Trees

- Larval feeding greatly reduces the tree's ability to circulate nutrients and water.
- Infested trees quickly starve to death, dry out, and fall.
- EAB attacks only true ash trees (*Fraxinus*).
- EAB kills **99.9%** of the untreated ash trees it attacks.

The juvenile, larval stage of EAB damages ash trees

Larvae feed on the tree tissues that are critical for nutrient and water transport. When the cambium and phloem are damaged by larval feeding, the tree starves to death.



Emerald Ash Borer | Signs and Symptoms

for Green Industry Professionals

Vertical splitting in bark

Vertical splits occur when larval feeding kills vascular tissues underneath bark, causing it to die and split open.

Emerald Ash Borer | Signs and Symptoms

for Green Industry Professionals

Presence of S-shaped larval feeding galleries under bark

These zigzagging feeding tunnels are diagnostic of EAB in ash trees.

Feeding tunnels are packed with sawdust-like *frass*, or insect excrement.

Daniel Herms, The Ohio State University, Bugwood.org

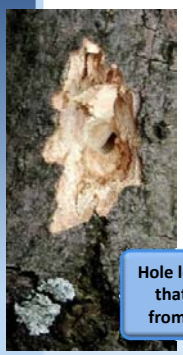
Emerald Ash Borer | Signs and Symptoms

for Green Industry Professionals

Woodpecker activity

Increased woodpecker feeding, especially during winter months, is a warning sign of infestation.

Woodpeckers are very good at locating EAB larvae under ash tree bark. They sometimes remove pieces of outer bark searching for them, leaving lighter patches on trunks of infested trees.



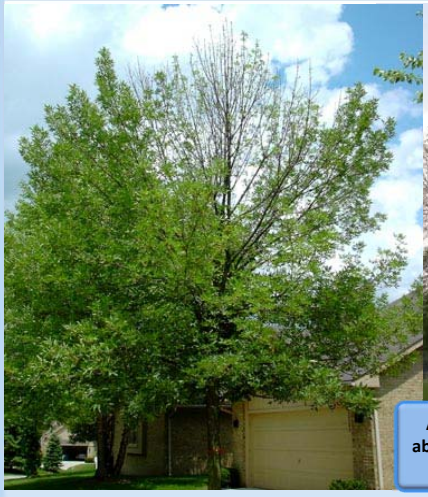
Hole left by a woodpecker that extracted an EAB from its pupal chamber

Emerald Ash Borer | Signs and Symptoms

for Green Industry Professionals

Thinning of leaves in the upper canopy

Decline usually begins in the top 1/3 of the canopy. Leaves may be lost or appear smaller than normal.



As more EAB larvae begin feeding in the tree, its ability to circulate water and nutrients is destroyed, causing branch decline and death.

Emerald Ash Borer | Signs and Symptoms

for Green Industry Professionals

Epicormic sprouting

Formation of epicormic shoots or "water sprouts" at the tree's base, on the trunk, or on large branches is a stress response to loss of leaves in the canopy.

Though leaves on these thin shoots may appear lush and healthy, they will not support the tree.

Heavy epicormic sprouting, such as that seen at left, often appears just before the tree dies.

Only Professionals Should Remove Ash

Dying Ash Branches are BRITTLE!!

ASH TREE FAILS CAN BE DEADLY!

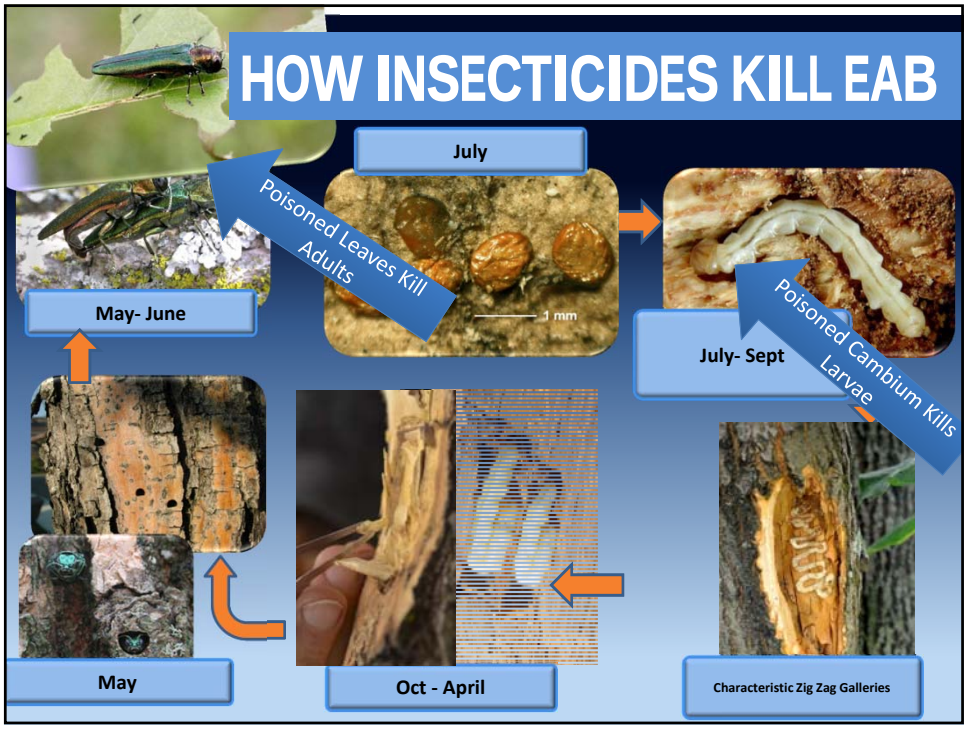
Emerald Ash Borer | Overview

- EAB Primer
- **Insecticide Options**
- Invasion Management
- **Rallying Communities**
- Summary and Resources

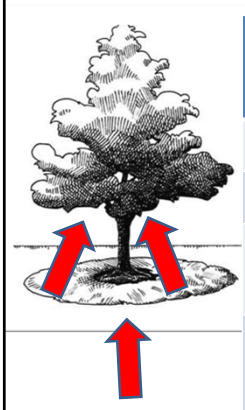
Insecticide Options

Learn about:

- Types of applications
- How well insecticides work
- Treatment and removal costs for a 20″ individual ash tree



Effects of Insecticides on EAB Lifestages



Insecticide	Egg	Larvae				Toxicity of Poisoned Leaves to adults
		L1	L2	L3	L4	
Imidacloprid	No	Yes	Yes	No	No	Sustained feeding
Dinotefuran	No	Yes	Yes	No	No	A few bites
Emamectin Benzoate	No	Yes	Yes	Yes	Yes	One or two bites
Azadirachtin	No	Yes	Yes	Yes	Yes	Not toxic, but reduces fecundity of adults

