USDA APHIS RESEARCH UPDATE

Spotted lanternfly

Otis Laboratory Scientists Working on Spotted Lanternfly

Chemical ecology & behavior

Pesticides

Biological control

Trap design

Artificial rearing

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Spotted lanternfly

Cooperband lab update

- Trap and Lure Development
- Host preference & suitability
- Behavioral bioassays
- Volatile profiles & electrophysiology
- Dispersal study

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Jacob Wickham Chinese Academy of Sciences
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Greg Setliff Kutztown University
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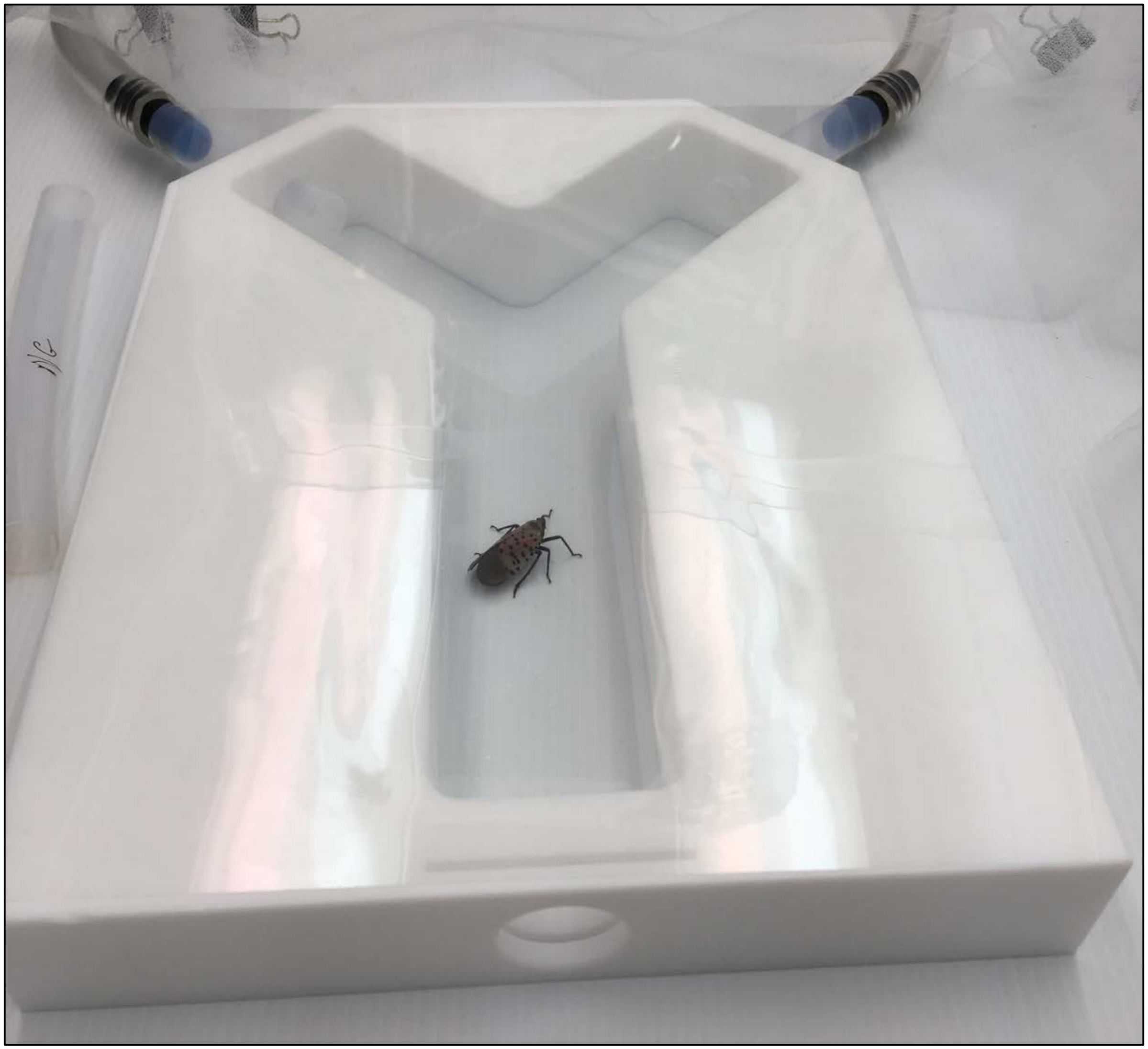
Tom Baker Pennsylvania State University
Daniel Carrillo University of Florida

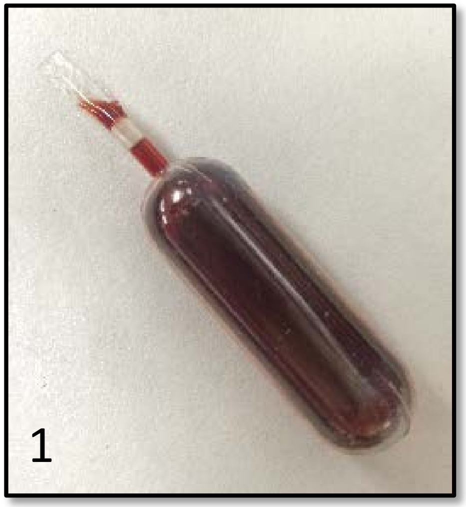
Spotted Lanternfly Kairomones

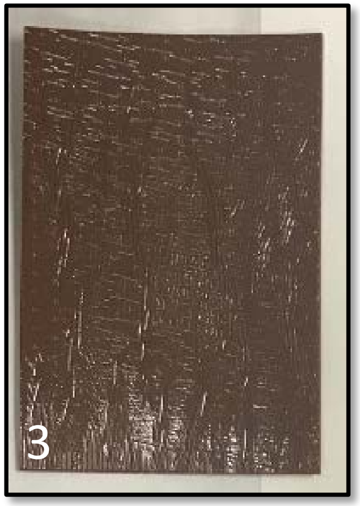


Cooperband lab

Lure Release Rates & Longevity

Compound	Maker	Lure Type
Methyl salicylate	AlphaScents	1. Pipette bulb
	Sino Green	2. Black heart
	Hercon	3. Laminate square
	AlphaScents	4. High release





