

# Laurel wilt vectors: biology and management

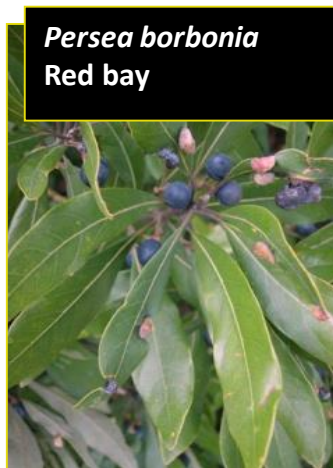


**Carrillo, Ploetz, Crane (UF-TREC) – Cave (UF-IRREC) – Stelinski (UF-CREC) - Kendra, Rooney (USDA-ARS) – Wasielewski UF/IFAS Extension Miami-Dade County**

# *Xyleborus glabratus*, Redbay Ambrosia Beetle



- Native to Taiwan, Japan & South East Asia
- infected ~ 0.5 billion native lauraceous trees with *R. lauricola* in the southeastern U.S.
- Does not breed in avocado



# Transmission of LW in avocado is more complex

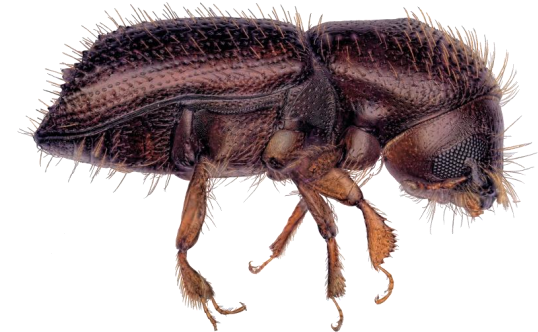
 Other ambrosia beetles gathered *R. lauricola* while breeding in LW infected trees

 Several species of AB now carry *R. lauricola*

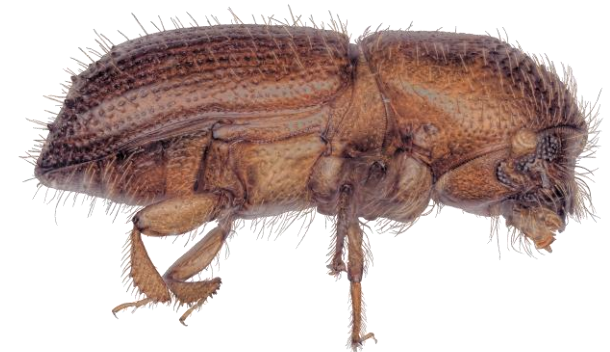
 At least two native species can transmit *R. lauricola* to avocado



*Xyleborus bispinatus*



*Xyleborus volvulus*



*Plant Pathology* (2014) 63, 54–62

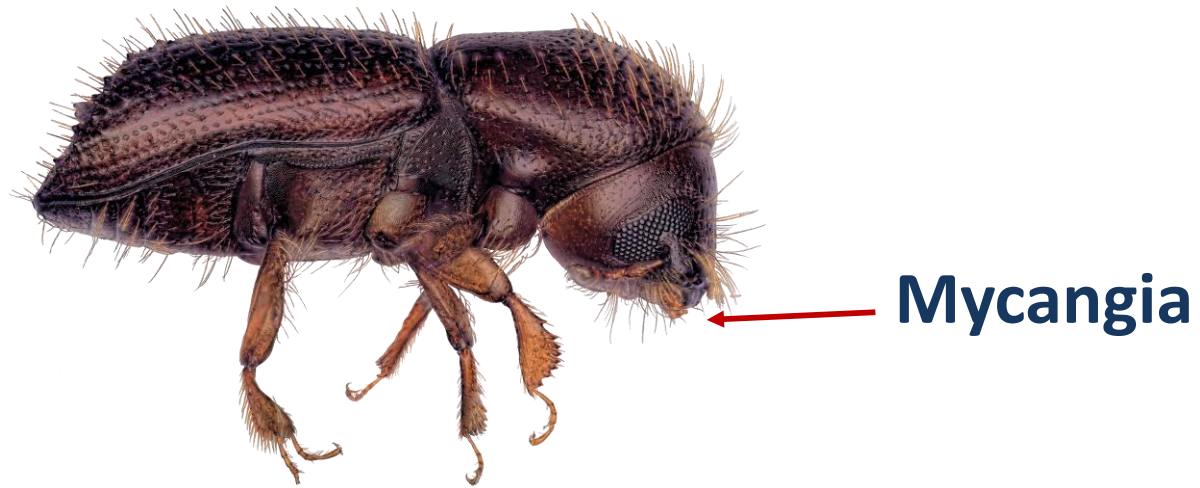
Doi: 10.1111/ppa.12073

**Lateral transfer of a phytopathogenic symbiont among native and exotic ambrosia beetles**

D. Carrillo\*, R. E. Duncan, J. N. Ploetz, A. F. Campbell, R. C. Ploetz and J. E. Peña

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# Ambrosia beetles are fungal farmers