Water carries the pesticide

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Journal of Economic Entomology, 109(2), 2016, 705–716
doi: 10.1093/jee/tov381
Advance Access Publication Date: 31 December 2015
Research article

Forest Entomology

Laboratory Evaluation of the Toxicity of Systemic Insecticides to Emerald Ash Borer Larvae

Therese M. Poland,[1,2] Tina M. Ciaramitaro,[1] and Deborah G. McCullough[3]

FOREST ENTOMOLOGY

Evaluation of *Agrilus planipennis* (Coleoptera: Buprestidae) Control Provided by Emamectin Benzoate and Two Neonicotinoid Insecticides, One and Two Seasons After Treatment

DEBORAH G. MCCULLOUGH,[1,2,3] THERESE M. POLAND,[4] ANDREA C. ANULEWICZ,[1] PHILLIP LEWIS,[5] AND DAVID CAPPAERT[1]

J. Econ. Entomol. 104(5): 1599–1612 (2011); DOI: http://dx.doi.org/10.1603/EC11101

Poison Profile

Imidacloprid (Imicide)

- Adults
  - Take days to die
- Larvae
  - Avoid feeding on infused diet
  - At 1 ppm LT 50 = 48.5 days
  - With 50 d exposure LC 50 = 2.04 ppm

Poison Profile

Dinotefuran (Safari)

- Adults
  - Die after eating a few bites
- Larvae
  - Avoid feeding on infused diet
  - At 0.5 ppm LT 50 = 34.8 days
  - With 49 d feeding LC 50 = 0.52ppm
    - (1/4 of imidacloprid)

Poison Profile

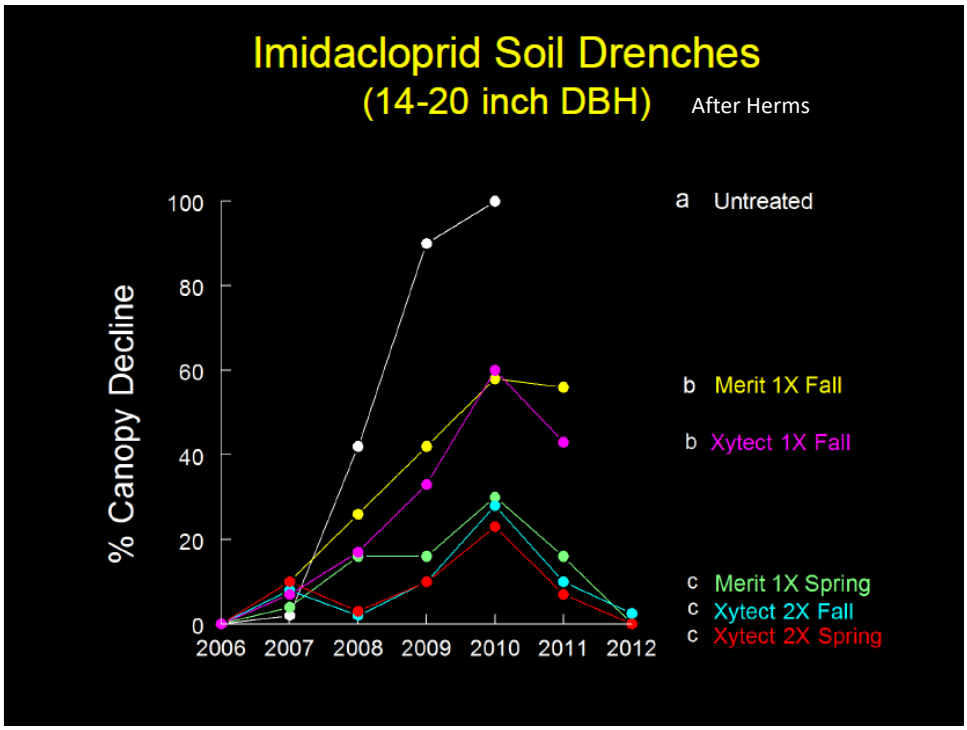
Emamectin Benzoate (TreeAge)

- Adults
  - Die after eating one or two bites
- Larvae
  - Readily eat impregnated diet
  - At 1 ppm LT 50 = 23.1 days
  - At 32 days LC 50 = 0.34 ppm

Poison Profile

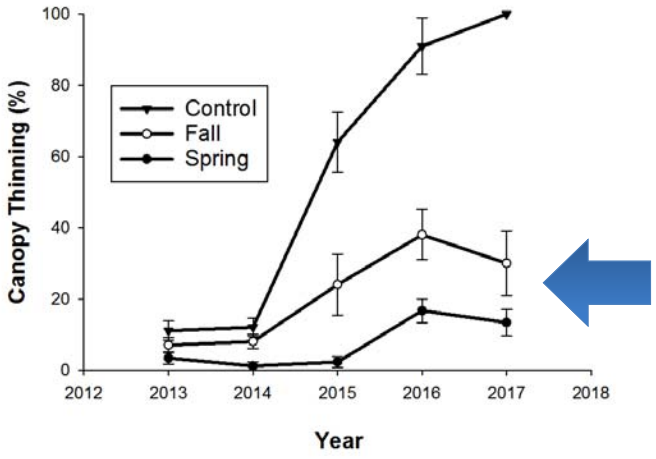
Azadirachtin (TreeAzin / Azasol)

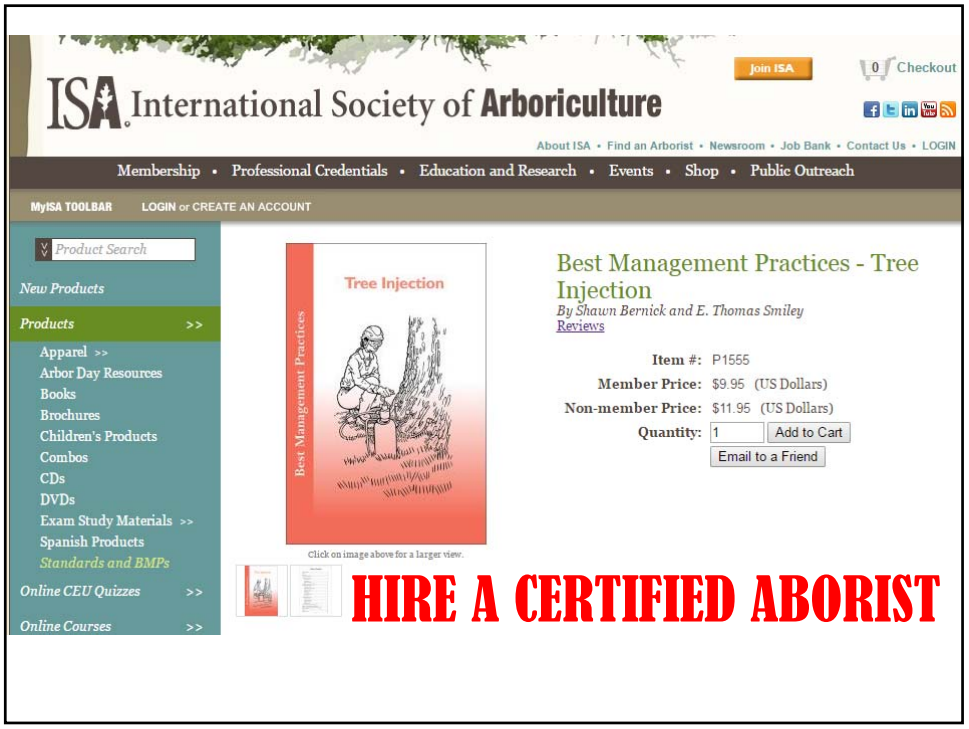
- Adults
  - Reduces adult fecundity
- Larvae
  - Readily feed on infused diet
  - At 1ppm LT 50 = 12.1 /15.0 days
  - At 24 days LC 50 TreeAzin = 0.4 ppm
  - At 27 days LC 50 Azasol = 0.4 ppm