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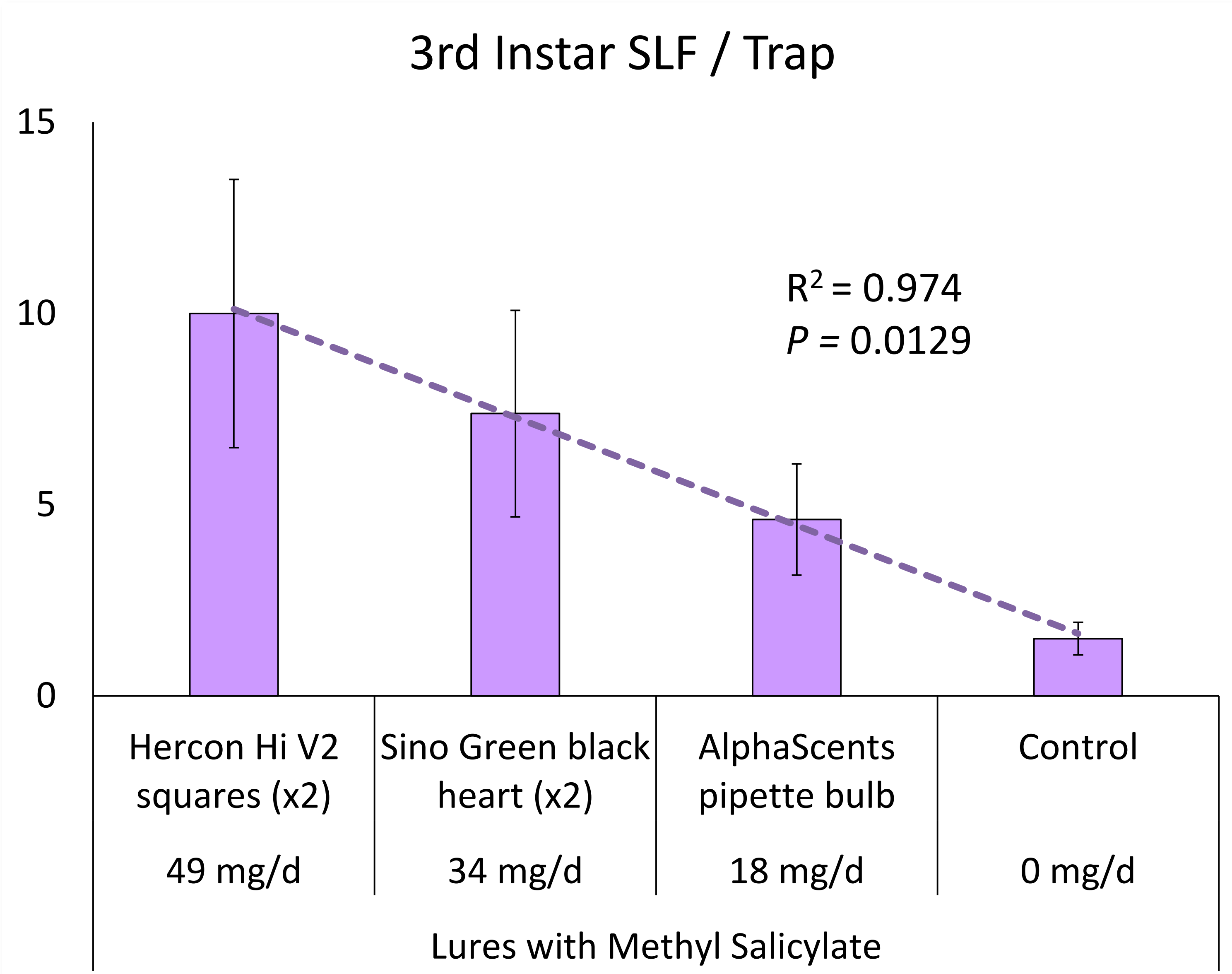
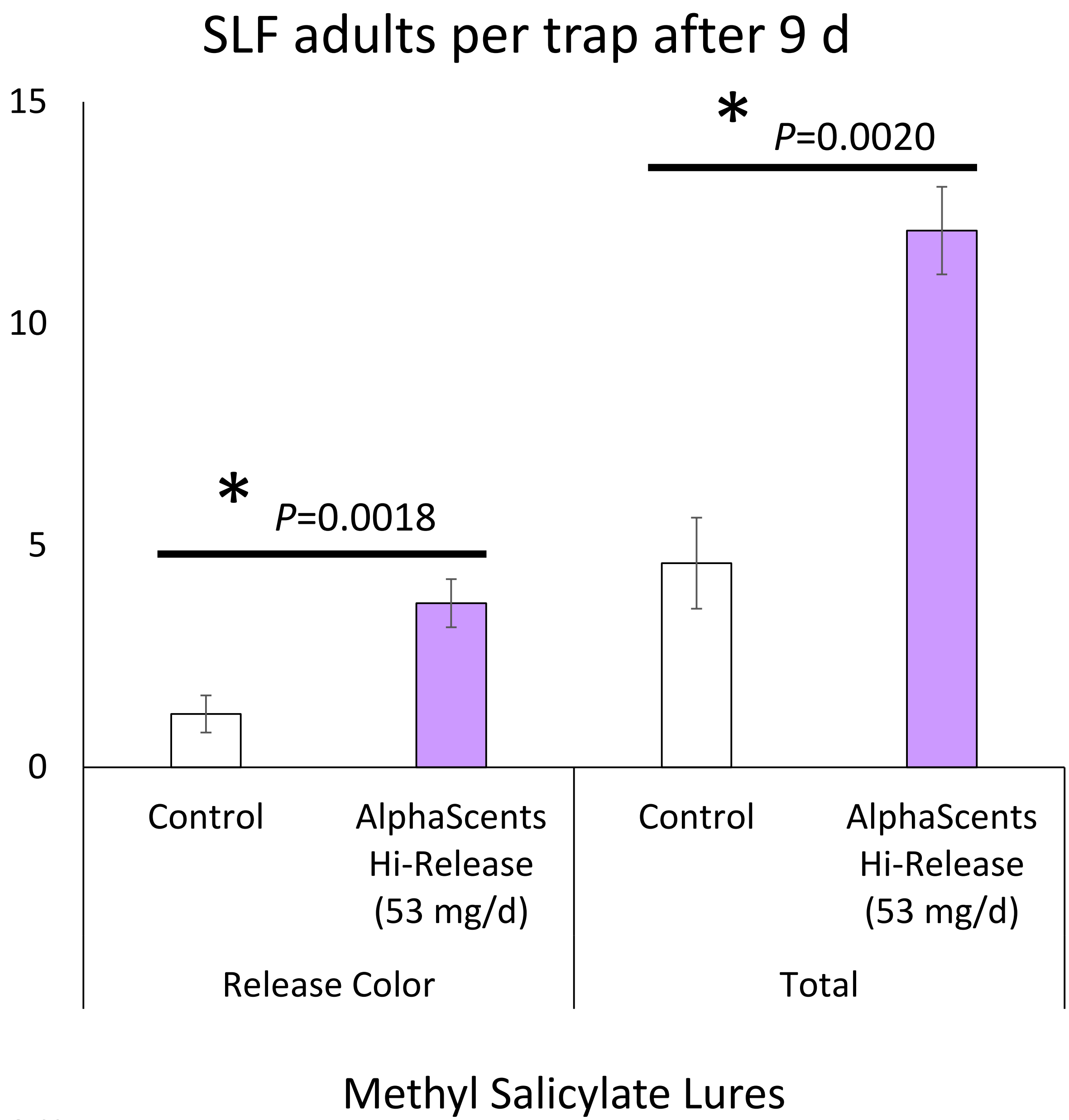