 **Nutritionally important**

 **Many are saprophytic**

 **Few pathogens:**

***-R. lauricola***



# Host seeking



 **Chemical cues emitted by trees**

 **Weakened trees**

 **Visual cues**

 **Generally fly low and short distances**

 **At dusk (low light, no wind)**



FOUNDRESS

# Initial boring



FOUNDRESS



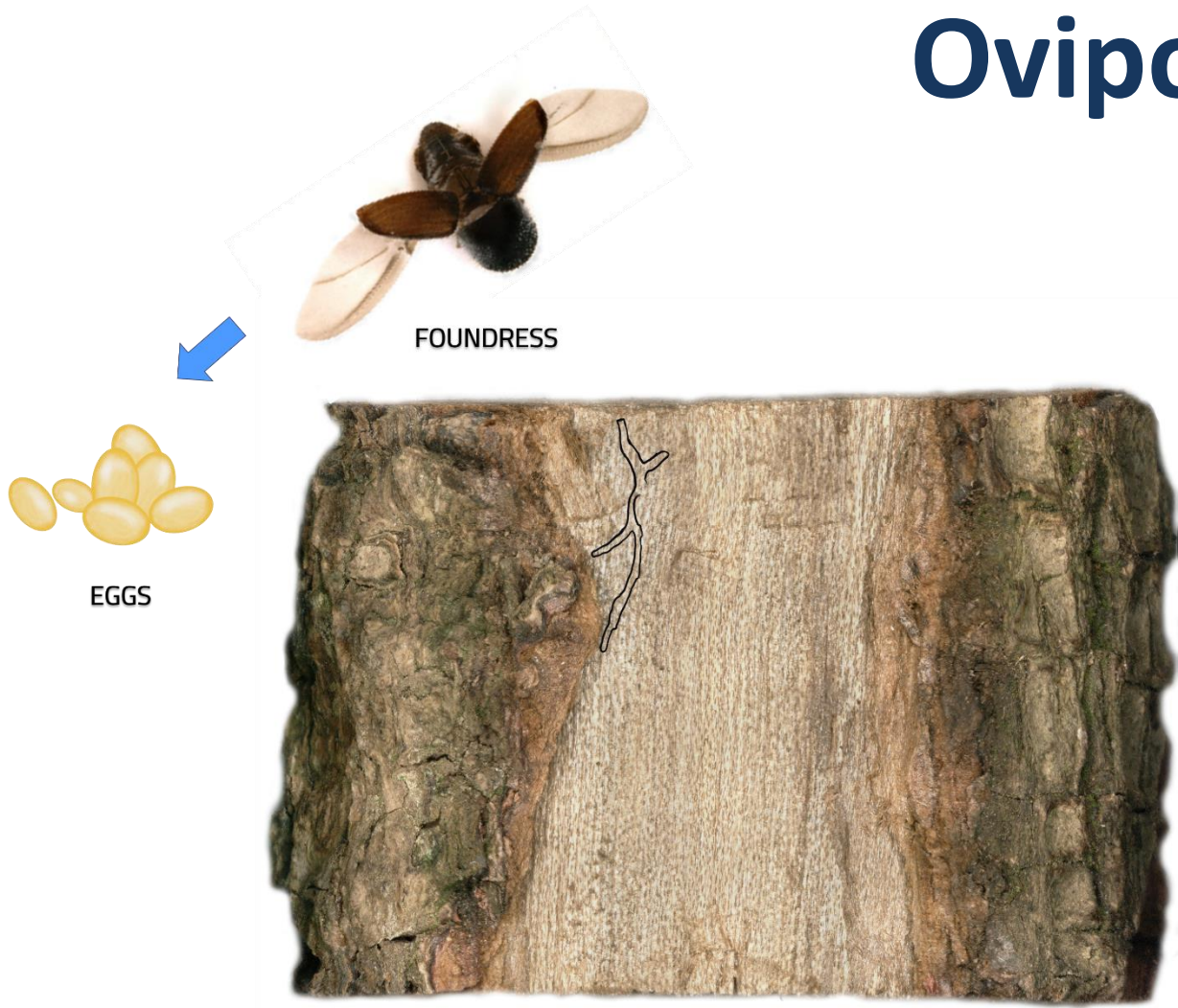
# Gallery construction & Fungus inoculation



