Flatheaded Borer Ecology and Management in Ornamental Trees

Karla Addesso, Jason Oliver, Axel Gonzalez, Sujan Dawadi

Tennessee State University
Otis L. Floyd Nursery Research Center
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Program Overview

- Flatheaded Borers in the genus *Chrysobothris*
- Flatheaded appletree borer and relatives
- Oviposition site selection and damage symptoms
- Management options
- Ongoing research
- Summary

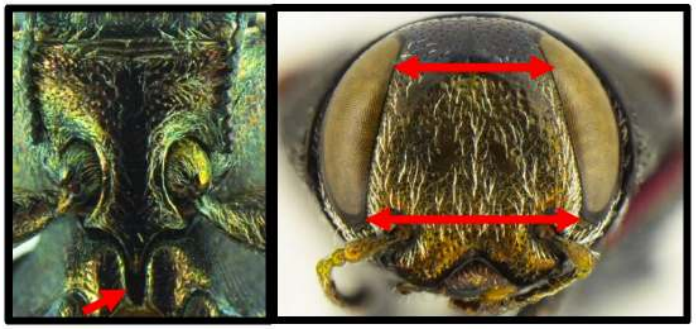
Family Buprestidae

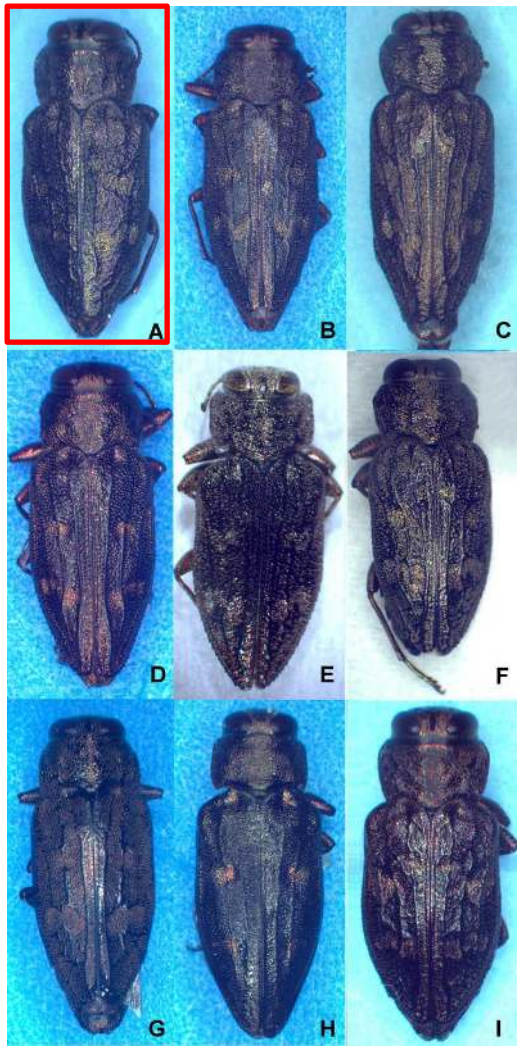
- ~15K species worldwide – Jewel beetles or Flatheaded Borers
- 514 genera, 52 in North America
- 787 species in North America
- Most attack dead or dying woody host plants
- Some attack living trees*

Pennsylvania Department of Conservation and Natural Resources - Forestry , Bugwood.org

The Genus *Chrysobothris*

- Not as showy
- Many species that look very similar
- They have different preferred hosts, but cause similar damage
- ID: prosternum acutely angulate behind procoxae, frons narrowed between eyes, elytral fovea





The flatheaded appletree borer, *Chrysobothris femorata* (FAB)

- Found throughout the United States
- Wide host range
- One larva can girdle a small tree within one season
- Can kill or structurally weaken trees
- *Chrysobothris femorata* complex