Cooperband & Wickham

2017

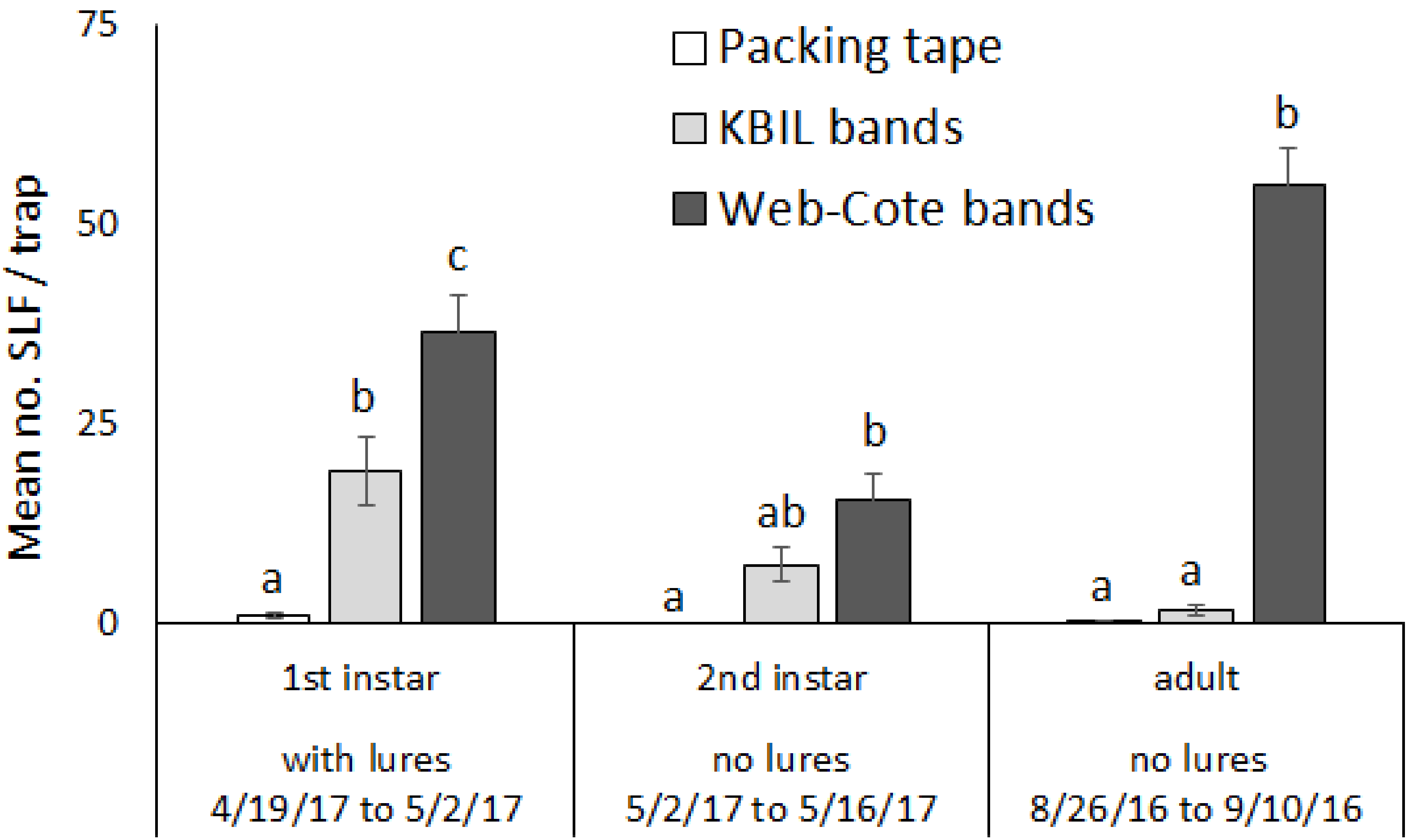
Spotted Lanternfly Kairomones



Cooperband & Wickham

2017

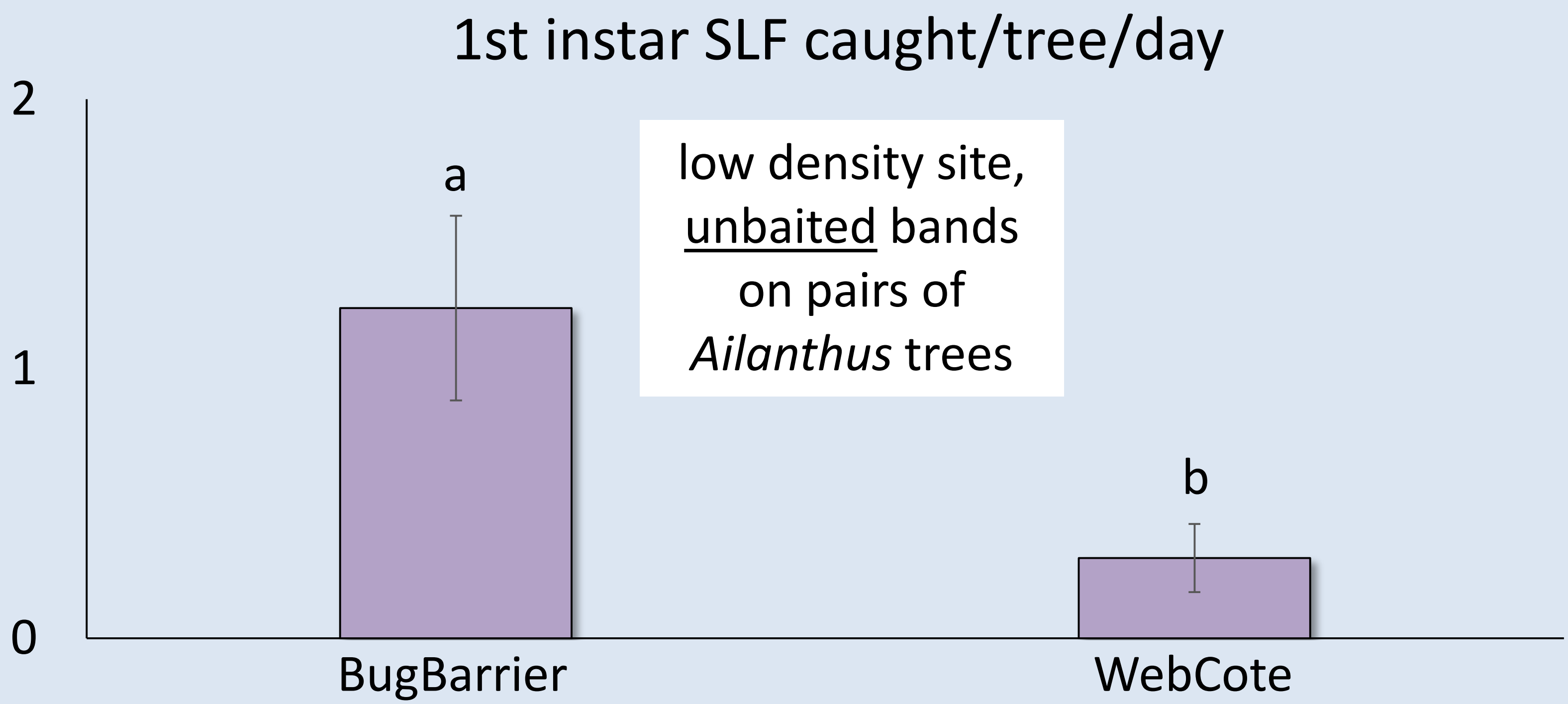
Trap Testing for Spotted Lanternfly



Cooperband & Wickham

2016 & 2017

Trap Testing for Spotted Lanternfly



More SLF, fewer non-targets!

2018

Traps & Lures for Spotted Lanternfly

- Methyl salicylate lures improved trap capture of 3rd instar and adult SLF by roughly 3-fold.
- Webcote sticky bands caught roughly twice as many nymphs and 30x as many adults as KBIL bands.
- BugBarrier caught 3-4 times more 1st instar SLF at a low density site than Webcote, making it a better detection tool at least for 1st instars.
- It was observed that BugBarrier also reduced non-targets, and had a longer field life.
- We continue to test BugBarrier and several additional trap designs in 2018 to develop better trapping options for 4th instars and adults.

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Leslie Abreu, Stefani Cannon, Kelley Murman, & Matt Wallace
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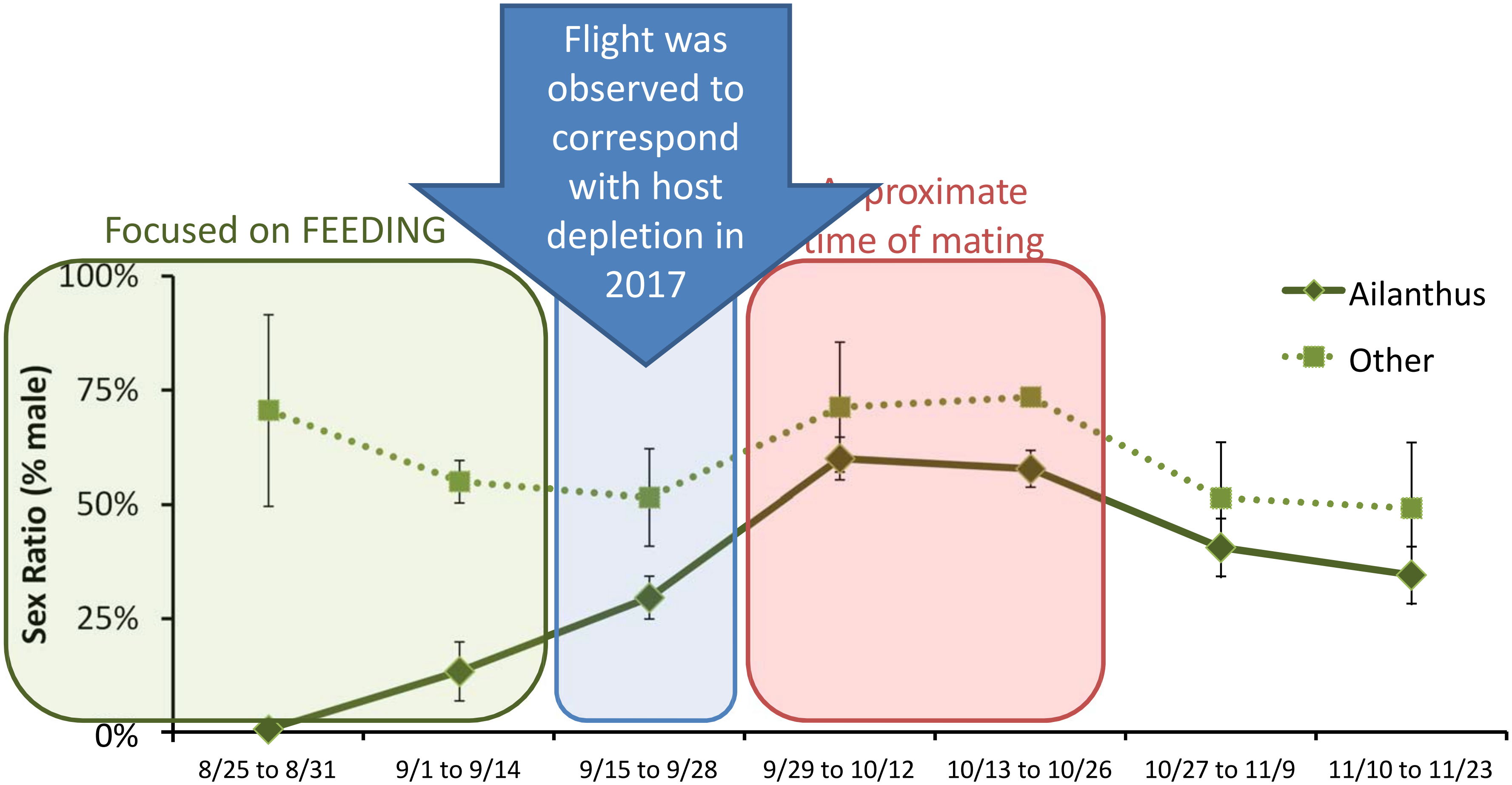
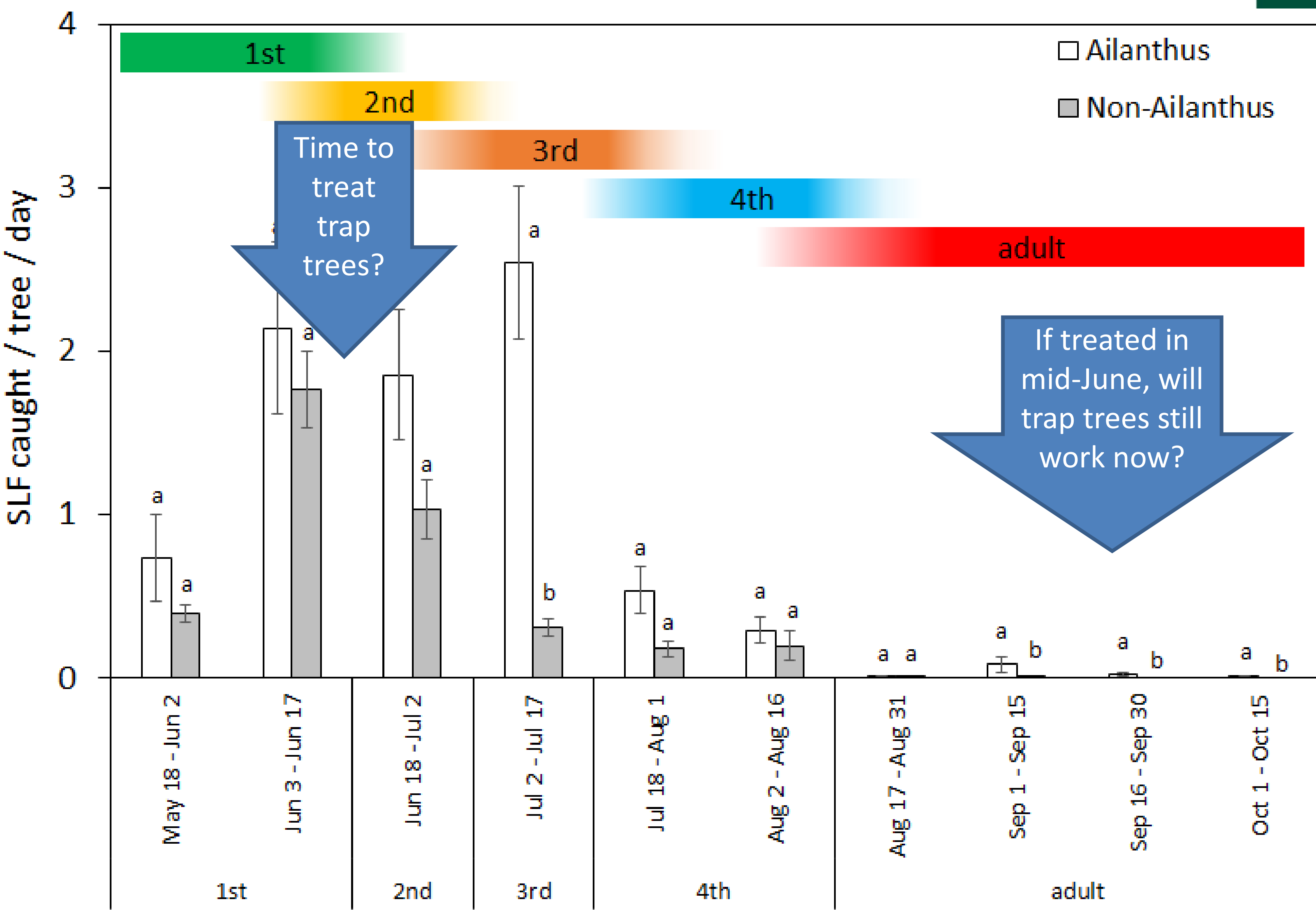
Kutztown University