Eagle Creek Park

Eagle Creek Once @ 3 yrs
Average DBH = 39 ±3.16 inches
Range = 28-62, 10 trees per treatment
5 ml/DBH, TreeÄge in 2013 and 2016

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Tree Injection
Best Management Practices
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Best Management Practices - Tree Injection
By Shawn Bernick and E. Thomas Smiley
Reviews
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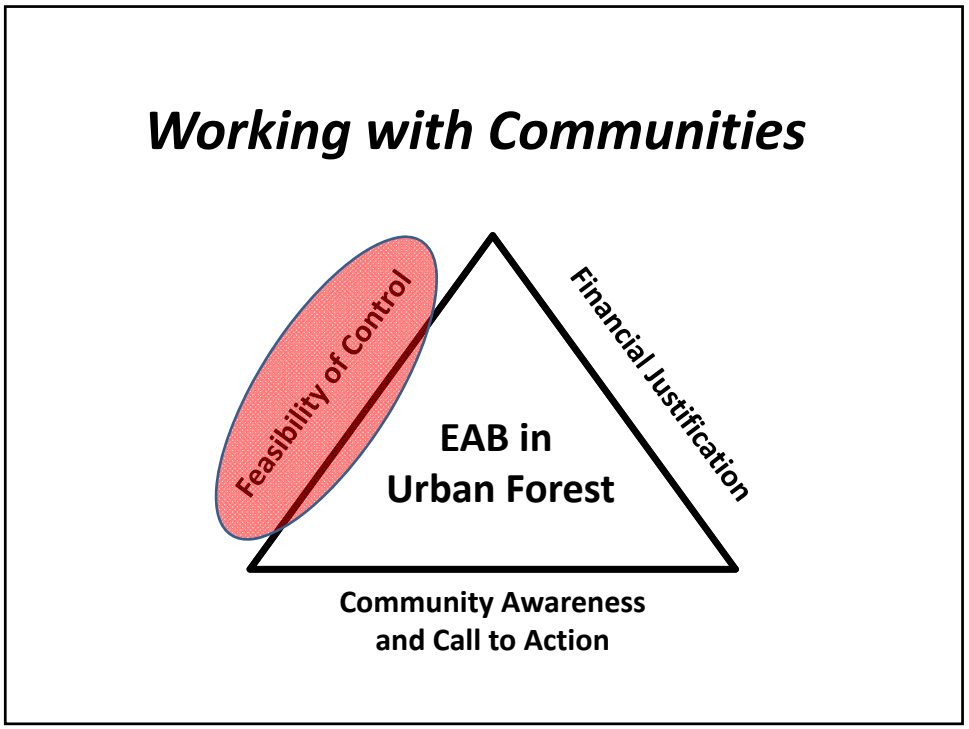
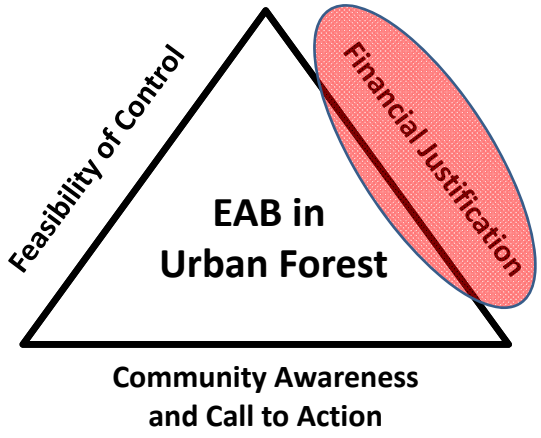

Working with Communities
Feasibility of Control
Financial Justification
EAB in
Urban Forest
Community Awareness
and Call to Action

Working with Communities



Ten Year Cost Estimates for 20" Ash Tree

Removal and Replacement Cost = $880

- Removal and stump grinding
  - @$22/inch DBH = $440 (Not near target)
- Replacement
  - @ $400 to buy, plant and stake 2" DBH tree

Treatment Cost = $660

@ $10/inch DBH once every 3 years (assuming tree growth = 0.5 in DBH/yr)

= $660

Emerald Ash Borer | Overview

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- Insecticide options
- **Invasion Management**
- Rallying Communities
- Summary and Resources

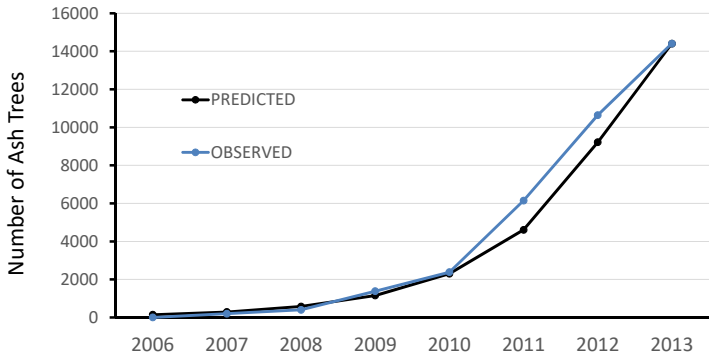
Invasion Management

Learn about:

- EAB population and ash decline cycle
- Staging your infestation
- Cost/Benefits of intervention at different stages of invasion

Rate of Ash Decline

Observed Ash Removals in Fort Wayne, IN Support Doubling Model



Stage Year	1	2	3	4	5	6	7	8
PCT>removed	1	2	4	8	16	32	64	100

Year Detected

Emerald Ash Borer | To Treat or Not To Treat?

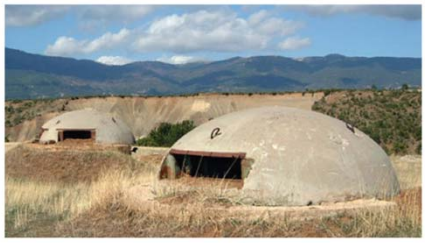
for Master Gardeners

Sometimes trees can look worse the year following treatment. This is common if the tree was already infested or if beetle densities in the area are high. Continue with properly applied treatment, and trees generally begin to recover in the second year.