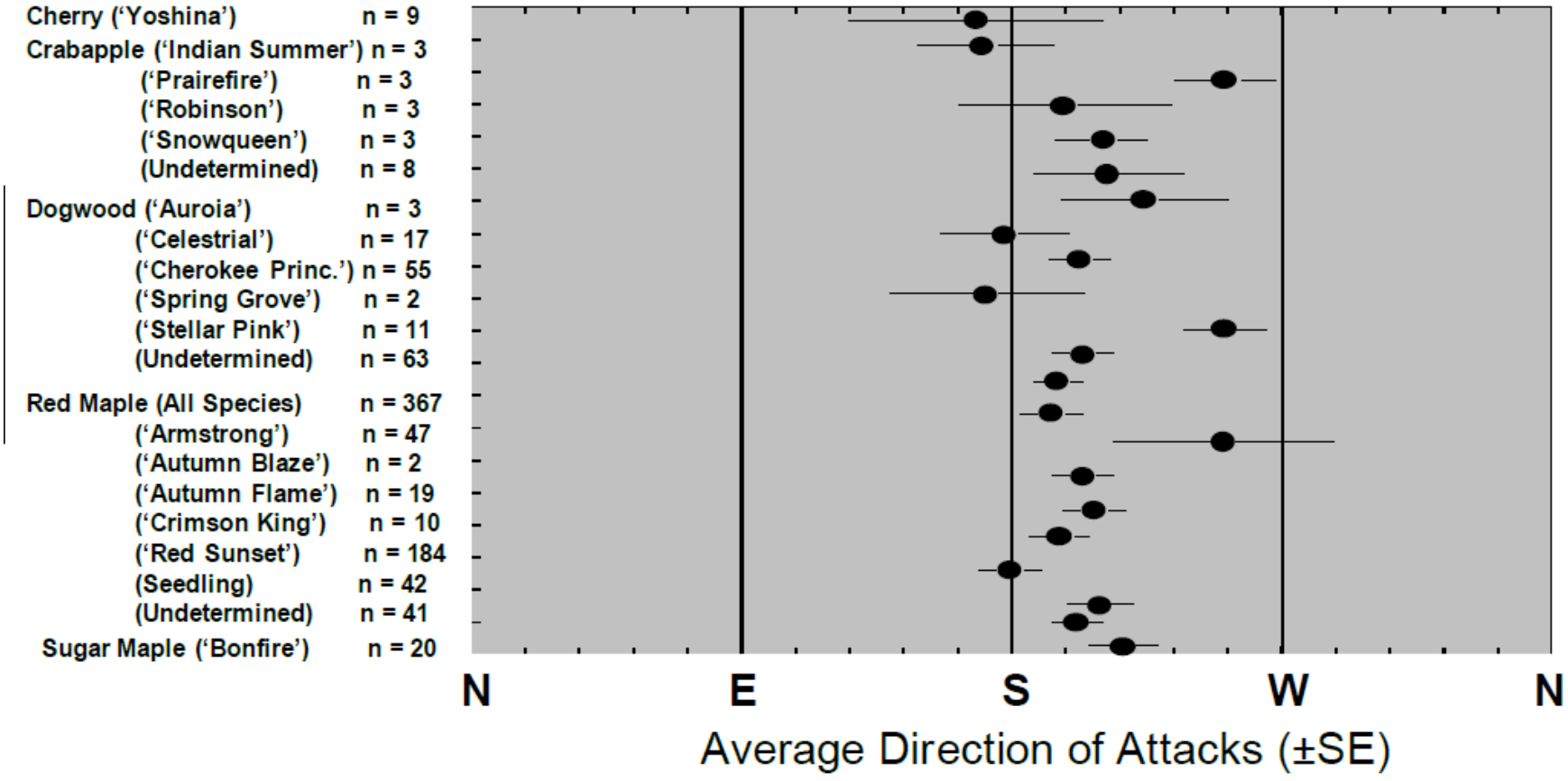
FAB Host Plants

- Maple (Acer), redbud (*Cercis*), dogwood (*Cornus*), oak (*Quercus*), elm (*Ulmus*), cherry (*Prunus*), apple (*Malus*)
- Recently found attacking blueberry in Florida
- Faster growing cultivars appear more resistant; slower growing more susceptible

Red maple (*Acer rubrum* L.)

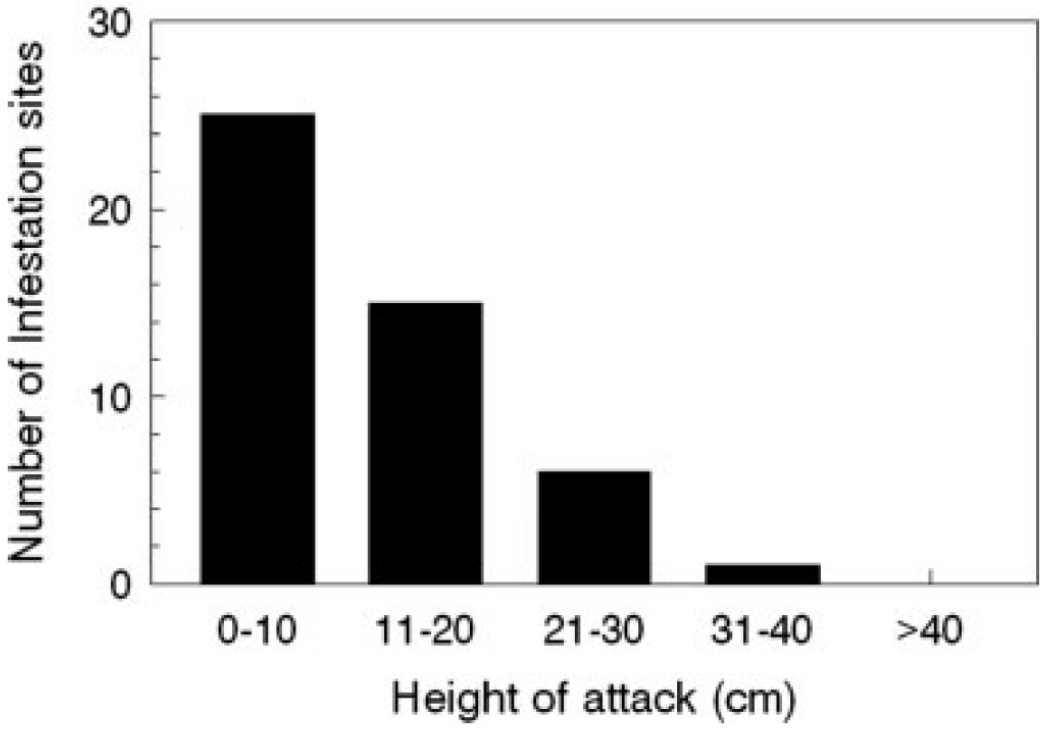
- One of the most common ornamental plants in eastern North America
- Rapid growth rate
- Resistant to extreme soil-moisture conditions
- Sparkling fall colors

Where on trunk do females lay eggs?



Oliver (unpublished)

Height of Damage



Seagraves et al. 2012

Stressed Plants are More Susceptible

- Faster growing trees less susceptible
- Wounds at base of tree can be egg-laying sites
- Graft or bud union sites
- First year post-transplant
- **Weakened vascular system may be key**