Proposed Timing of Adult Behavior and Sex Ratio



Baker/Domingue/Cooperband



2016 Setliff

On what plants can SLF feed and develop exclusively from 1st instar to adult?

Field sleeves in PA
(10 SLF each)

Cages at Otis Lab
(5 SLF each)

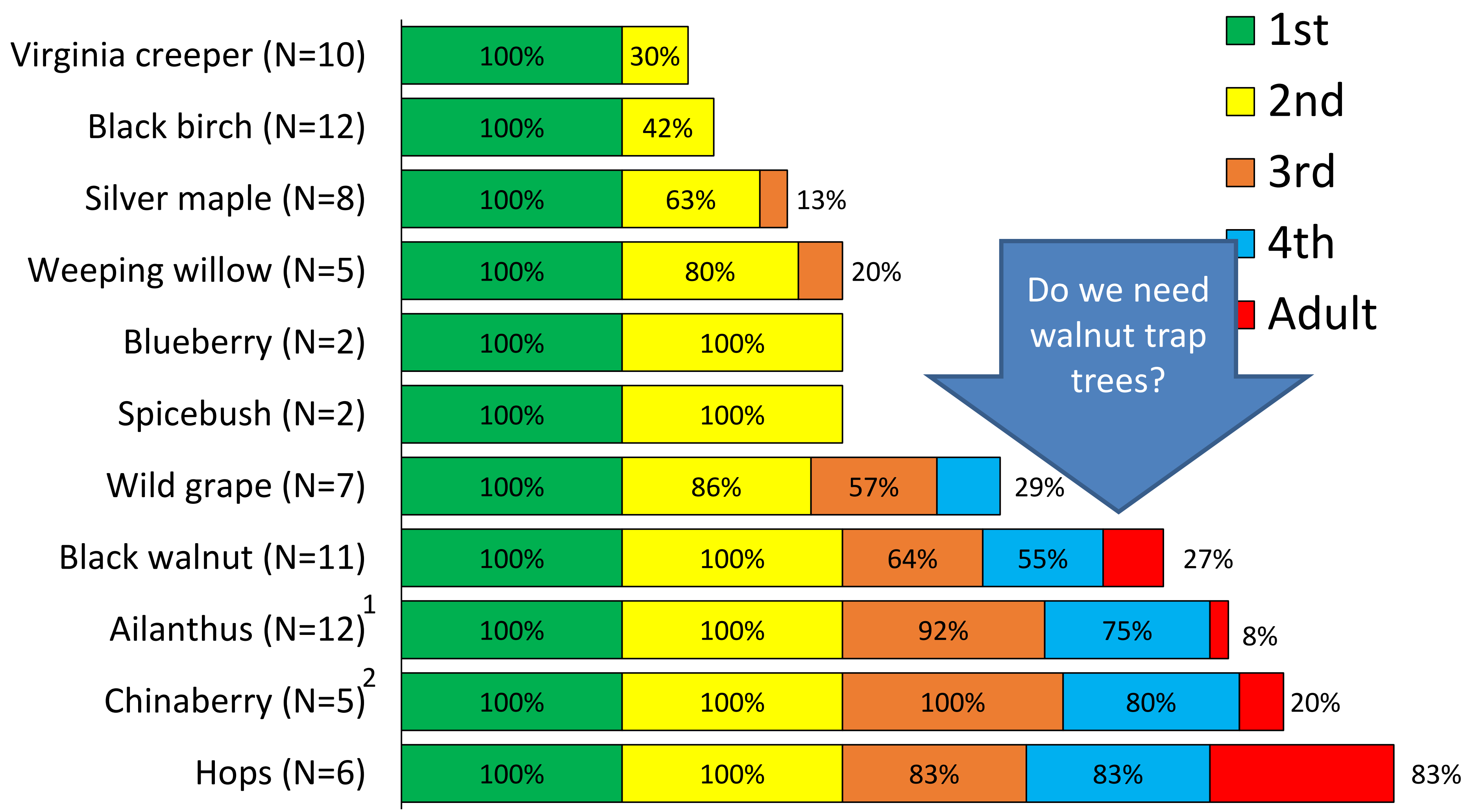
2017 Cooperband/Murman/Wallace

On what plants can SLF feed and develop exclusively from 1st instar to adult?

Field sleeves set up on *Ailanthus* and Chinaberry by cooperators in China (5 sleeves per tree species with 10 SLF each)

2017 Cooperband/Wickham

% of field sleeves reaching developmental stage



2017 Cooperband/Murman/Wickham

[1] Field sleeves from PA and China
[2] Field sleeves from China

Summary of Host Suitability Results

Plant tested	Scientific Name	Feeding? (survived >7d)	Suitable host for development from first instars to adults?
Tree-of-heaven	*Ailanthus altissima*	YES	YES
Chinaberry	*Melia azedarach*	YES	YES
Hops	*Humulus lupulus*	YES	YES
Black walnut	*Juglans nigra*	YES	YES
Wild grape	*Vitis vinifera sylvestris*	YES	NO
Oriental bittersweet	*Celastrus orbiculatus*	YES	NO?
Virginia creeper	*Parthenocissus quinquefolia*	YES	NO
Weeping willow	*Salix babylonica*	YES	NO
Black birch	*Betula nigra*	YES	NO
Blueberry	*Vaccinium cyanococcus*	YES	NO
Horseradish	*Armoracia rusticana*	YES	NO
Silver maple	*Acer saccharinum*	YES	NO
Spicebush	*Lindera benzoin*	NO	NO
Basil	*Ocimum basilicum*	NO	NO