The EAB "Bunker"

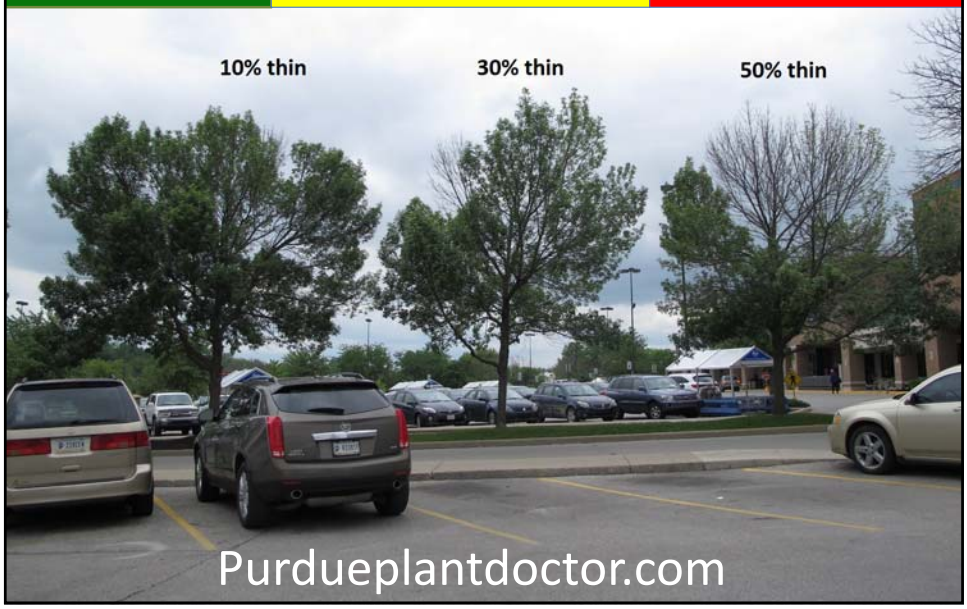
A good way to conceptualize treatment is that you are creating a protective "bunker" for the ash tree as the tidal wave of EAB moves through the area. The bunker must be very strong during the peak of the invasion, when pest pressure on the trees is high.

Begin treating when EAB is reported within 15 miles of your trees.

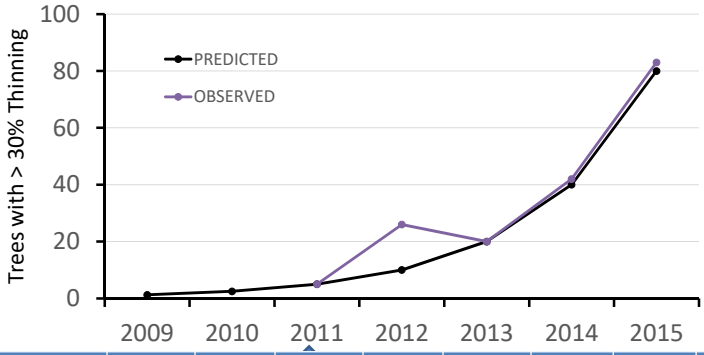


Early intervention is critical for saving an ash tree

Good < 10%	Fair > 10% and ≤ 30%	Poor or worse > 30% thinning

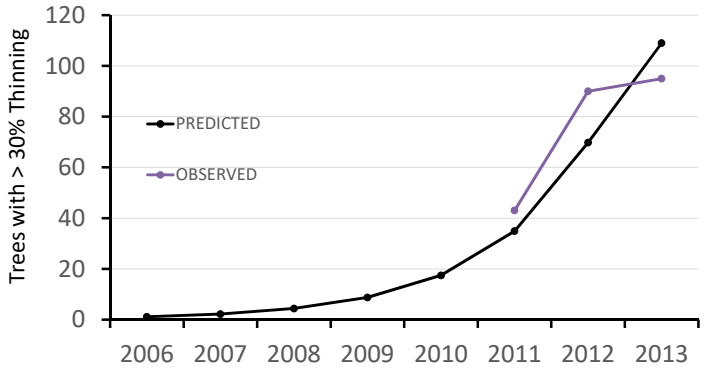


Predicted and Observed Ash Decline Lafayette, IN



Stage Year	1	2	3	4	5	6	7	8
PCT>30% thin	1	2	4	8	16	32	64	100

Predicted and Observed Ash Decline (Indianapolis – Sahm Park)