FOUNDRESS



# Oviposition





# Larval feeding



FOUNDRESS



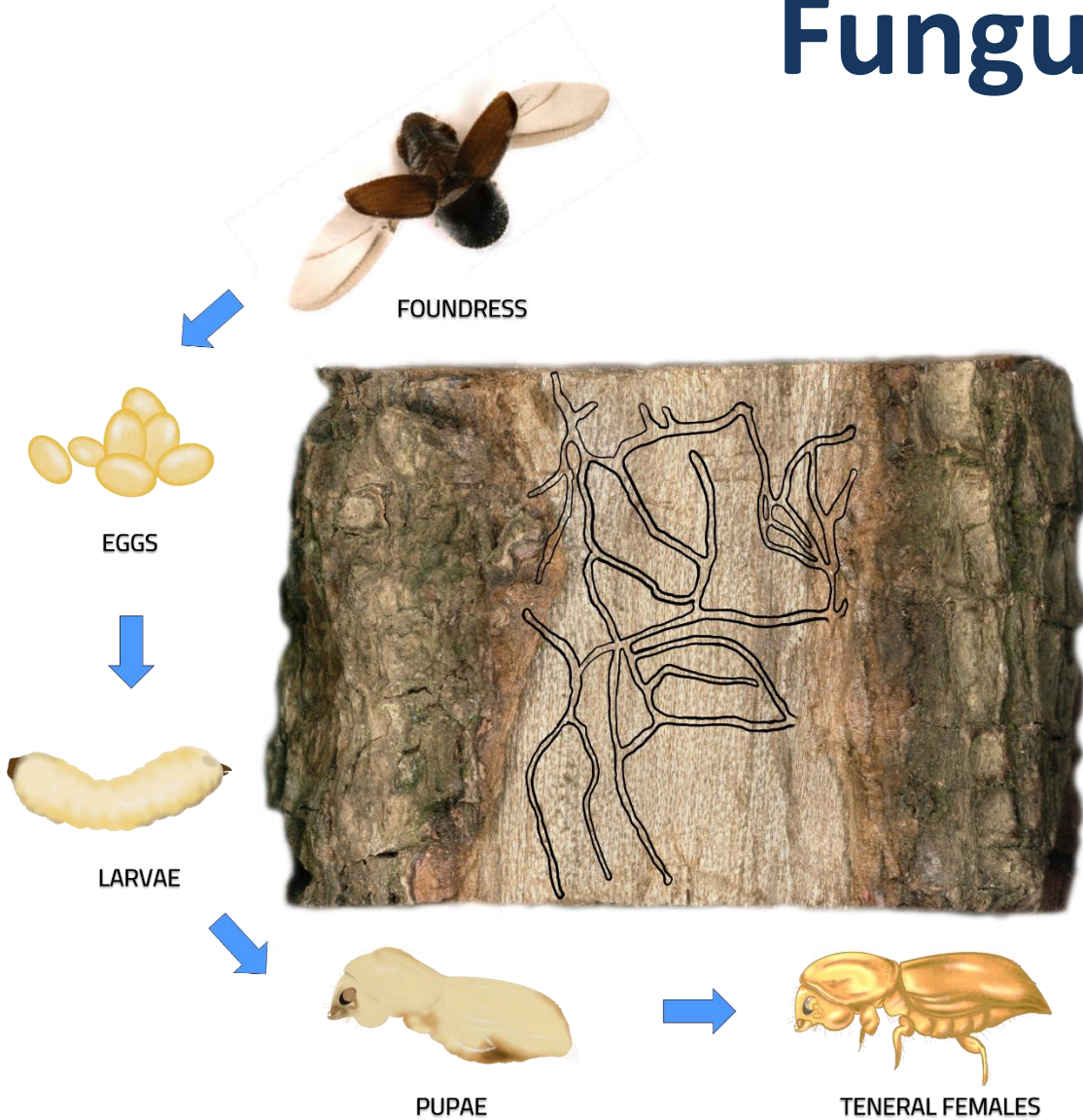
EGGS



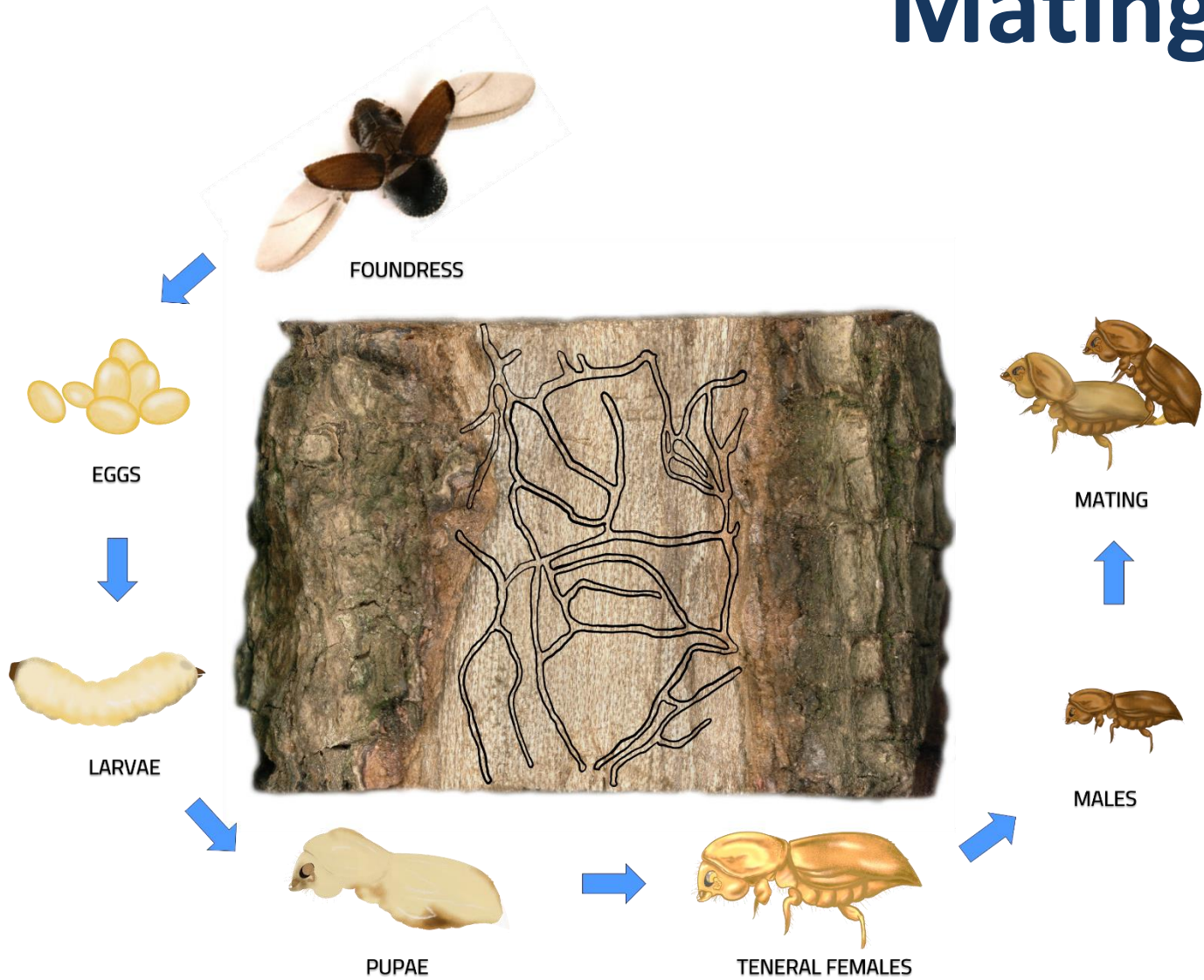
LARVAE



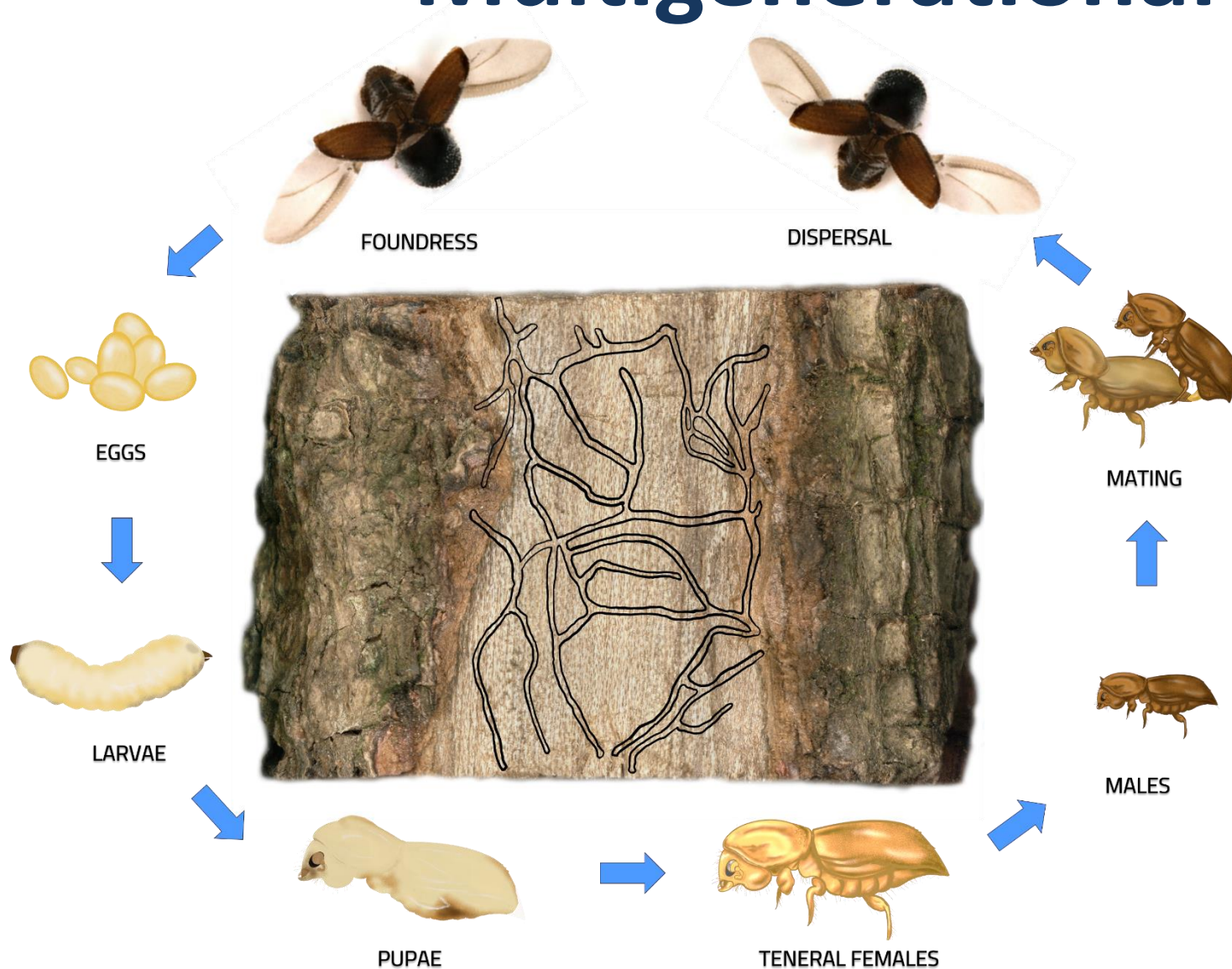
# Fungus acquisition



# Mating



# Multigenerational Colonies



 **3 generations or more in one gallery**

 **Females disperse carrying fungi**

 **Phoretic transport**

**ABs exhibit social behavior: cooperative brood care, fungus gardening, division of labor, sibling mating and overlapping generations inside galleries.**



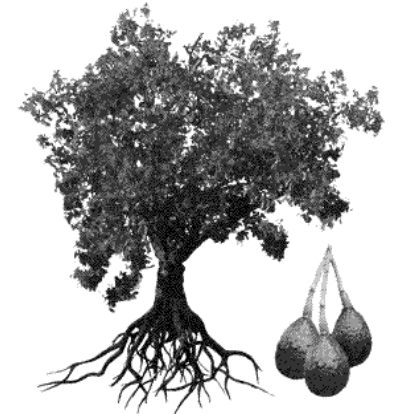
# Management: Ambrosia beetles are notoriously difficult to control

- >95% of time hidden inside the tree
- Feed on fungi not on plants



# Maintaining healthy trees is the first line of defense against ambrosia beetles

- 🪲 ABs generally attack stressed trees.
- 🪲 Mitigate potential causes of avocado tree decline (flooding, *Phytophthora*, poor nutrition, lightning, freezing).
- 🪲 Make the crop environment less suitable for ABs.
- 🪲 ABs prefer dense plantings, overcrowded, overlapping branches.
- 🪲 Pruning and removing dead branches.