2017 Cooperband/Murman/Wickham

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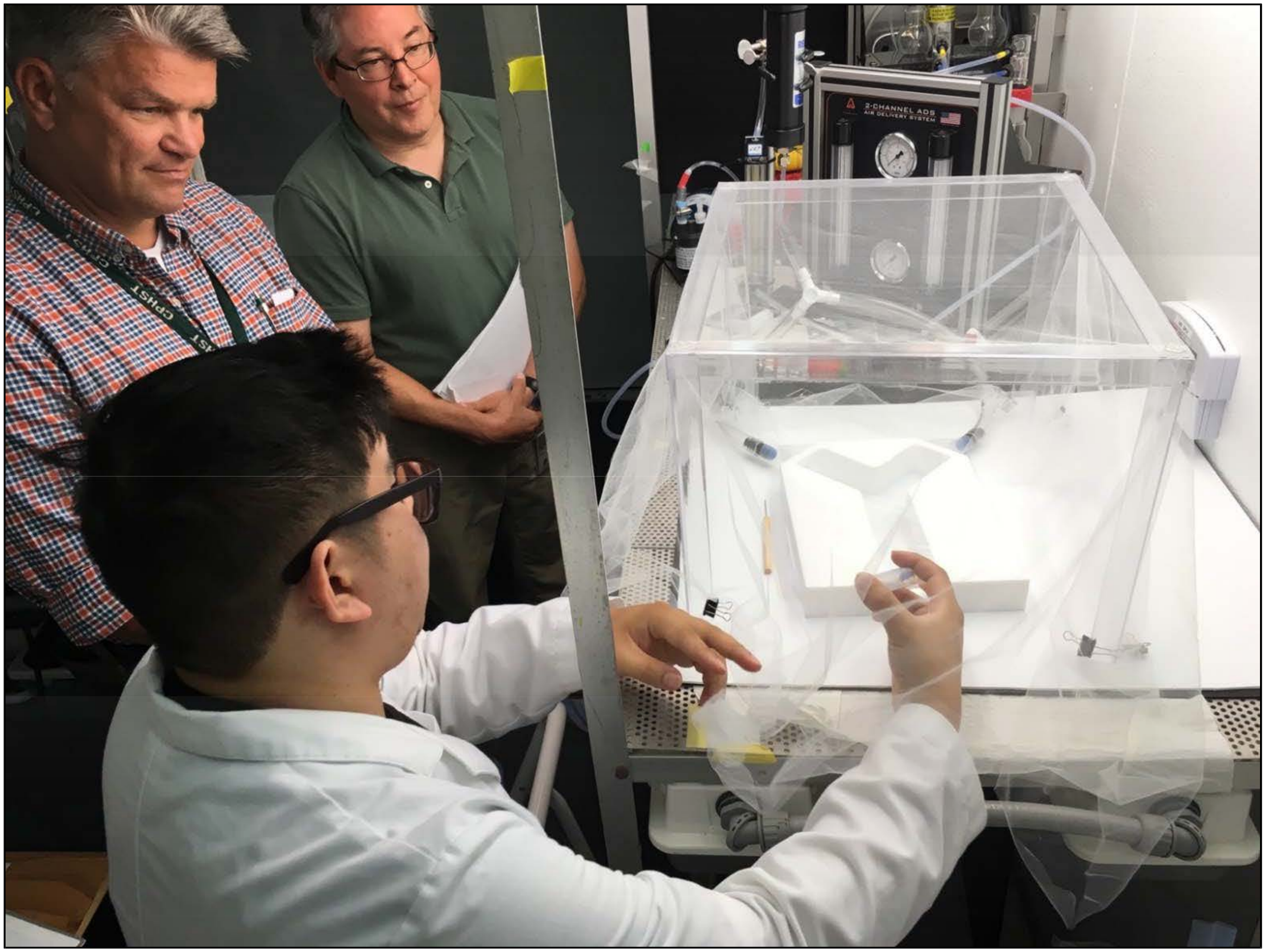
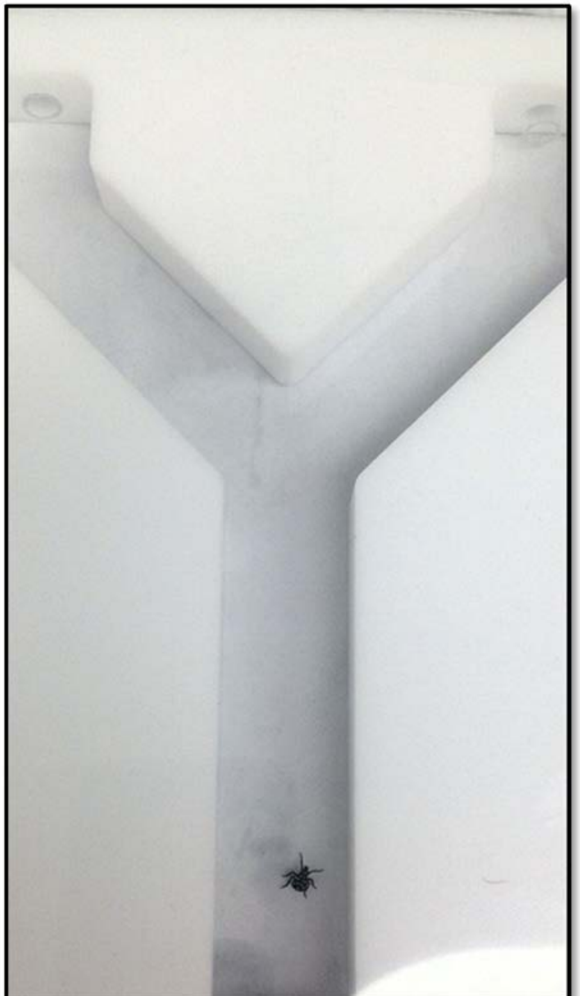
Isaiah Canlas & Katie Cleary
Otis Laboratory / University of Florida Cooperator

Laboratory Behavioral Bioassays



Cooperband lab

Laboratory Behavioral Bioassays



- Leaves
- Plant volatile collections
- Plant essential oils
- Synthetic compounds
- Compound blends
- Insect volatile extracts

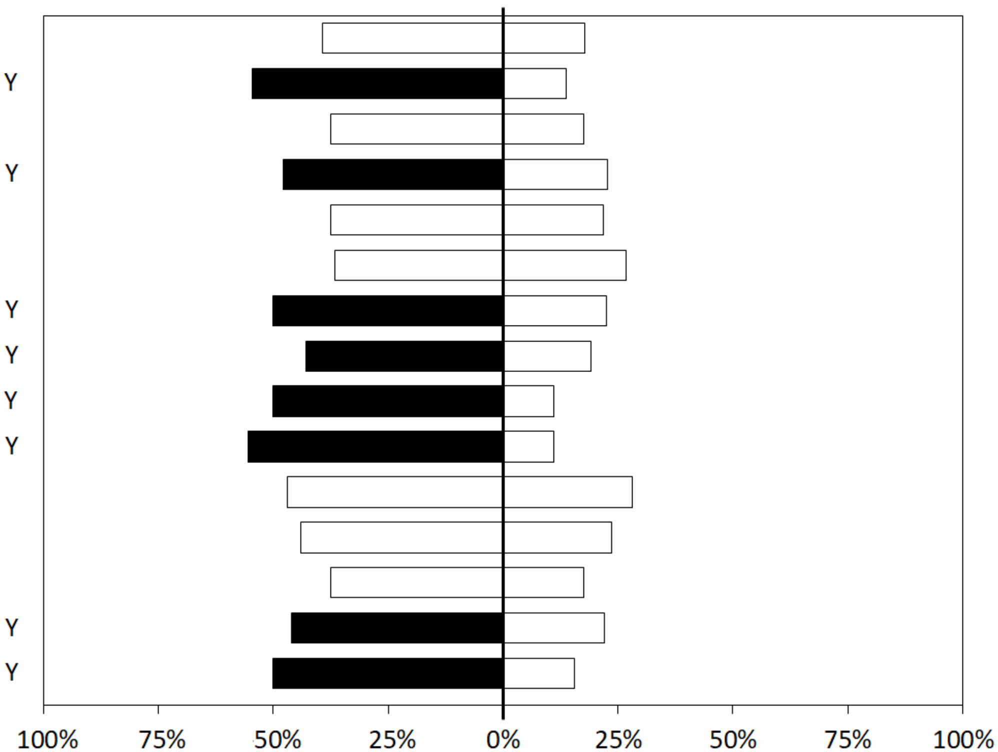
Cooperband lab

Laboratory Behavioral Bioassays

USDA

Frequency and Direction of Choice

Instar	N	Comparison	Signif.
1st	28	black cherry vs control	
2nd	22	Ailanthus vs control	Y
2nd	40	alfalfa vs control	
2nd	44	Chinaberry vs control	Y
2nd	32	horseradish vs. control	
2nd	30	oriental bittersweet vs control	
2nd	40	hops vs control	Y
2nd	42	wild grape vs control	Y
3rd	18	Ailanthus vs control	Y
3rd	18	Chinaberry vs control	Y
3rd	32	hops vs control	
3rd	34	Basil vs control	
3rd	40	milkweed vs control	
3rd	50	wild grape vs control	Y
4th	32	wild grape vs control	Y