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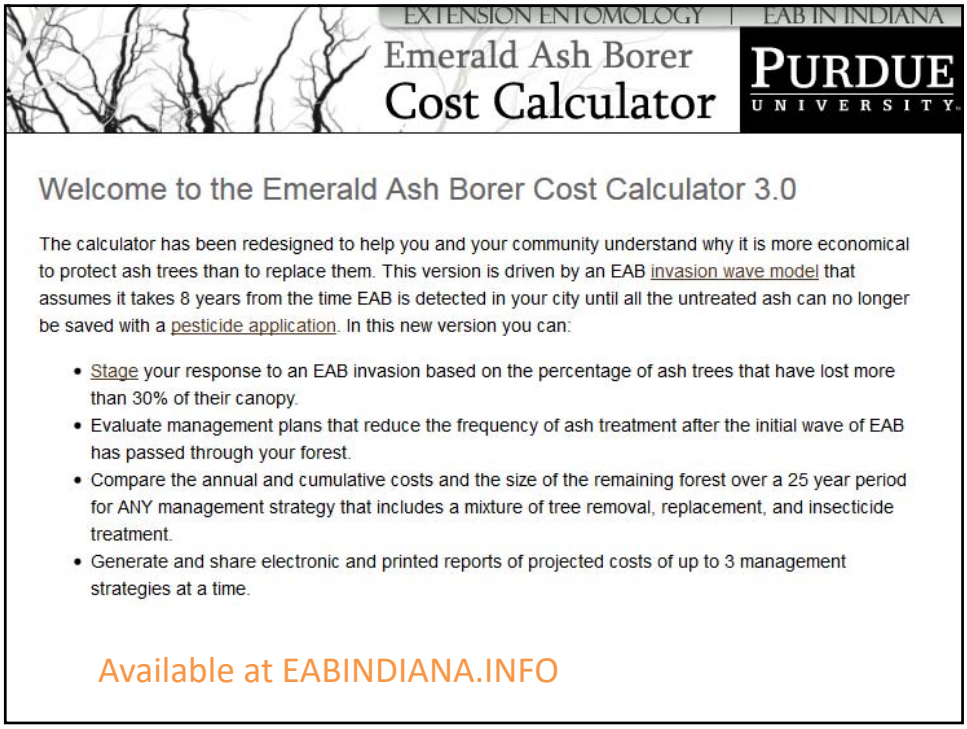
EXTENSION ENTOMOLOGY | EAB IN INDIANA
Emerald Ash Borer
Cost Calculator
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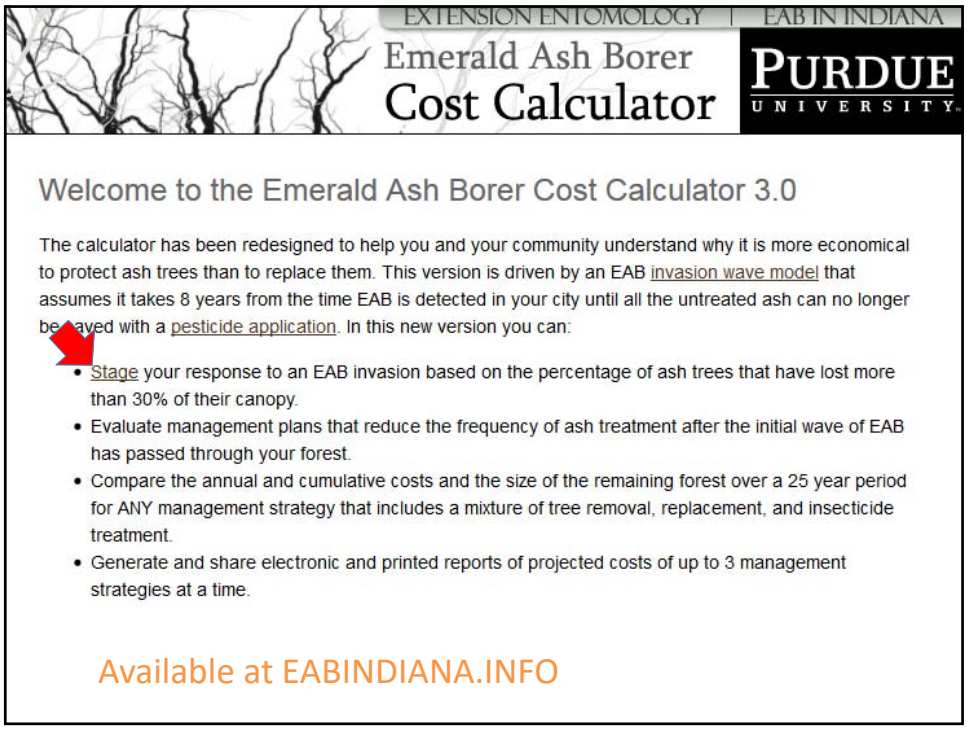
Welcome to the Emerald Ash Borer Cost Calculator 3.0
The calculator has been redesigned to help you and your community understand why it is more economical to protect ash trees than to replace them. This version is driven by an EAB invasion wave model that assumes it takes 8 years from the time EAB is detected in your city until all the untreated ash can no longer be saved with a pesticide application. In this new version you can:
• Stage your response to an EAB invasion based on the percentage of ash trees that have lost more than 30% of their canopy.
• Evaluate management plans that reduce the frequency of ash treatment after the initial wave of EAB has passed through your forest.
• Compare the annual and cumulative costs and the size of the remaining forest over a 25 year period for ANY management strategy that includes a mixture of tree removal, replacement, and insecticide treatment.
• Generate and share electronic and printed reports of projected costs of up to 3 management strategies at a time.
Available at EABINDIANA.INFO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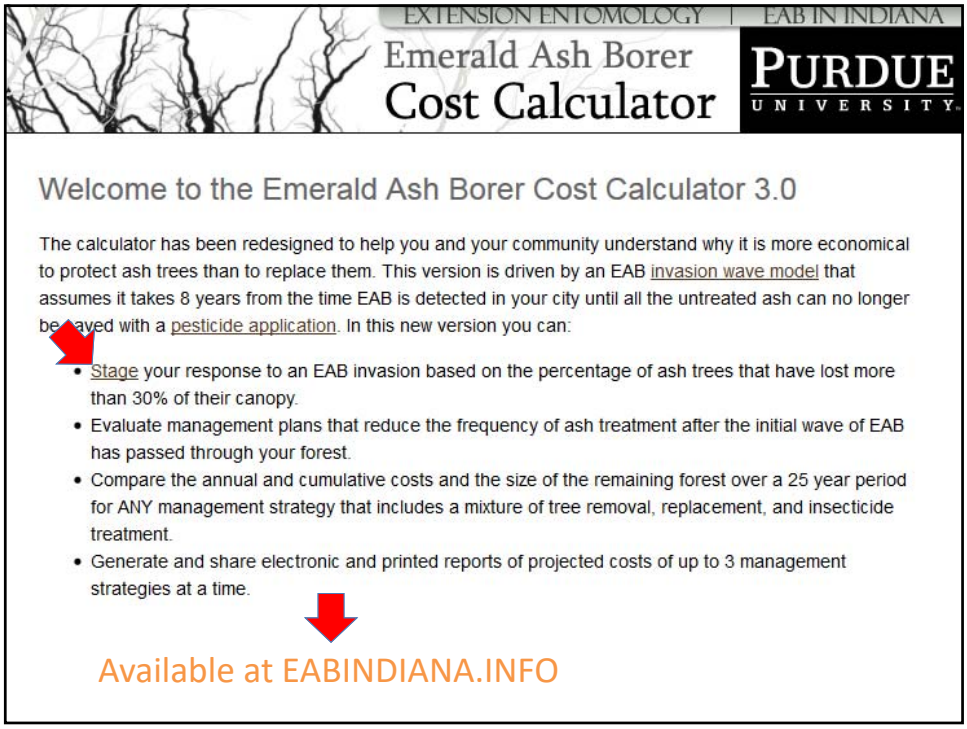


Staging your infestation

% of Trees Damaged or Lost to Date	Years w/ EAB	Years Until All Trees Are Damaged or Lost to EAB
1%	○ 1	7
2%	○ 2	6
4%	○ 3	5
8%	○ 4	4
16%	◉ 5	3
32%	○ 6	2
64%	○ 7	1
100%	○ 8	0

How long will you aggressively protect your trees from EAB? Default value is 10 years to reflect the time it takes from when 1% of trees are beyond saving until all of the remaining untreated ash trees are completely dead and unable to sustain and feed EAB larvae.