# Monitoring - Scouting

Early detection of symptoms and rapid removal of infected/infested trees



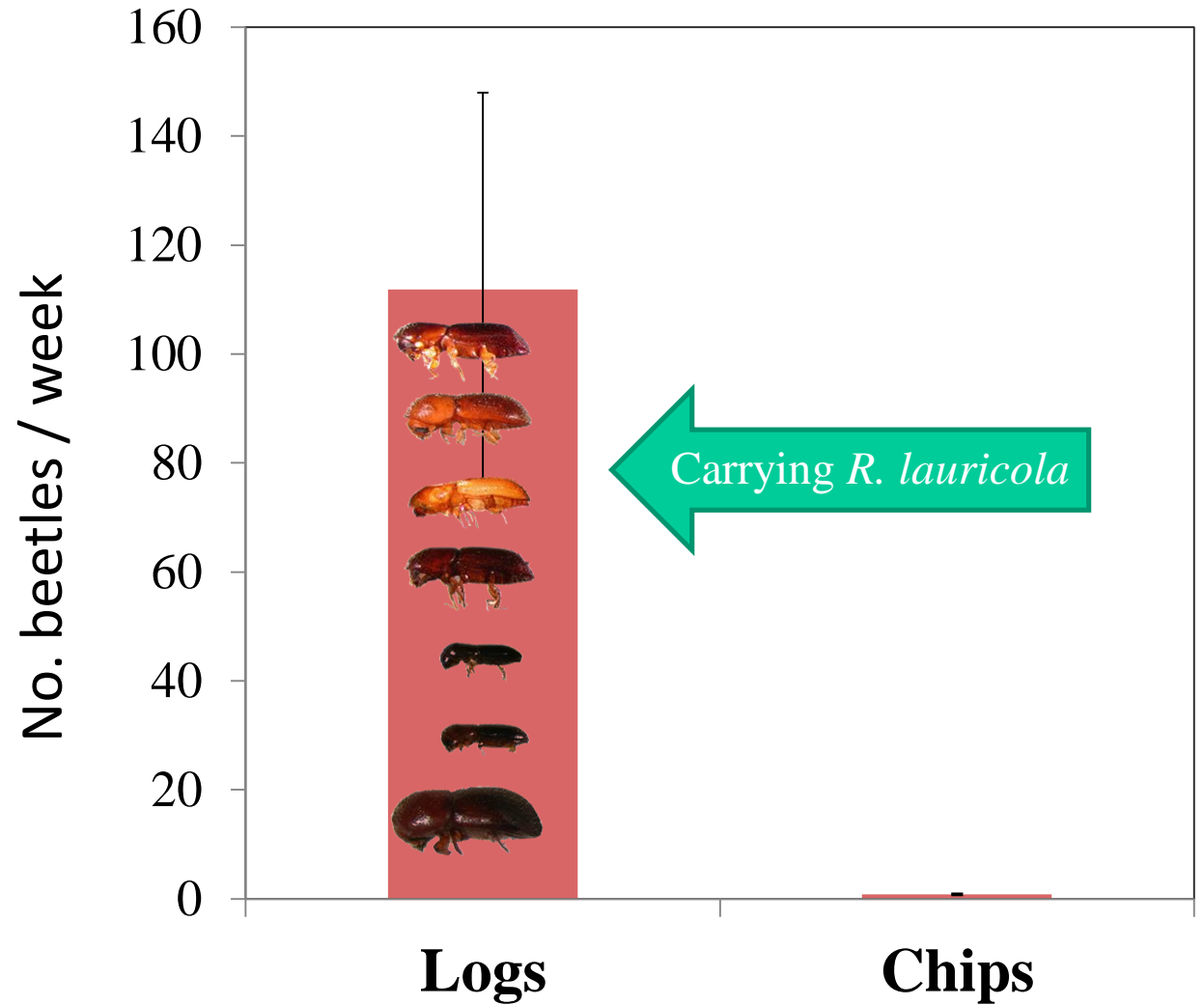


# Sanitation: Mechanical Control

- 🐛 Remove and destroy (chip or burn) infested trees including limbs, stump & roots.
- 🐛 Solarization (bagging)?



 Chipping wood is an effective way of killing beetles inside the trees.



A person wearing a white protective suit and a hat is standing in a forest, applying insecticide to the trunk of a large tree. The person is holding a spray nozzle and is positioned to the right of the tree trunk. The forest floor is covered with fallen leaves, and the background is filled with dense green foliage and tree branches.

## Contact insecticides:

**Do not kill ambrosia beetles that are inside the tree.**

**Low persistence - estimated efficacy 2-3 weeks when applied with a sticker.**

# Contact insecticides following sanitation



Hero<sup>®</sup> zeta-cypermethrin+ bifenthrin  
(S18)

Trunk directed sprays to one acre  
surrounding removed trees

# Available contact insecticides

Low volume trunk-directed sprays

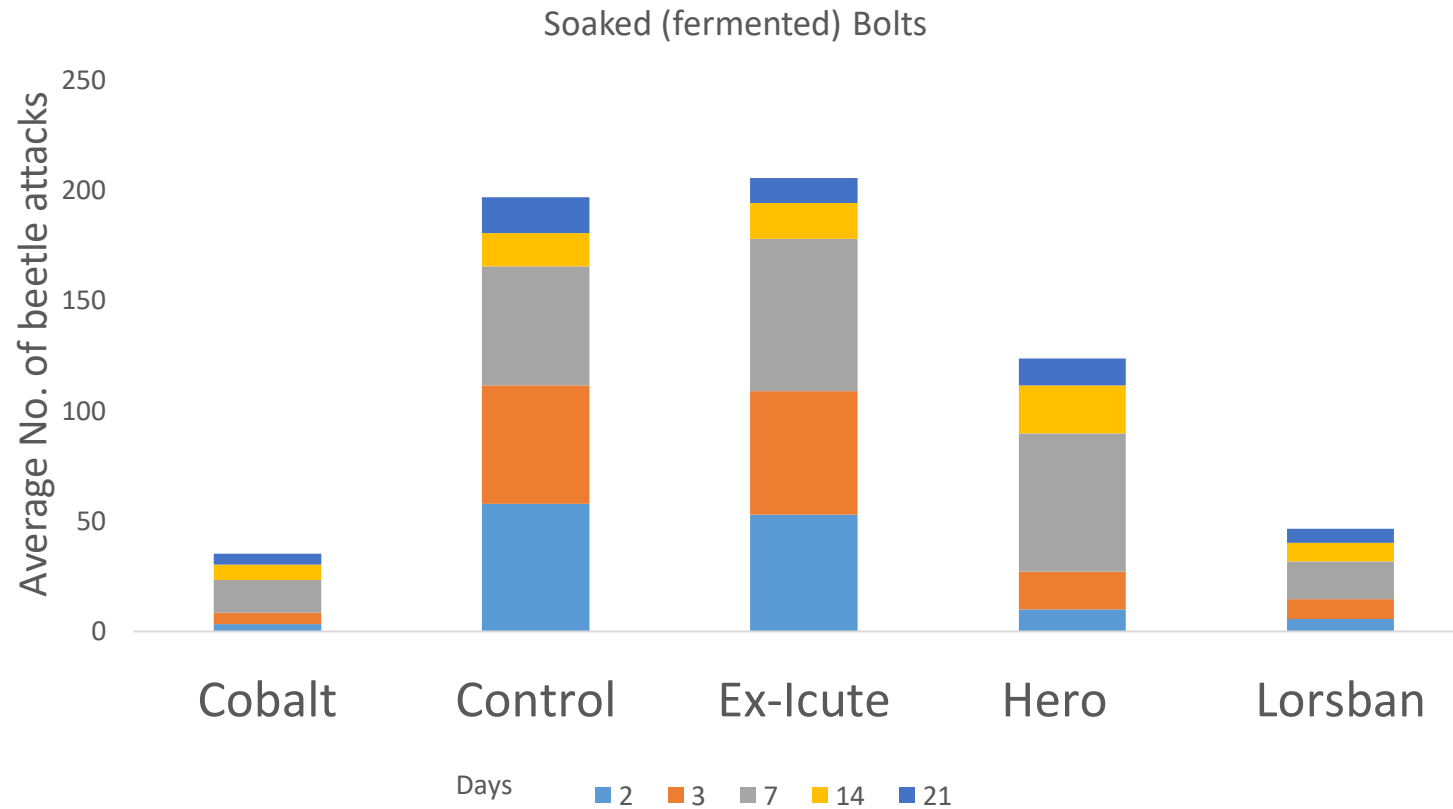
Use a sticker (Nu-Film) to prolong the efficacy