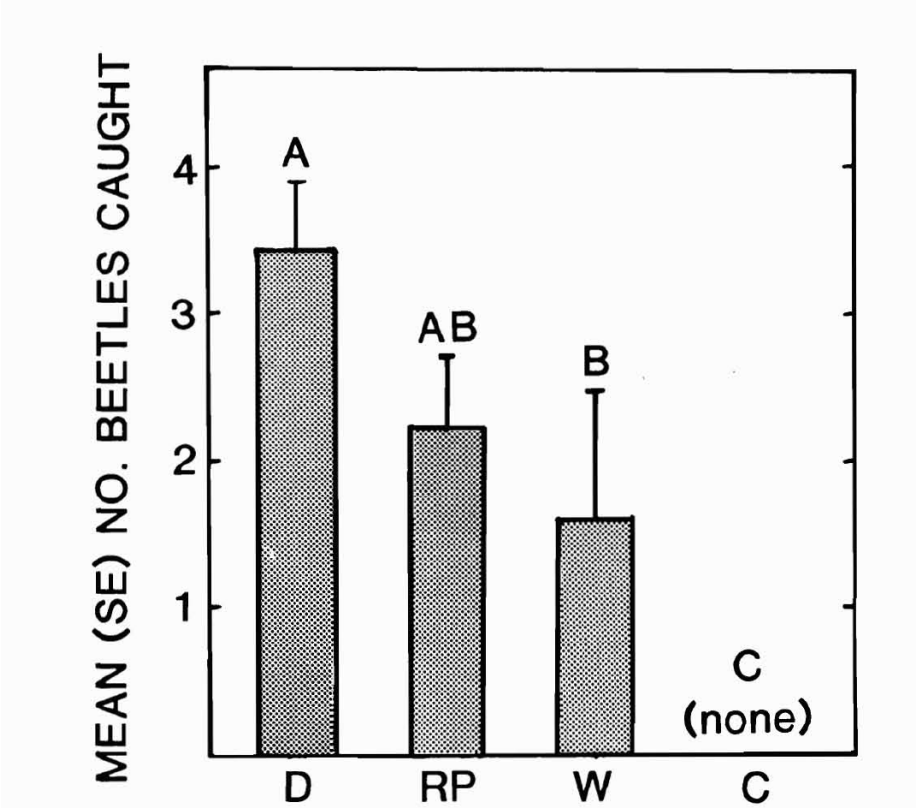


Fig. 2. Response of adult Buprestidae to experimentally stressed red maple trees, May 13 to June 14, 1985. D = defoliated, RP = root-pruned, W = wounded, C = control.

Potter et al. 1988

Nature of Damage

Photo by Nadeer Youssef

Larvae develop mainly in the cambium.

Photo by Axel Gonzalez

Feeding tunnels packed with frass.

Photo by Nadeer Youssef

Characteristic “D” shape hole after emerging.

Video by Axel Gonzalez

Adults are metallic olive-gray to brown with oval shape.

Nature of Damage

Nature of Damage

Larva in Trunk

Current Methods of Control

Cultural - proper plant selection and planting location will reduce plant stress

Systemic insecticide drenches

Trunk sprays with contact pesticides

Plant & Site Selection

Choose the Best Plant

Seagraves et al. 2012

Table 2. Incidence of flatheaded appletree borer infestation in trees infested during the first growing season (2005) and evaluated in summer 2006 after those borers had emerged (pooled Lexington and Princeton sites)

Species and cultivar	Number of trees	Number infested	Number of exit holes	Percentage infested
Red maples				
Burgundy Belle	16	6	8	37.5
October Glory	20	4	4	20.0
Northwood	16	3	2	18.6
Red Sunset	19	3	1	15.8
Somerset	20	3	3	15.0
Sun Valley	20	3	1	15.0
Brandywine	20	2	0	10.0
Autumn Flame	16	0	0	0.0
Sugar maples				
Green Mountain	20	4	2	20.0
Commemoration	17	2	5	11.8
Crescendo	17	2	1	11.8
Legacy	18	0	0	0.0
Freeman maples				
Autumn Fantasy	20	2	3	10.0
Sienna Glen	20	1	0	5.0
Autumn Blaze	20	0	0	0.0
A. truncatum × *platanoides*	19	2	2	10.5
A. campestre	20	0	0	0.0

Choosing the Best Planting Site

0-35% Impervious surface

Good

36-63% Impervious surface

Fair

64-100% Impervious surface

Poor

Dale et al. 2016

Just et al. 2018

Pace to Plant Technique

- https://content.ces.ncsu.edu/measuring-impervious-surface-cover-with-the-pace-to-plant-technique
- Take 25 steps at a 45 degree angle to closest impervious surface
- Count the number of steps that land on impervious surface
- Repeat 90, 180, and 270 degrees to first line, creating an X through the planting site
- The number of steps on impervious surface = the % impervious surface