How to determine
2 Yr Decline Survey (Ginzel- Sadof)

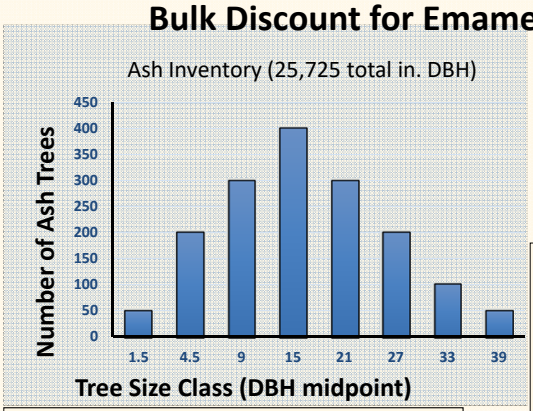
Year 1 Identify and Survey equal numbers of trees with < 10% canopy thinning and 10- 30% canopy thinning

Year 2 Survey and record trees with > 30% Canopy Thinning. The percentage tells you your year in the cycle.

Year	1	2	3	4	5	6	7	8
PCT>30% thin	1	2	4	8	16	32	64	100

Representative Forest with 1600 Ash Trees

Bulk Discount for Emamectin Benzoate Trt



Strategies
Reactive Replace Ash
Replace unsalvageable ash (poor)
Proactively replace ash
Replace over next 7 years
Save all trees with DBH > 12"
Optimize investment in larger trees
Replace the rest over next 7 years

Treatment Assumptions
Costs
$5.00/ in DBH
Frequency
Aggressive = every 3 years through yr 10
Maintenance = every 5 years
Treatments save 95% of trees
Annual mortality of replaced or saved tree is 2%

Cost of removal + Stump grinding (Actual Indianapolis Prices)

DBH[1]	Avg Cost / DBH
1 - 3	$ 14.00
3 - 6	$ 14.00
6 - 12	$ 14.75
12 - 18	$ 18.00
18 - 24	$ 21.75
24 - 30	$ 25.10
30 - 36	$ 30.50
36 -	$ 36.00

Replacement Tree Assumptions
Tree Size is 2.5" DBH
Trees Cost $400 to purchase, plant and stake

Costs for Bulk Spray Bid

$5.00/in DBH

Aggressive trts @ 3 yrs; Maintenance trts @ 5 yr

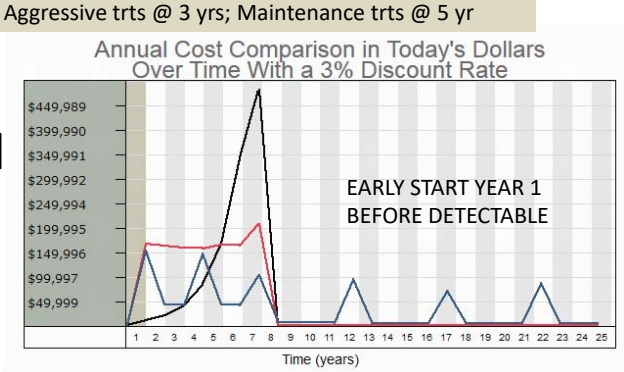
Highest annual cost

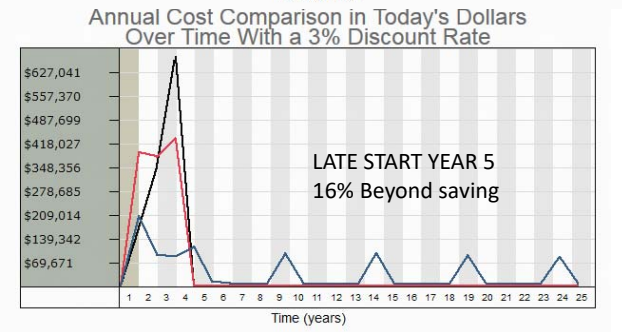
Reactively Replace All

Proactively Replace All

Replace <12

Lowest annual cost





Costs for Bulk Spray Bid

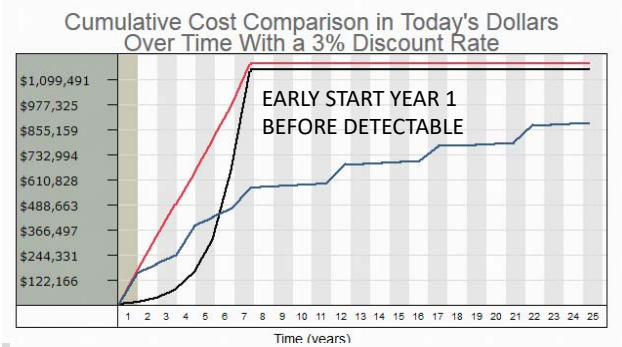
Highest annual cost

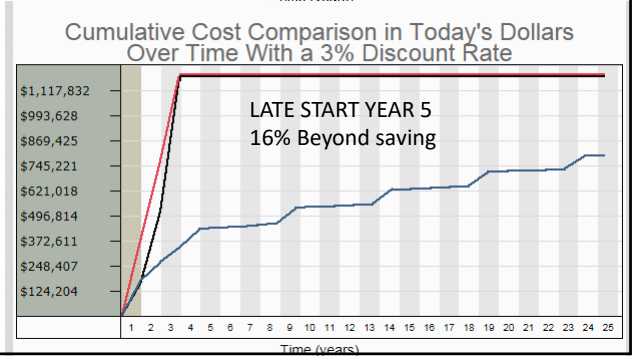
Reactively Replace All

Proactively Replace All

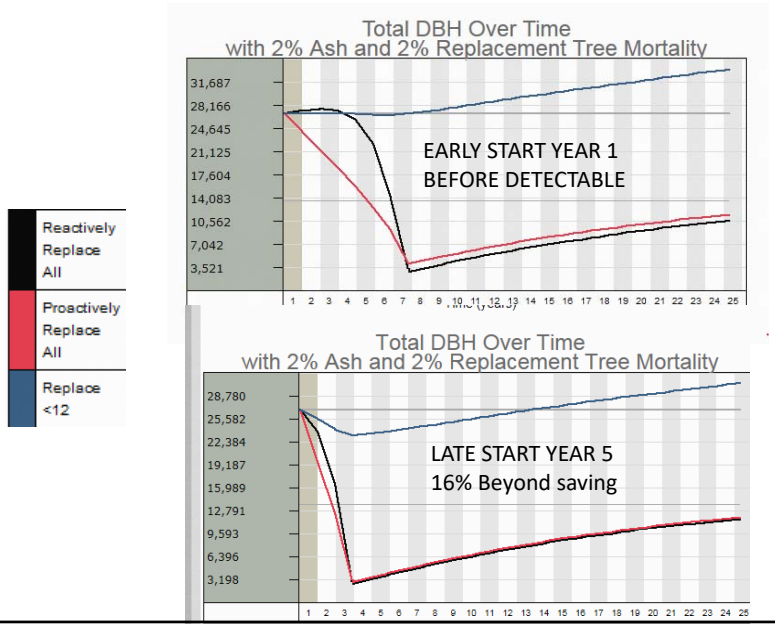
Replace <12

Lowest annual cost





Relative Benefits in Forest Size -Treated forest is largest



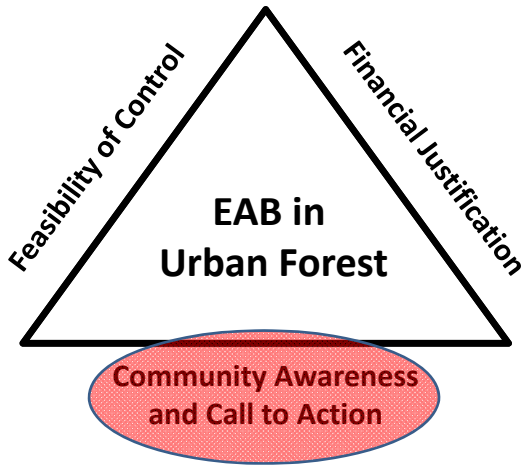
Discounted Cost to Produce Accumulated Years of Benefit ($/m DBH)