Product	Comments
Danitol 2.4 EC <sup>®</sup> (fenpropathrin)	
Malathion 5EC <sup>®</sup> (malathion)	
Epi-mek 0.15EC <sup>®</sup> (abamectin)	
<b>Hero<sup>®</sup> (zeta-cypermethrin+ bifenthrin)</b>	non-bearing
Talstar S <sup>®</sup> (bifenthrin)	non-bearing

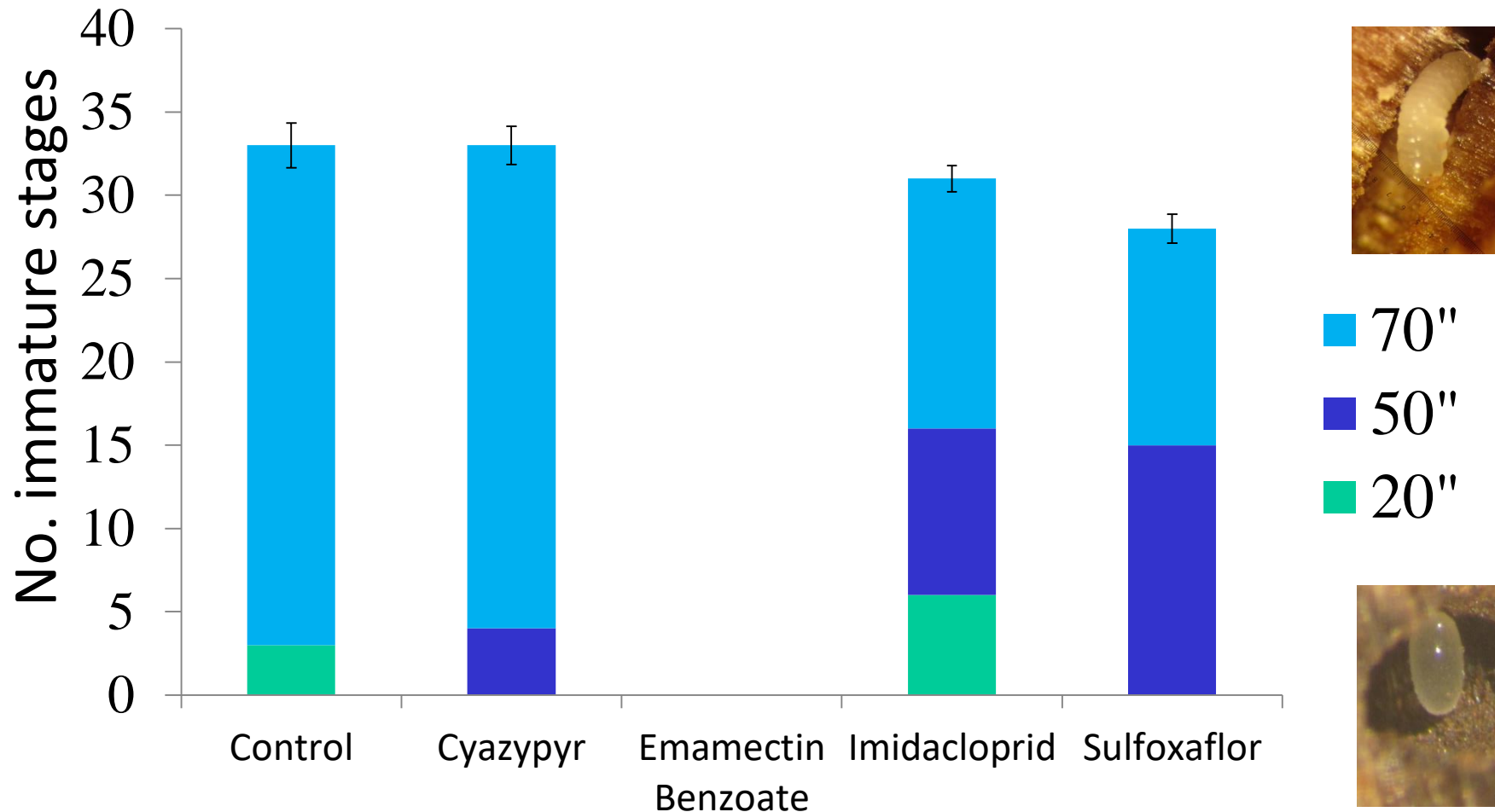
**Most efficacious: Section 18**

# Cobalt (Chlorpyrifos + Lambda-cyhalothrin)

## No registration



# Systemic Insecticides-Trunk Injections

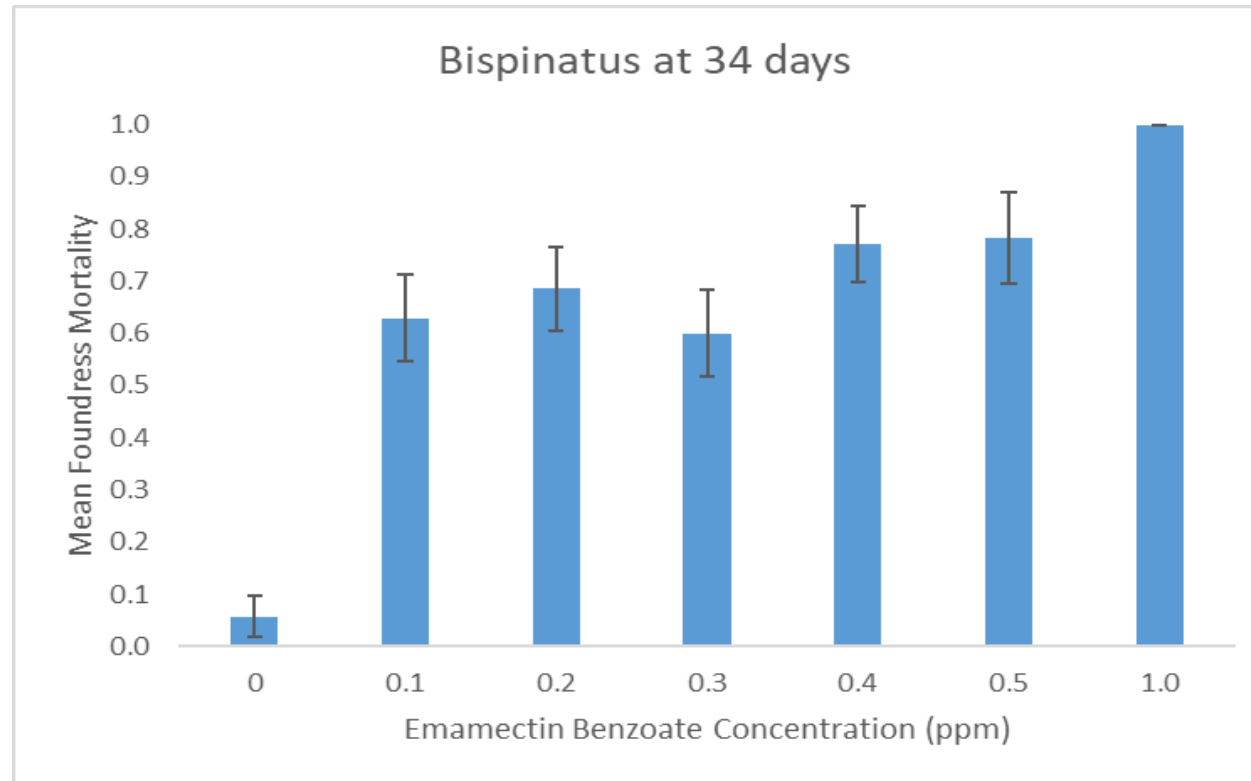