45º
45º

Thresholds Calculated for Red Maple

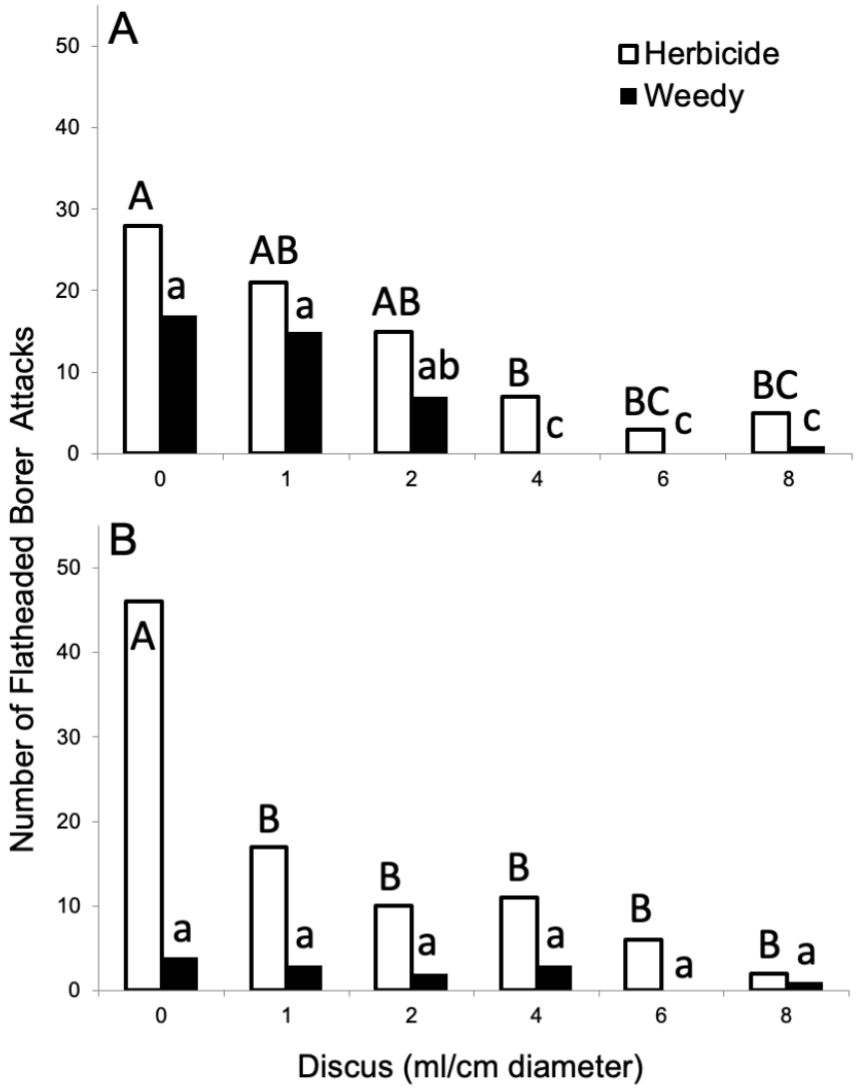
	Impervious surface thresholds		
City	**Good**	**Fair**	**Poor**
Newark, DE	0-32%	33-63%	64-100%
Asheville, NC	0-35%	36-68%	69-100%
Knoxville, TN	0-38%	39-54%	55-100%
Raleigh, NC	0-35%	36-54%	55-100%
Charlotte, NC	0-39%	40-53%	54-100%
Atlanta, GA	0-36%	37-80%	81-100%
Savannah, GA	0-44%	45-64%	65-100%
Gainesville, FL	0-28%	29-63%	64-100%
Average (8 cities)	0-35%	36-63%	64-100%

Cities are arranged in ascending order of mean winter temperature

Just et al. 2018

Systemic Drenches

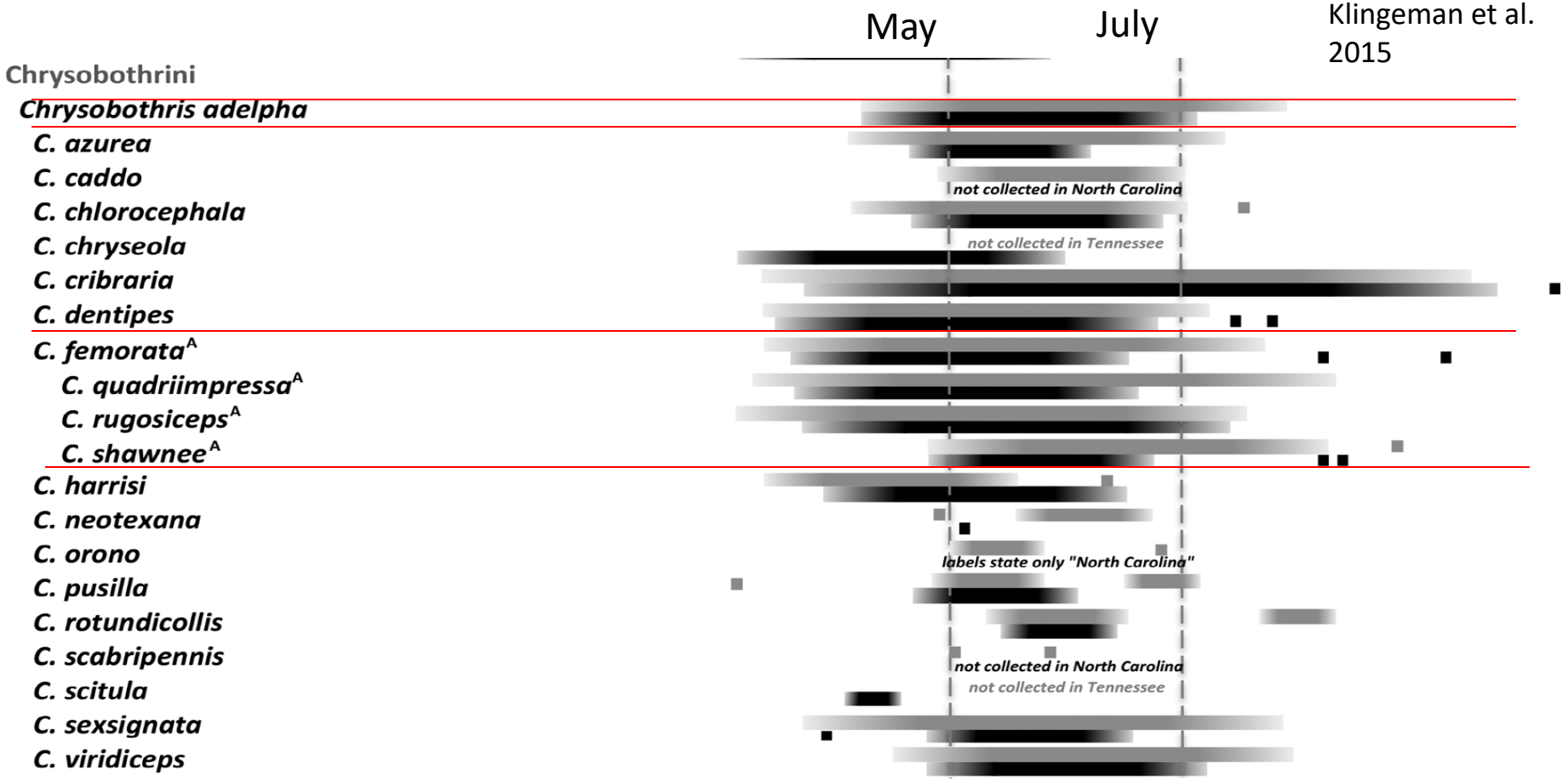
Imidacloprid Rates and Efficacy



Addesso et al. 2020

Contact Sprays

Contact Spray Timing



Klingeman et al. 2015

We don't know exactly when they lay eggs!
This makes timing and duration of sprays difficult