Cooperband lab

Laboratory Behavioral Bioassays

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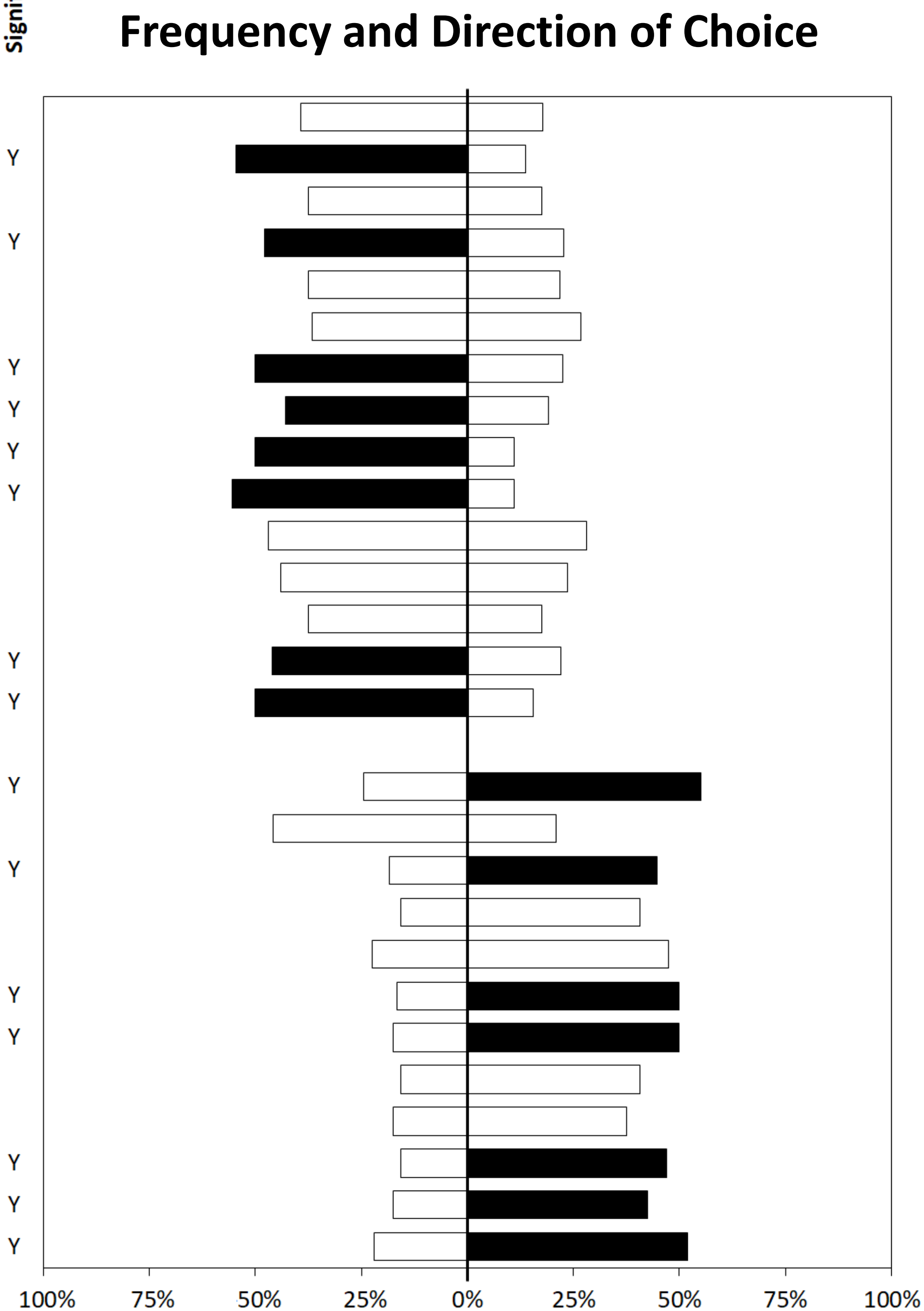
2nd	44	Chinaberry vs control	Y
2nd	32	horseradish vs. control	
2nd	30	oriental bittersweet vs control	
2nd	40	hops vs control	Y
2nd	42	wild grape vs control	Y
3rd	18	Ailanthus vs control	Y
3rd	18	Chinaberry vs control	Y
3rd	32	hops vs control	
3rd	34	Basil vs control	
3rd	40	milkweed vs control	
3rd	50	wild grape vs control	Y
4th	32	wild grape vs control	Y
1st	49	Chinaberry vs Ailanthus	Y
1st	24	black cherry vs Ailanthus	
2nd	38	Chinaberry vs Ailanthus	Y
2nd	32	horseradish vs Ailanthus	
2nd	40	oriental bittersweet vs Ailanthus	
2nd	30	hops vs Ailanthus	Y
3rd	40	wild grape vs Ailanthus	Y
3rd	32	black cherry vs Ailanthus	
3rd	40	alfalfa vs Ailanthus	
3rd	32	hops vs Ailanthus	Y
3rd	40	milkweed vs Ailanthus	Y
3rd	50	wild grape vs Ailanthus	Y



Cooperband lab

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Linnea Meier
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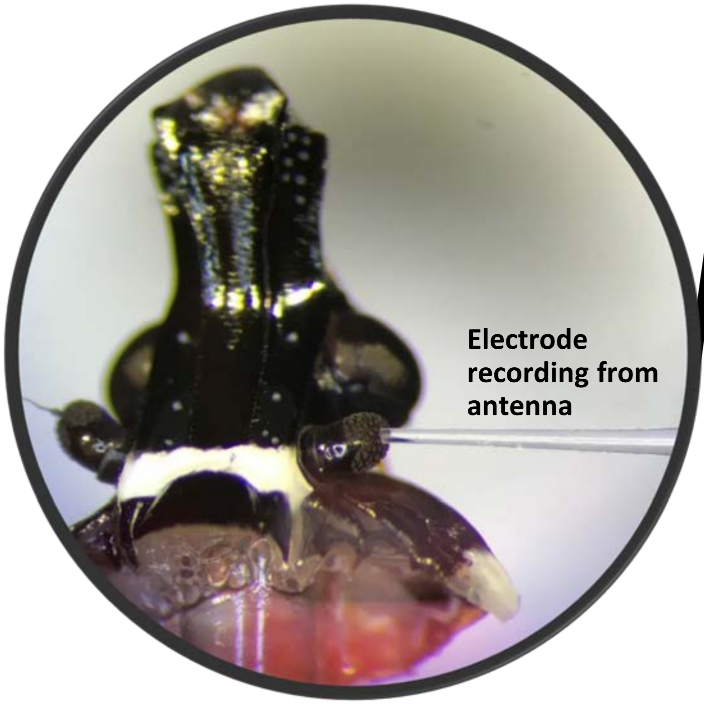
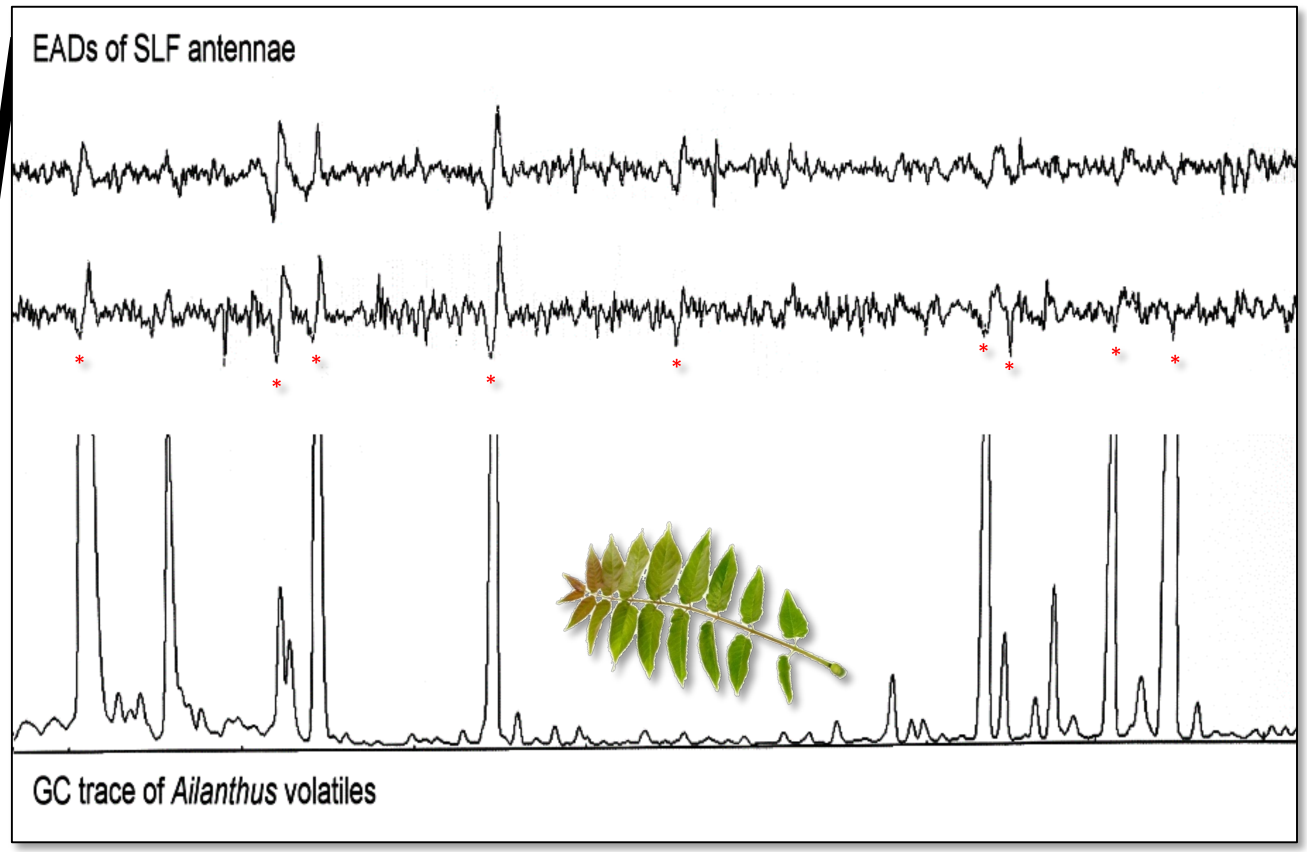
Gas Chromatograph (GC) coupled with Electroantennographic Detector (EAD)