 No immature stages ~ no reproduction after Emamectin benzoate treatment.

# Emamectin Benzoate

 **NO REGISTRATION: issues with solvent -Tetrahydrofurfuryl Alcohol.**

 **New formulation more likely to be accepted for food crops.**





# Biological Control: Entomopathogenic Fungi



Contents lists available at ScienceDirect

Biological Control

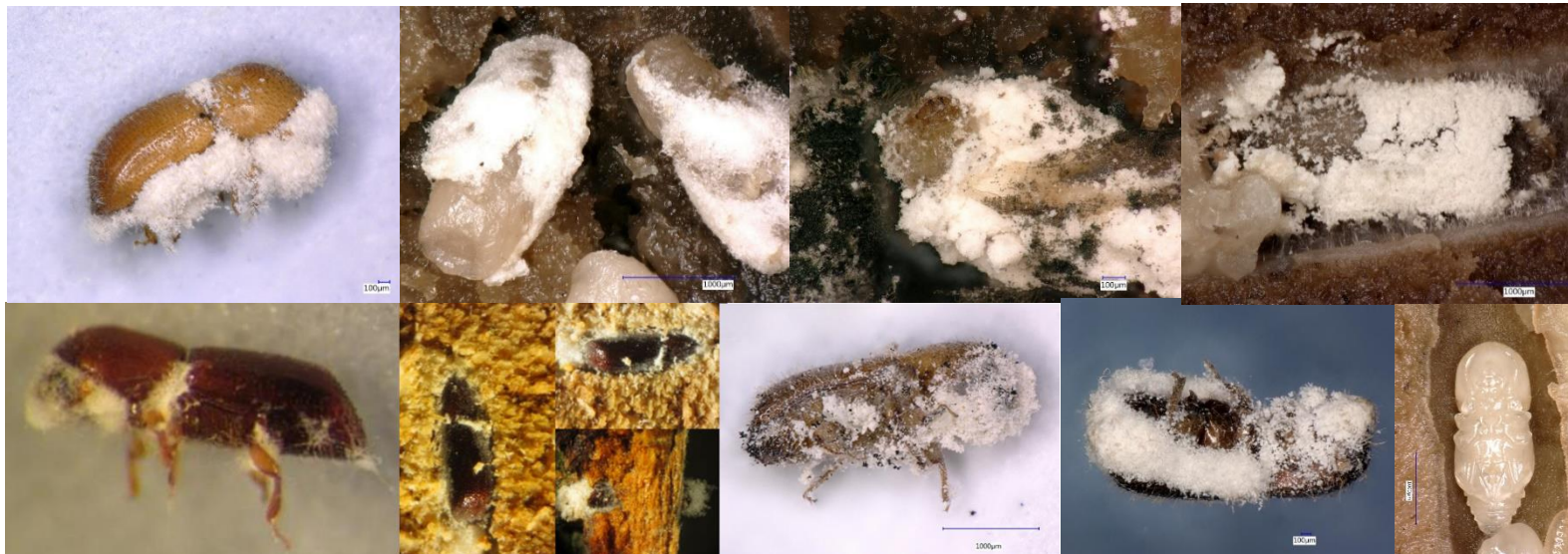
journal homepage: [www.elsevier.com/locate/ybcon](http://www.elsevier.com/locate/ybcon)