Southeastern U.S. Pest Control Guide for Nursery Crops and Landscape Plantings

Table 4-3. Insecticides registered for control of borers, foliage feeders, and leafminers
See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names[1]	Use site[3]	REI (hours, unless noted otherwise)	Borers					Foliage feeders						Leafminers		
					Ambrosia beetles	Bark and Pine beetles	Clearwing borers	Flatheaded borers	Longhorned (roundheaed) borers	Flea beetles	Japanese beetles (adult)	Leaf beetles	Weevils	Caterpillars	Sawflies	Flies and midges	Moths	Wasps
1A	carbaryl	Sevin SL	L,N,G	12		X			X	X	X	X	X	X	X	X	X	X
1B	acephate	Orthene	L,N,G	24							X	X	X	X	X		X	X
		Lepitect	L,N,G	24							X	X	X	X	X	X	X	X
		Precise GN	N,G	12								X	X					
	chlorpyrifos	Dursban 50W	N	24	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		DuraGuard ME	N,G	24						X	X	X	X	X		X		
	dicrotophos	Inject-A-Cide	L	N/A			X	X	X			X		X	X			X
	dimethoate	Dimethoate 4E,4EC	N	10-14 days								X		X	X	X	X	X
	malathion	Malathion 5EC	L	12							X			X		X	X	X
	oxydemeton methyl	Harpoon	L	0		X	X	X	X			X		X				
		MSR Spray Concentrate	N	10 days									X	X		X	X	X
	trichlorfon	Dylox 420 SL	L	N/A										X				
3A	bifenthrin	Attain TR	G	12										X				
		Menace GC	L,N,G	12	X	X				X	X	X	X	X				
		Onyx	L	N/A	X	X	X	X		X	X	X		X	X	X	X	X
		Onyx Pro	L.N,I	12	X	X	X	X		X	X	X		X	X	X	X	X
		Talstar S Select	N,G	12						X	X	X	X	X				
		Talstar Nursery G	N	12									X					
	cyfluthrin	Decathlon	L,N,G,I	12						X	X	X	X	X	X			
	beta-cyfluthrin	Tempo Ultra WP	L,I	N/A				X		X	X	X	X	X	X			
		Tempo SC Ultra	L,I	N/A				X		X	X	X	X	X	X			

Cost/Benefit of Chemical Methods

Systemic Drenches

- ★ Long lasting (up to 3 seasons)
- ★ Safer for pets, humans and many non-target organisms
- Active ingredients may be problematic in flowering plants
- ★ Broad window for application
- Labor-intensive/slower
- Higher water requirement
- More expensive

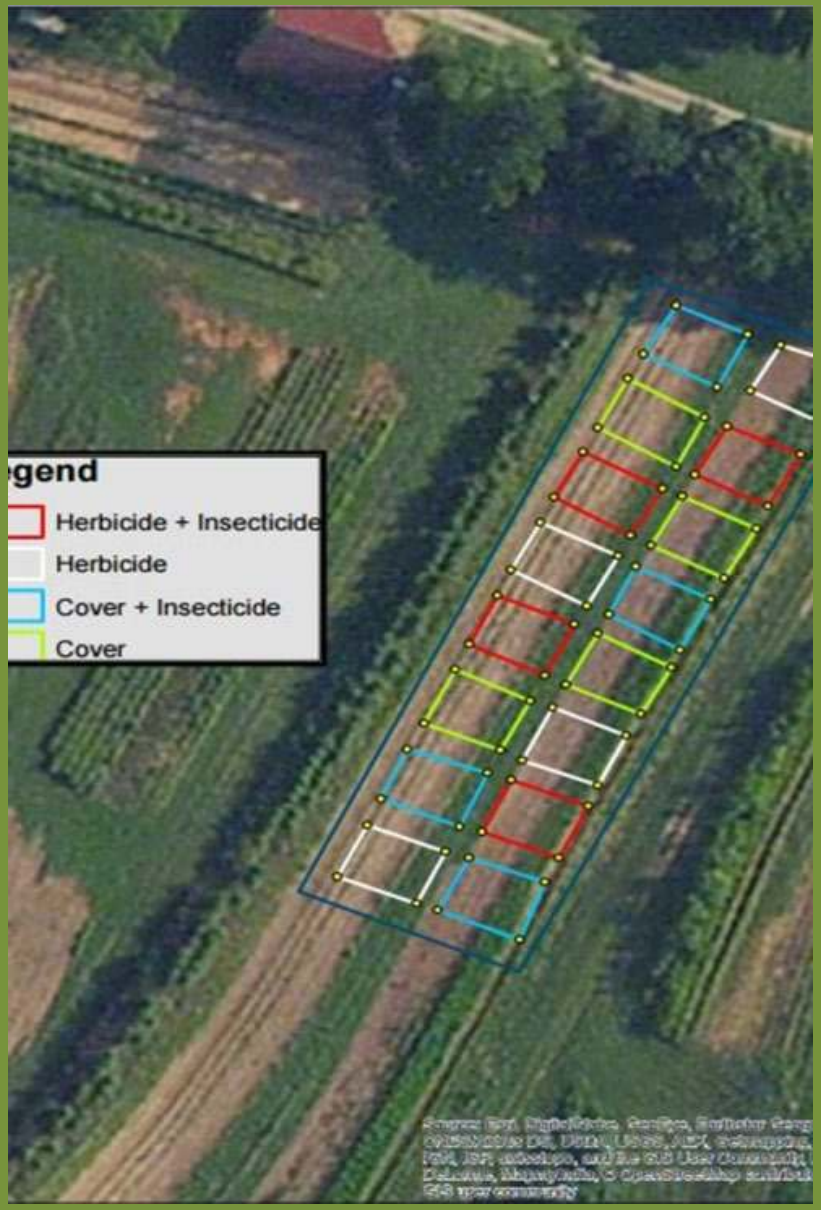
Contact Sprays

- Multiple applications per year
- Off-target drift and exposure risk higher
- Optimal timing unknown
- ★ Less labor-intensive/faster
- ★ Lower water requirement
- ★ Cheaper

Are there any other control methods?