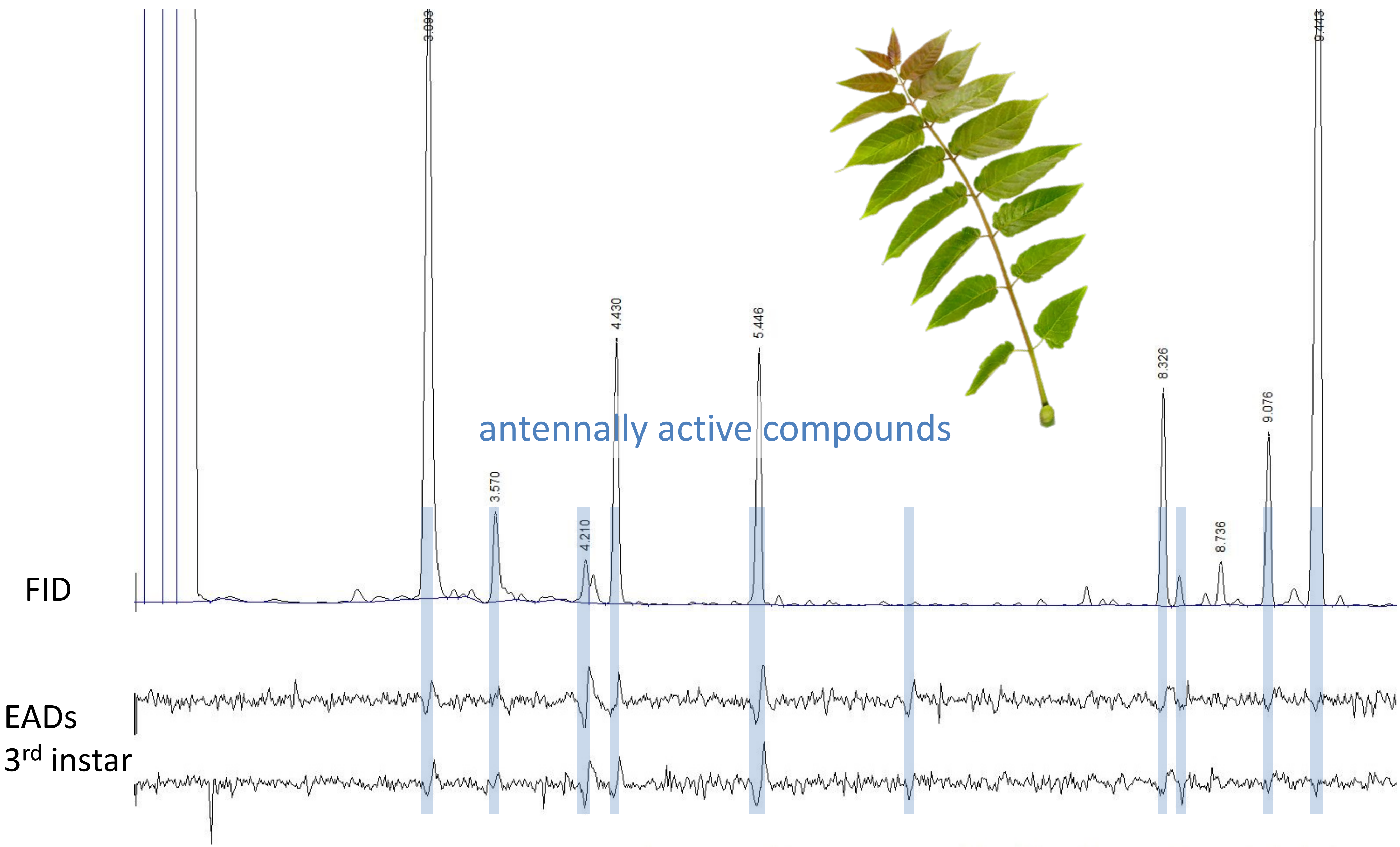
*** Antennally active compounds.**

Volatile collections of plant odors

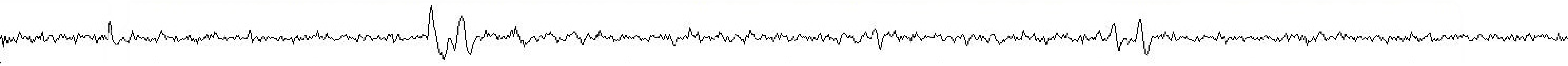
Ailanthus trunk with adult SLF

Black walnut branch

Ailanthus branch volatiles



Electrophysiology



Volatile Collections	Antennally Active Compounds
Ailanthus branch	10
Ailathus branch + SLF	3
Ailanthus trunk	3
Black walnut branch	17
Hops	10

- Developed a GC-EAD method for *Lycorma delicatula*
- Sampled volatiles from 6 different potential hosts
- Identified 39 unique EAD responses from host plant volatiles
- Identified 19 of those compounds
- Tested/ing novel compounds in behavioral bioassays and field

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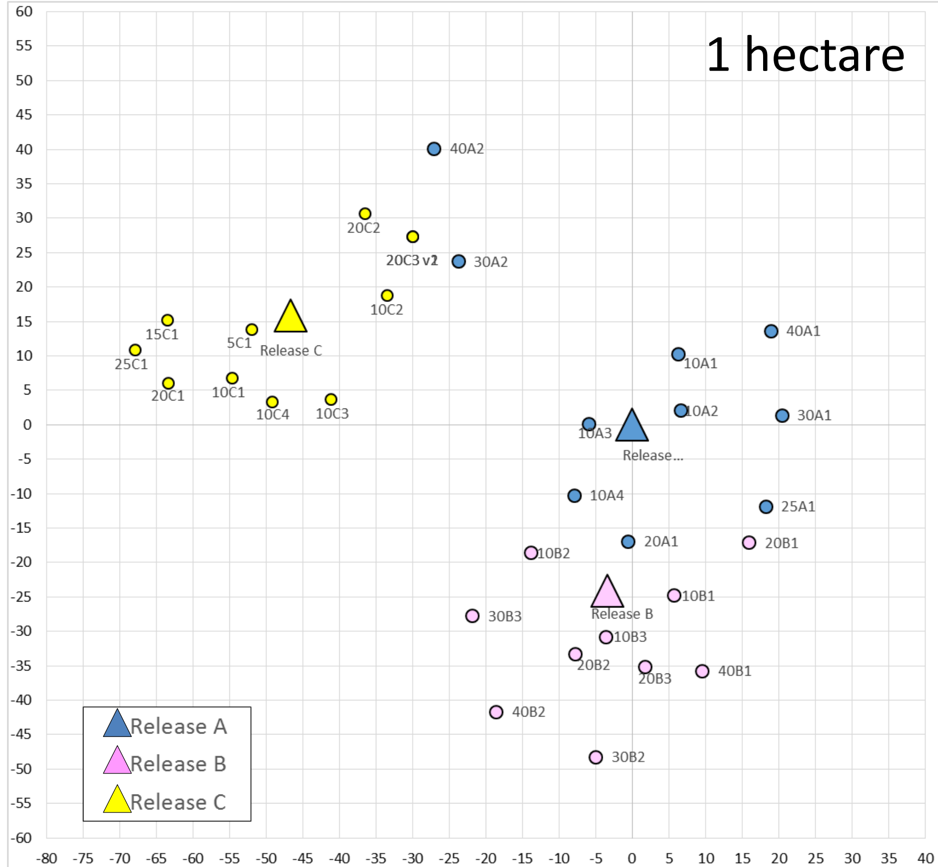
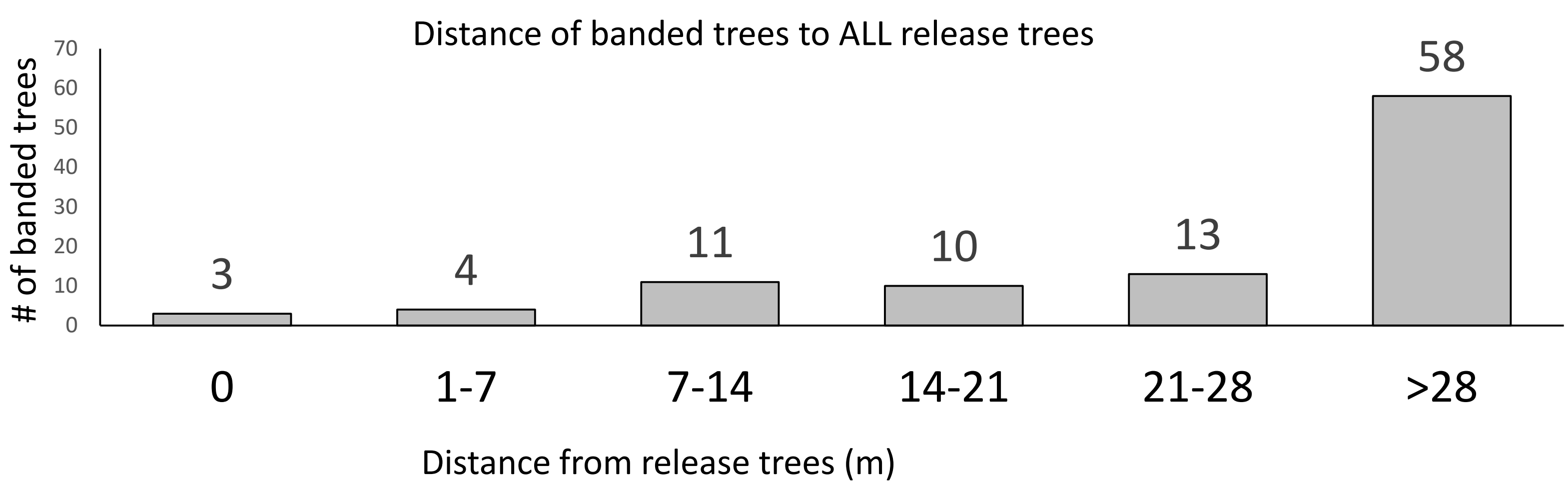
2017 Methodology