	Time step of Initiation	Start in Year 5 of 25 yr cycle	
	Dollars per (inch) for treatment	**$5**	**$10**
-2.5%	Reactive Replace	$1,933.32	$1,933.32
	Proactive Replace	$1,983.20	$1,983.20
-68%	Treat > 12" DBH	$625.40	$981.56
-55%	Treat 50%	$886.33	$1,148.08
-67%	Treat best 80%	$648.75	$962.17
-71%	Treat All	$579.32	$952.74

Summary

- Starting your management program in year 5 after damage is noticeable in community (16% poor) will:
  - provide benefit to up 84% of ash
  - cost less than replacement
- Hope for communities that must see damage before they act

Working with Communities



Emerald Ash Borer | Overview

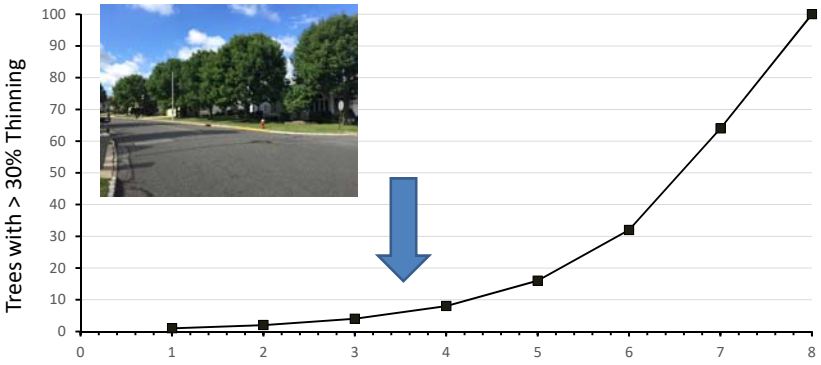
- EAB Primer
- Insecticide options
- Invasion Management
- **Rallying Communities**
- Summary and Resources

Rallying Communities

Learn about:

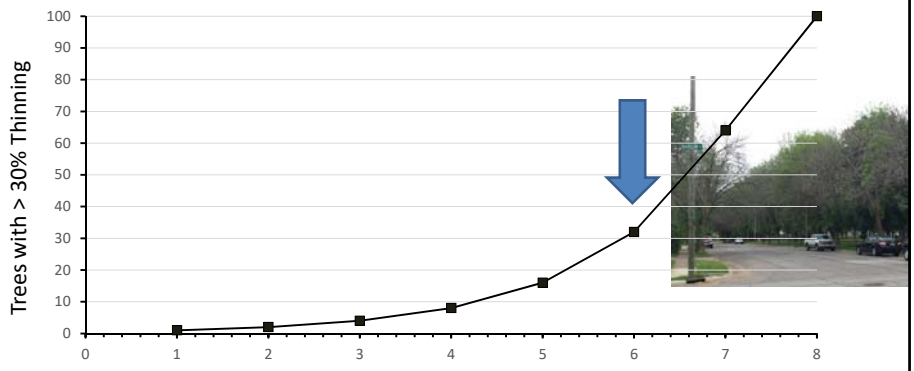
- Why communities fail to act
- Staging your infestation to get support
- EAB Action Cycle
- NABB examples over time

Hard to Detect Infestation Early in the Ash Decline Curve



Stage Year	1	2	3	4	5	6	7	8
PCT>30% thin	1	2	4	8	16	32	64	100

Easy to Detect Infestation Late in the Ash Decline Curve



Stage Year	1	2	3	4	5	6	7	8
PCT>30% thin	1	2	4	8	16	32	64	100

How to Get Things Moving:

Bottom-Up Approach

NABB

Neighbors Against Bad Bugs

Act now. Save trees. Save $.

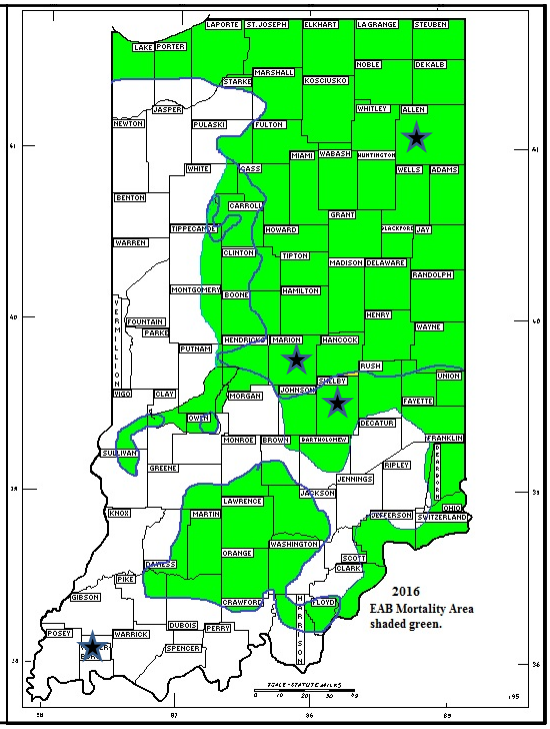
PURDUE UNIVERSITY

Purdue Master Gardener Program

Community outreach program that teams Purdue Master Gardeners, Extension Educators, and neighborhood associations to determine best management practices for ash trees.