Cover Cropping for FAB Protection

- Chose winter crops that grow ~60 cm tall by May 1
- Allowed cover to naturally senesce through summer
- Year 1 - winter wheat and crimson clover
- Year 2 – annual ryegrass and crimson clover



Cover Crop Plot Study

100 red maple ‘Frank’s Red’ trees (5 x 5 blocks)

1. Bare Rows (herbicided)
2. Current Recommendation – Bare Rows + Imidacloprid Drench
3. Cover Crop
4. Cover Crop + Imidacloprid Drench

Year 3 & 4 – cover cropped plots converted to herbicided rows to continue growing

Cover and Bare Row Blocks

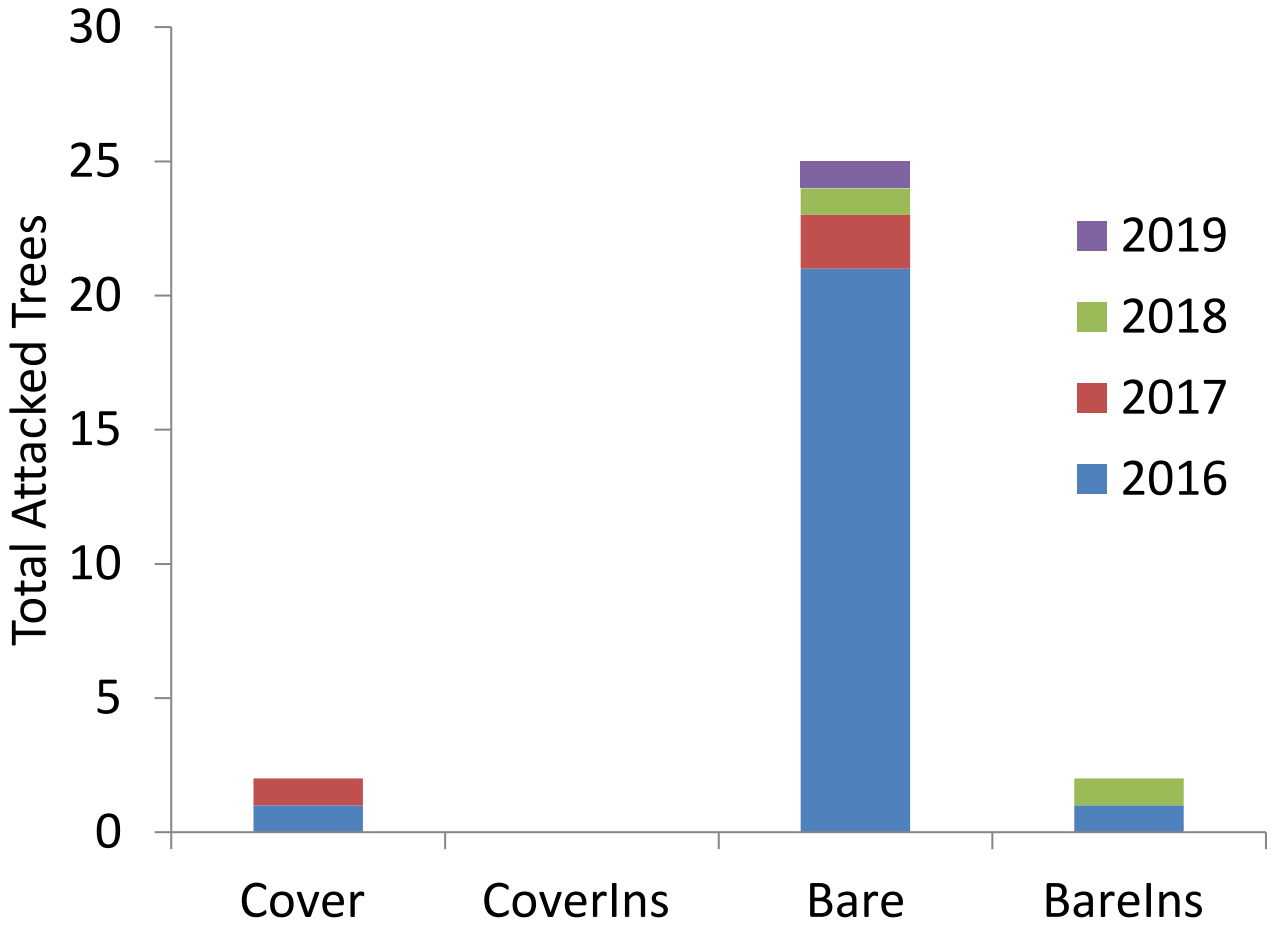
Results

Evaluation Parameters

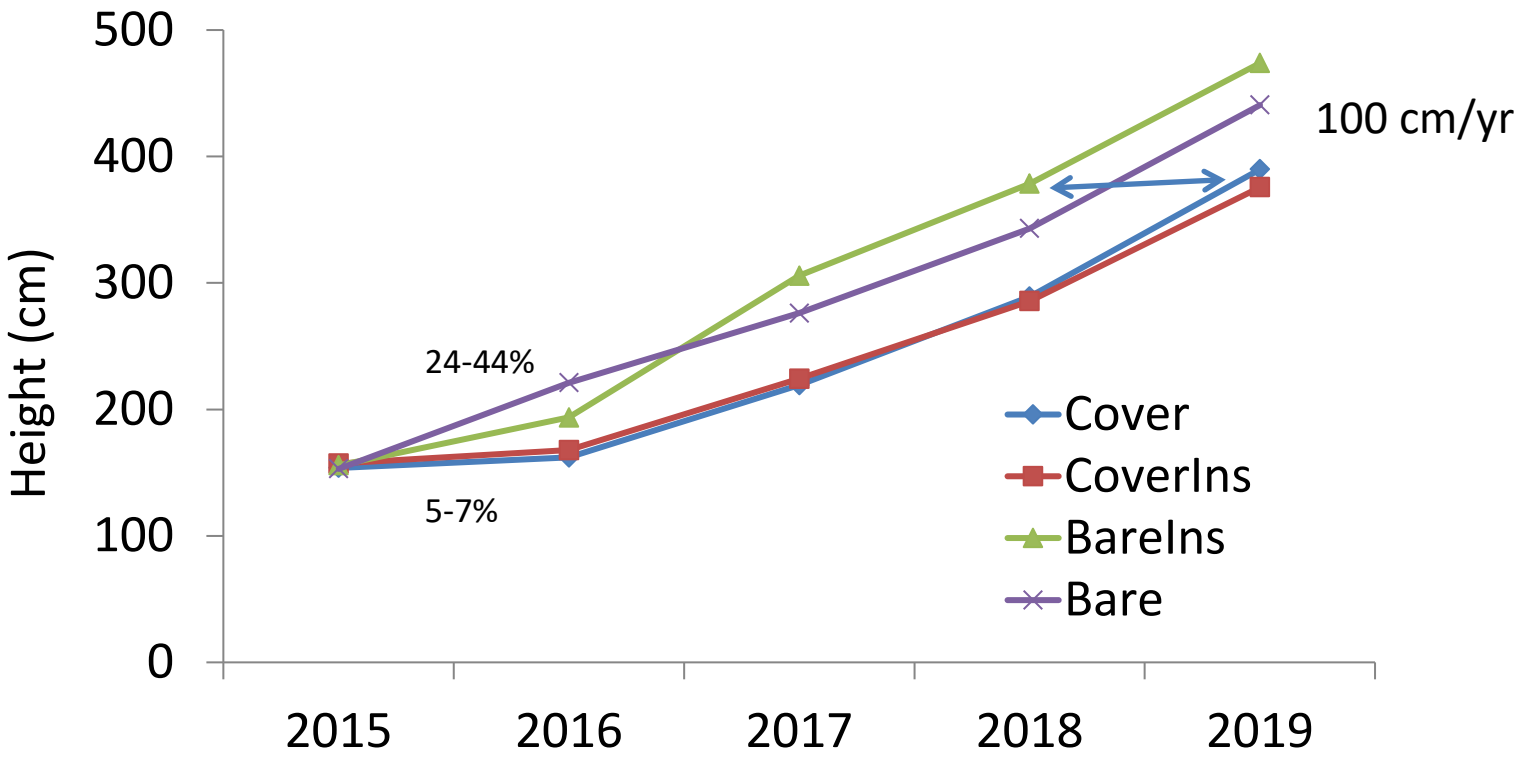
FHAB Damage Evaluation

Tree Growth Measurements