Capture… mark… release… recapture

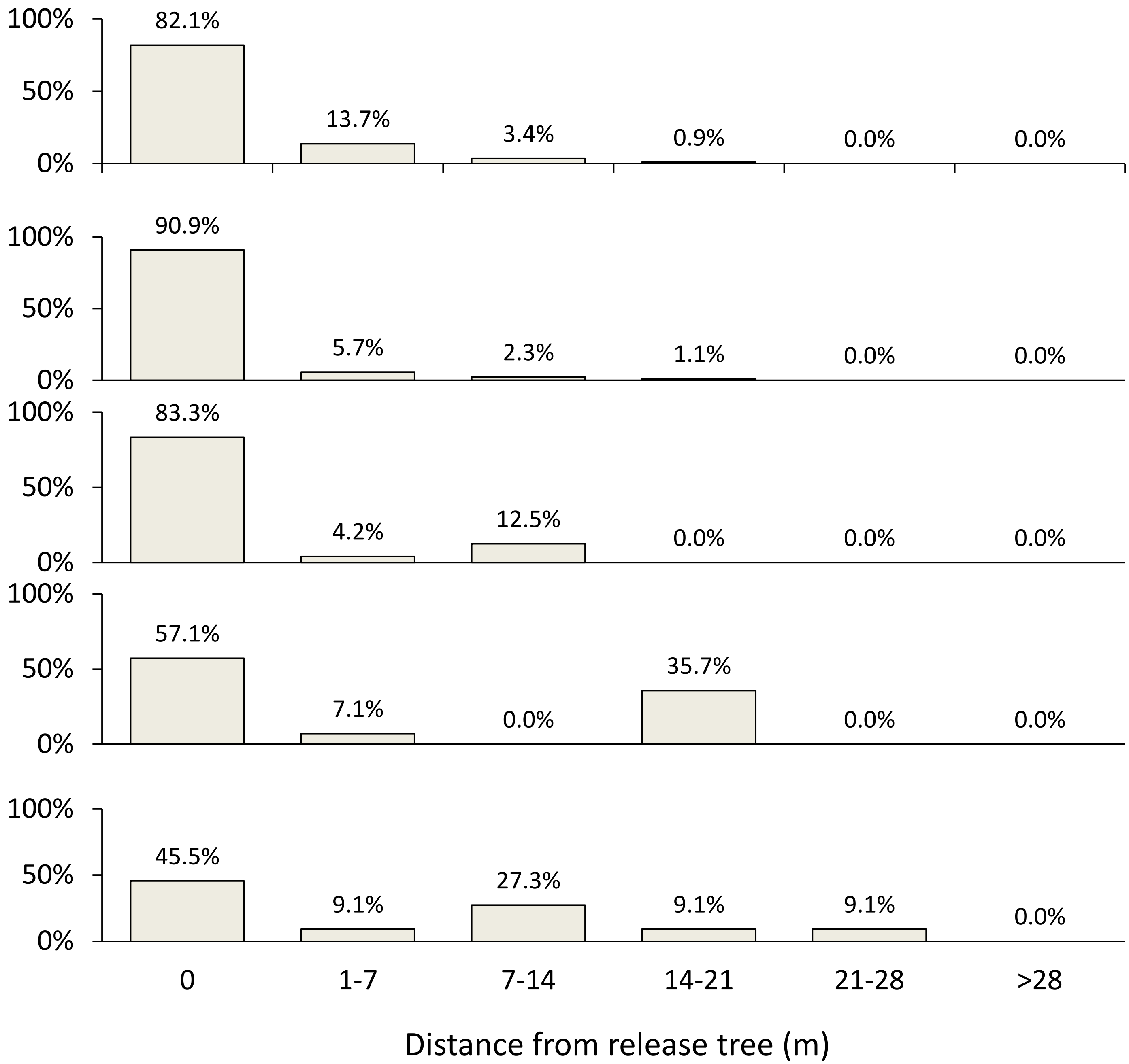
Methodology – … and recapture

24hr count

Interval counts with UV light

Recapture Distances

%Recaptured	
1st	10.3%
2nd	9.3%
3rd	1.6%
4th	1.6%
Adult	1.8%

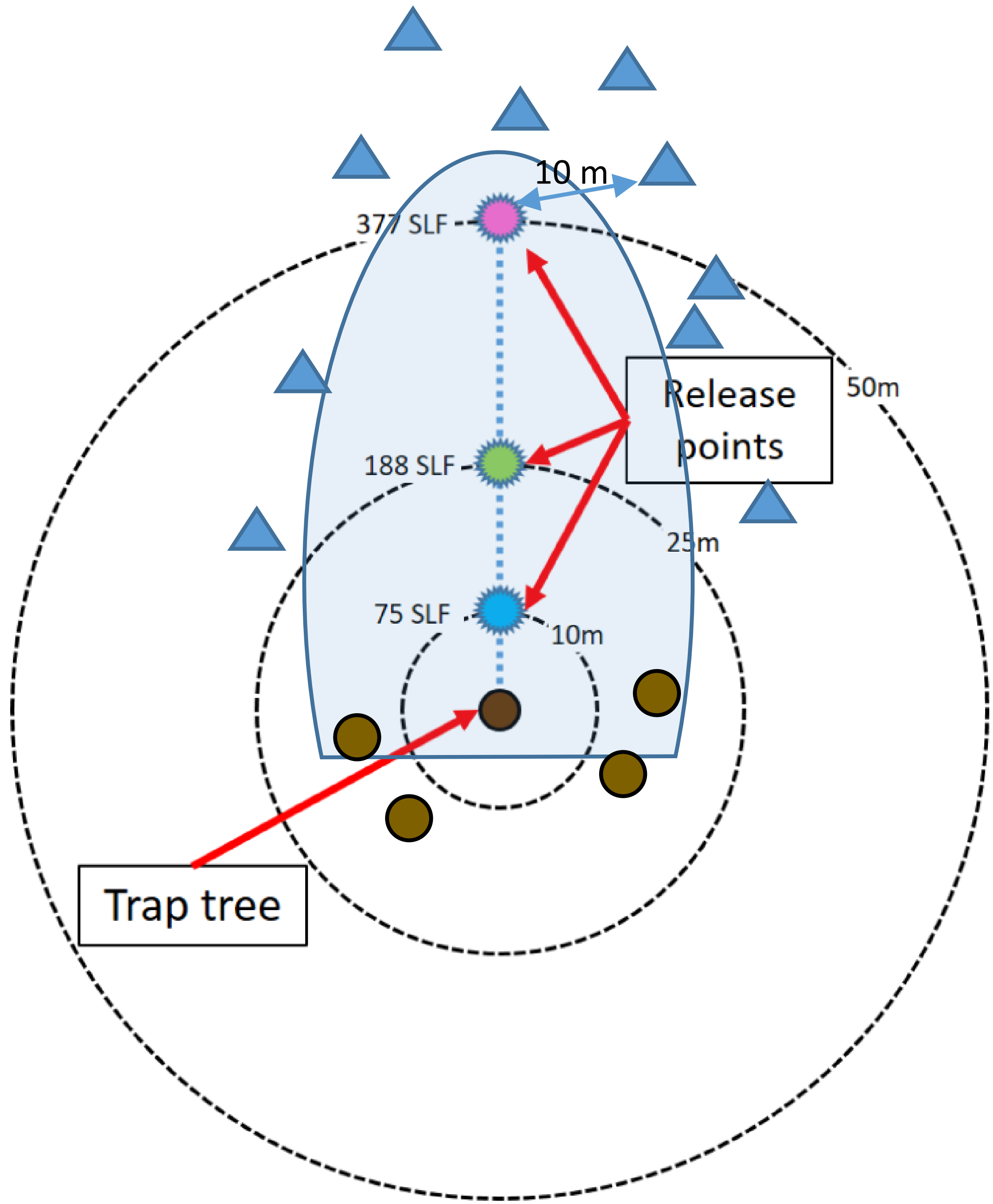


Summer 2018 Study Underway

- Measure the distance SLF are attracted by the *Ailanthus* trap tree(s) ●, and where else they end up △ (non-*Ailanthus* trees)

- % recapture of released SLF

- N=5 transects



Conclusions

- High release methyl salicylate lures improve trap catch by approximately 3x.
- Fourty other antennally active plant compounds exist, half of which have been identified.
- Kairomones were identified and certain blends were much more attractive than methyl salicylate in the laboratory.
- Improved traps are being investigated.
- New developmental host records: chinaberry, hops, black walnut.
- SLF prefer to stay on *Ailanthus* if available and do not move much if it's a healthy tree. However, movement started to increase at 4th instar and adults, coinciding with tree decline.

Spotted Lanternfly Kairomones

Chemical/behavioral ecology lab studies underway or planned in 2018:

- Continue semiochemical discovery by conducting volatile collections, analysis by GC-MS, GC-EAD, and Y-tube studies.
- Compare odors of more plants to Ailanthus for preference.
- Compare novel compounds against methyl salicylate and/or each other to determine the most attractive compound.
- Continue to develop and test blends in Y-tube against methyl salicylate.
- Develop lures to test novel attractive compounds in the field.
- GC-EAD of male antennae to female volatiles and vice versa.
- Electroretinograms to assess possible color preferences.

Spotted Lanternfly Kairomones

Field testing for 2018:

- Test AgBio and AlphaScents MeSal lures for longevity in the field.
- Evaluate MeSal lures in low density for detection.
- Test best blend lures against MeSal lures.
- Test new semiochemical(s) against MeSal.
- Test several new traps/designs.
- Trap tree active space test using mark-release-recapture.
- Field host suitability studies on additional species.
- Adult mating/attraction studies and volatile collections.

2018 Cooperband Lab SLF Team:

Satellite lab in PA:

- Kelly Murman
- Stefani Cannon
- Leslie Abreu

Otis Lab:

- Isaiah Canlas
- Nathan Derstine
- Linnea Meier
- Sam Stella

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- AlphaScents
- Hercon Environmental
- ISCA Tech
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- Sino Green
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- Kutztown University
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