NABBs Over Time

- 2008 Fort Wayne
  - Community bids
- 2011 Indianapolis
  - ABAte
    - KIB, INDY PARKs
    - King Park
- 2016 Evansville/ Shelbyville
  - Adopt A Tree
  - TruGreen



Emerald Ash Borer | Overview

- EAB Primer
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- **Summary and Resources**

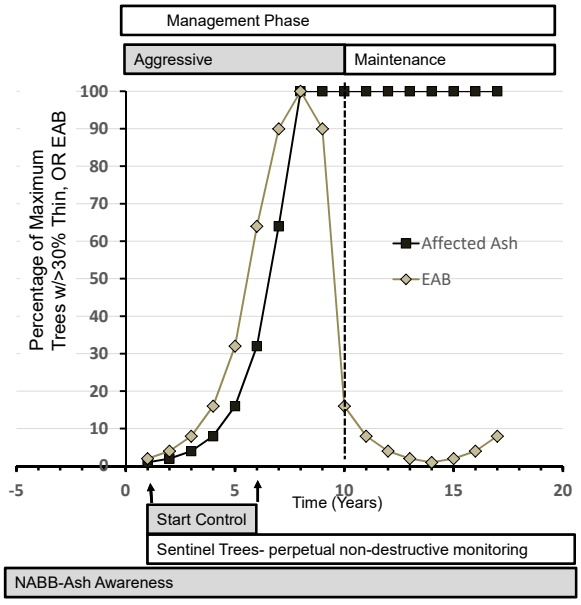
Summary

- Invasion Management Model

Resources

- Decision Guide for Communities
- Purdue Tree Doctor App

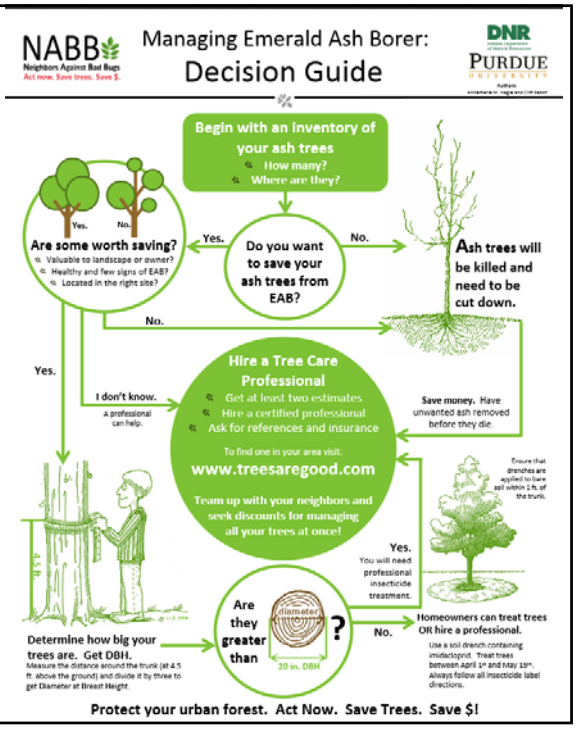
Urban Community EAB Action Cycle

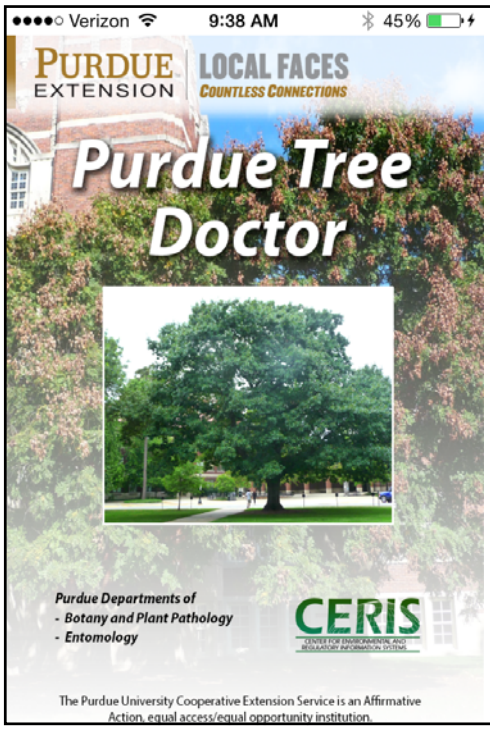


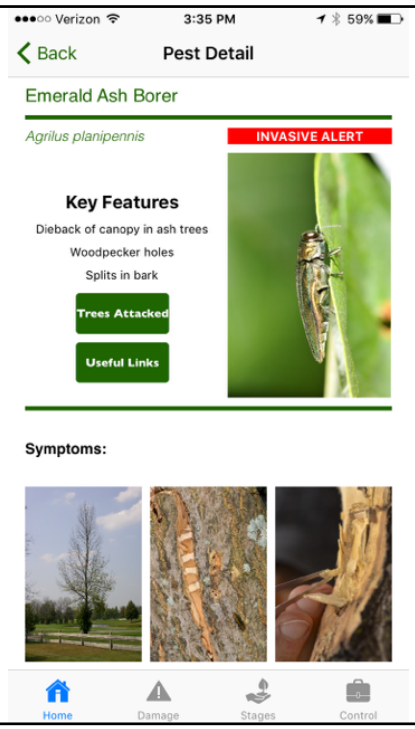
Getting Communities To Care B4 too late

- Tree Tagging/ Inventory indicates scope but not urgency

Available at
Eabindiana.info





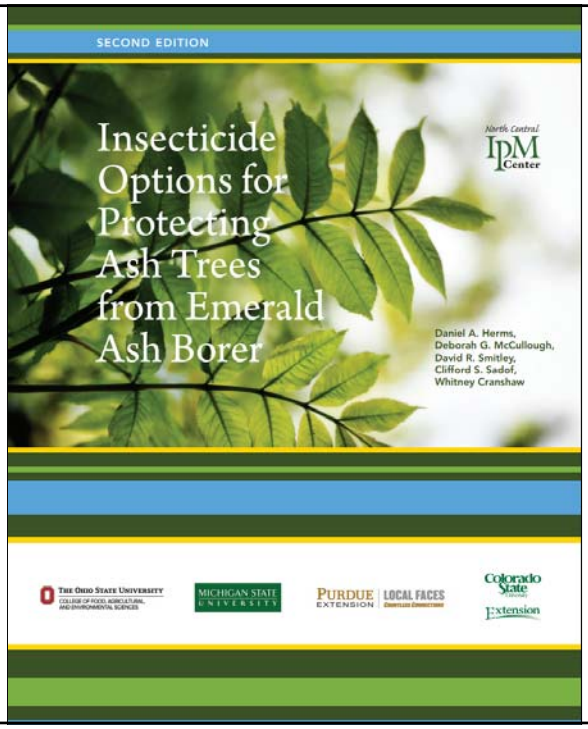


Early intervention is critical for saving an ash tree

Good < 10%	Fair > 10% and ≤ 30%	Poor or worse > 30% thinning

Use the Purdue Tree Doctor to estimate canopy thinning

Purdueplantdoctor.com


SECOND EDITION
Insecticide Options for Protecting Ash Trees from Emerald Ash Borer
North Central IPM Center
Daniel A. Herms,
Deborah G. McCullough,
David R. Smitley,
Clifford S. Sadof,
Whitney Cranshaw
The Ohio State University
College of Food, Agricultural, and Environmental Sciences
Michigan State University
Purdue Extension
Local Faces
Colorado State University Extension