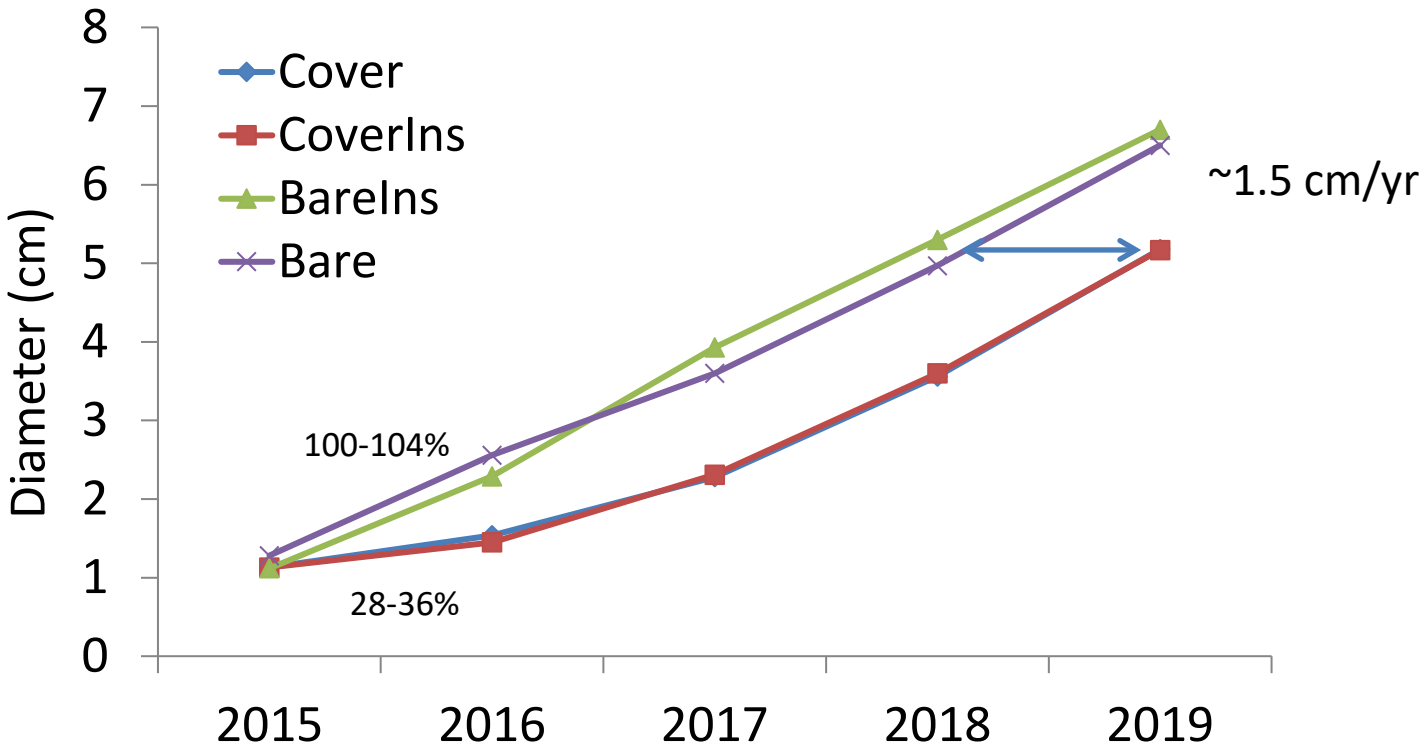
Tree Attacks from 2016-2019



Tree Height Growth Over Time



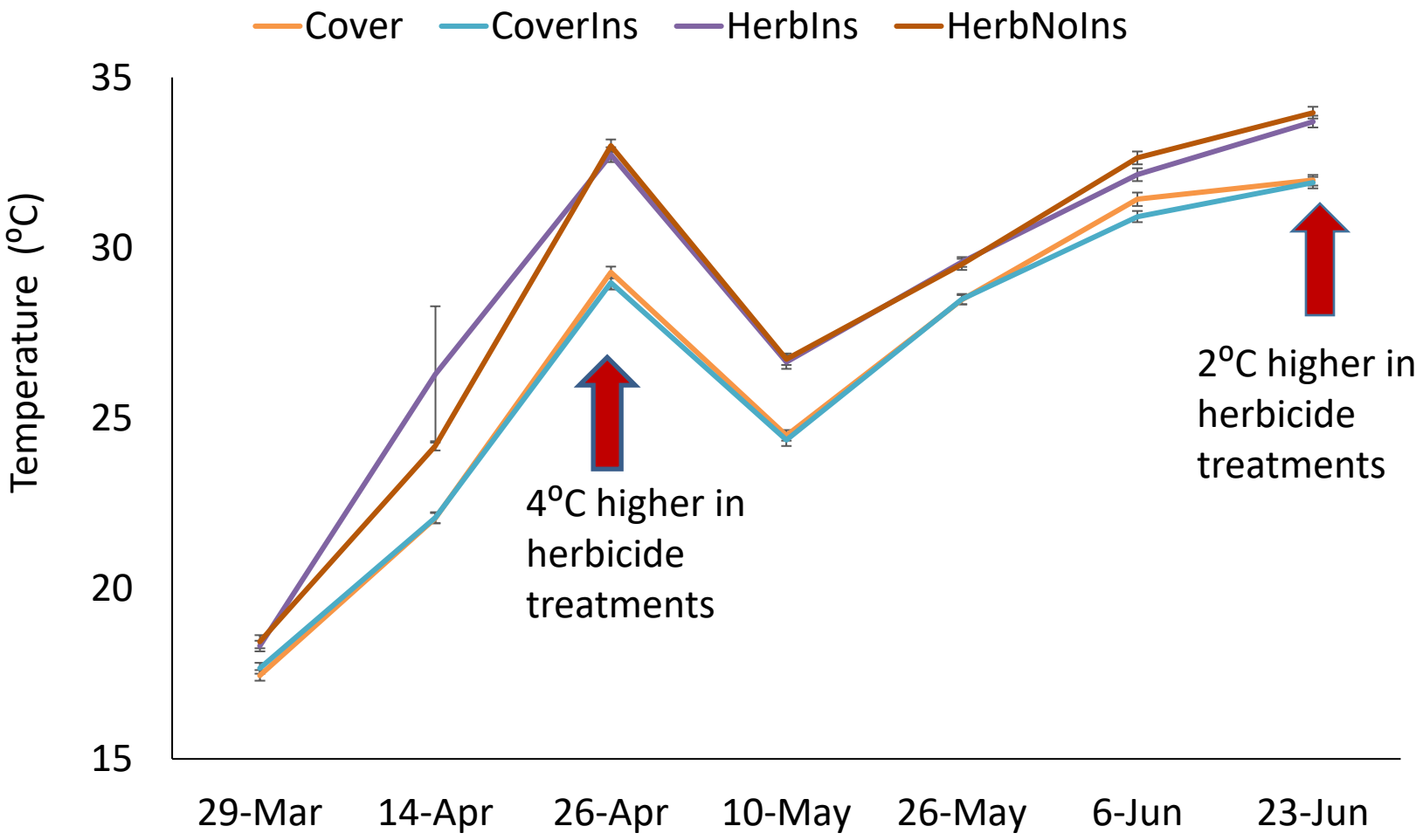
Tree Diameter Growth Over Time



2020 Wholesale Value of Trees

	Diameter (cm)	Wholesale Price	Survivors	Total
Cover	5.18	$120	98	$11,760
CoverIns	5.17	$120	100	$12,000
Bare	6.7	$150	75	$11,250
BareIns	6.5	$150	98	$14,700

Why no borers in cover crop trees?



FB Management Summary

Choose	Prevent	Protect
Choose the best plants for the region and best planting location	Prevent mowing or mechanical damage on new trees	Protect newly transplanted trees with systemic insecticide, targeted sprays or cover crop

Ongoing *Chrysobothris* Research SCRI Grant 2021-2024

1. Genetics of *Chrysobothris*
2. Phenology and Life History
3. Trapping and Monitoring
4. Insecticide & Biological Control
5. Economics of FB Control

Questions for 2021

- Are cuticular hydrocarbons extracted from elytra taxonomically informative for *Chrysobothris*?
- Does water stress increase borer attacks and can attacks be mitigated by irrigation?
- Can *C. femorata* be reared in artificial diet?
- When do females begin laying eggs?
- Do borers use plant odors to identify susceptible hosts?
- Do FABs use visual cues (VIS/NIR) to identify susceptible host plants?
- What timing is best in TN for controlling FABs with trunk sprays?
- Can ornamental grasses be used in landscapes to protect newly planted trees?

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