## *Beauveria bassiana* GHA + native strains

Entomopathogenic fungi as biological control agents for the vector of the laurel wilt disease, the redbay ambrosia beetle, *Xyleborus glabratus* (Coleoptera: Curculionidae)

D. Carrillo<sup>a,\*</sup>, C.A. Dunlap<sup>b</sup>, P.B. Avery<sup>c</sup>, J. Navarrete<sup>a</sup>, R.E. Duncan<sup>a</sup>, M.A. Jackson<sup>b</sup>, R.W. Behle<sup>b</sup>, R.D. Cave<sup>c</sup>, J. Crane<sup>a</sup>, A.P. Rooney<sup>b</sup>, J.E. Peña<sup>a</sup>



# Commercial formulations

Product	Rate per acre	Applications allowed per year per acre	Comments
BotaniGard ES ( <i>Beauveria bassiana</i> GHA)	32 oz	Open	
Mycotrol-O ( <i>Beauveria bassiana</i> GHA)	32 oz	Open	organic production



# Biological control with EPNS

## PROS

- 🪲 Provide control of other pests, including mirids and thrips during flowering period.
- 🪲 More persistent than chemical insecticides (Bb GHA infecting beetles 4 months after application).
- 🪲 Infect brood

## CONS

- 🪲 Do not kill ambrosia beetles that are already inside the tree.
- 🪲 Trunk directed sprays do not prevent the beetles from boring. Beetles bore and die inside the trunk.
- 🪲 Variable results for different ambrosia beetle species

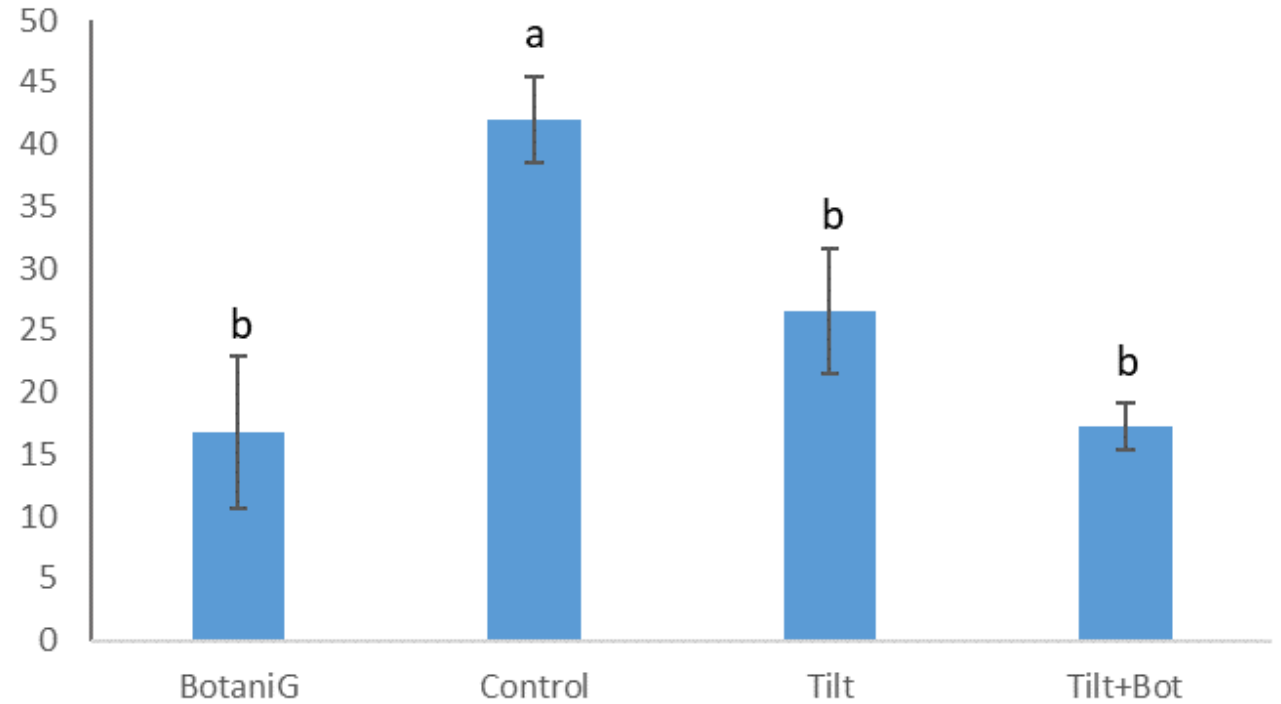


# Tilt (Propiconazole) ± BotaniGard (*B. bassiana*)

Tilt 200 ppm



Avg. Number of Progeny per foundress



# Attractants and Repellents

Kendra & Stelinski



Attractants: A-copaene + quercivorol (best available combination)  
Repellents for *X. glabratus*: Verbenone, Methyl salicylate (other beetles?)

# Regulatory control



Removal of infested  
unmanaged groves

# What can be done?

-  **Area wide management.**
-  **Identify more virulent strains of entomopathogens.**
-  **Search for more biocontrol agents.**
-  **Identify tactics that can control beetles inside trees (chemical, biological, ect.).**
-  **Continue developing attractants and repellents (Stelinski).**

# Thank you!



Florida Department of  
Agriculture and Consumer Services  
Adam H. Putnam, Commissioner