From biology to management: Practical tools for black stem borer control

Dr. Monique J. Rivera and Sandra Lizarraga

Outline

- Ambrosia beetles in apple overview
- Progress on development of a model to predict flight
- 2025 Results of Verbenone

Ambrosia beetles in Apple

Apple Tree Damage by Ambrosia Beetles

Photo by Arthur Agnello 2020

What ambrosia beetles do we see in apple?

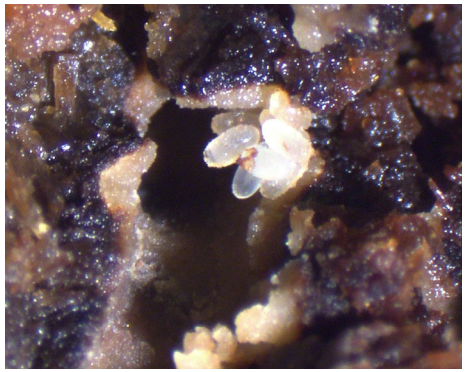
ISSUE: VOL. 5506 NO. 2: 6 SEPT. 2024 TYPE: ARTICLE PUBLISHED: 2024-09-06 DOI: 10.11646/ZOOTAXA.5506.2.6 PAGE RANGE: 261-271 ABSTRACT VIEWS: 197 PDF DOWNLOADED: 33

FIRST REPORT OF *ANISANDRUS MAICHE* (COLEOPTERA: CURCULIONIDAE: SCOLYTINAE) INFESTING APPLE TREES

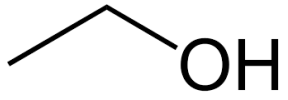
KELSEY N. TOBIN[+], M. ELIZABETH MOORE[+], SANDRA LIZARRAGA[+], JANE PETZOLDT[+], COREY REESE[+], BRIAN LOVETT[+], MONIQUE J. RIVERA[+]

Flight of Foundress Female

1 Beetle = Full Colony within Tree



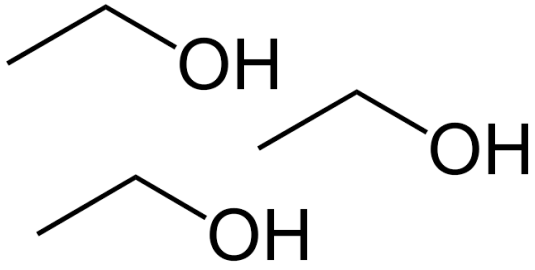
Ambrosiella grosmanniae



Why are ambrosia beetles attacking apples?

Black stem borer

Photo by Betsy Anderson 2016, *Journal of Integrated Pest Management*



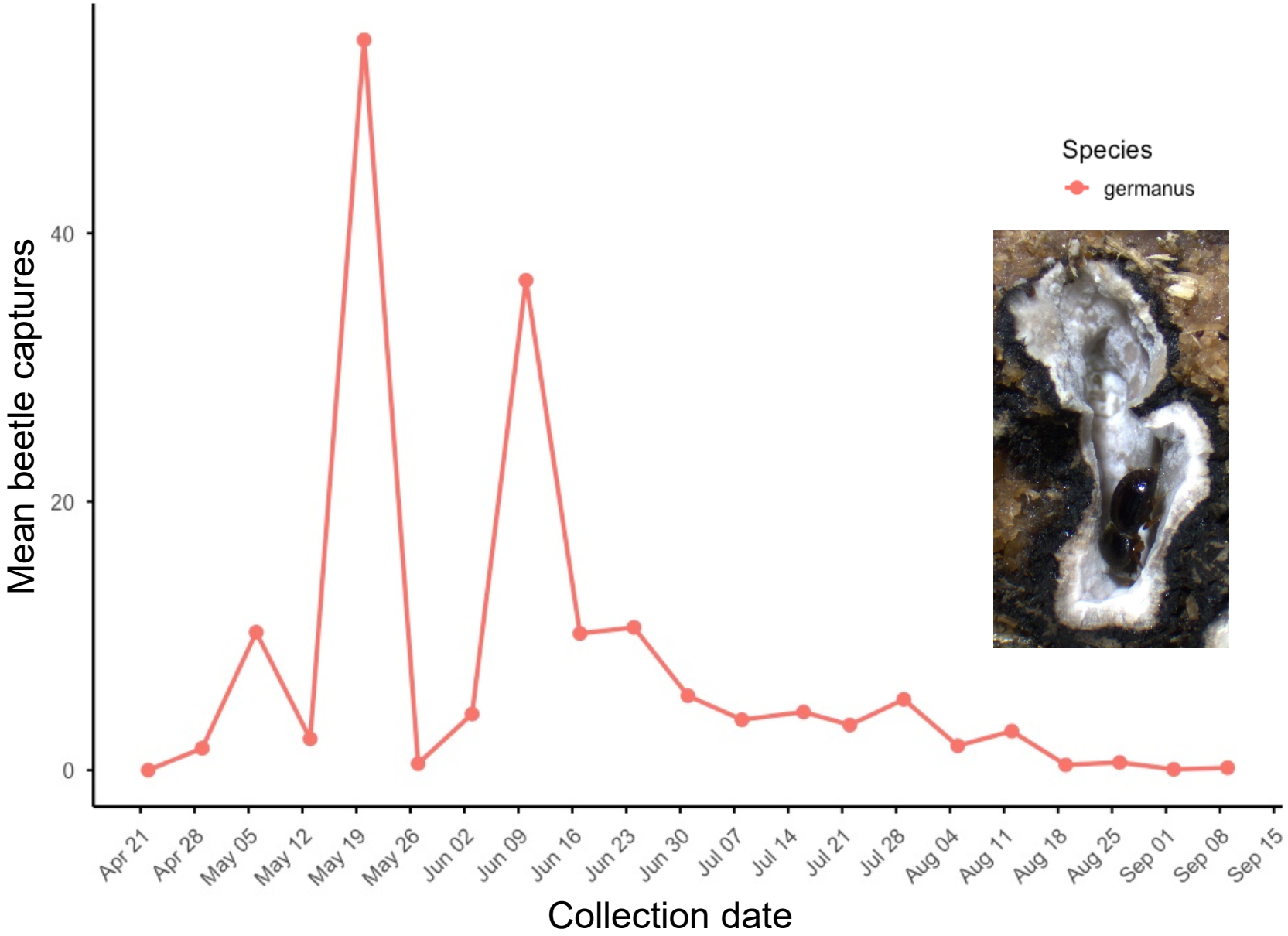
Tree stress → Ethanol and other cues → Ambrosia Beetle Attacks

ABIOTIC **BIOTIC**

Younger, smaller trees = More stress

Possible other stress sources: pruning, viral load, topworking

Black Stem Borer Seasonal Flight Patterns



- Two peak flights
- Overwinter as adults
- Can emerge as soon as the weather is suitable

Anisandrus maiche

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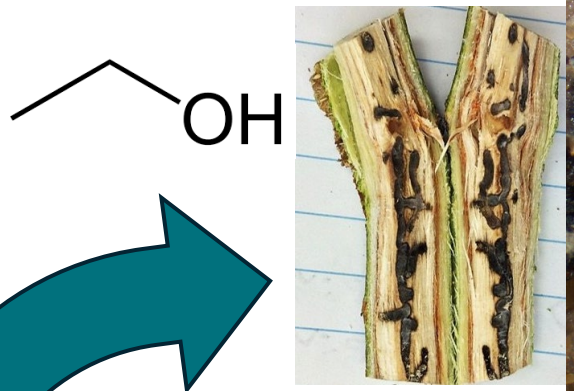
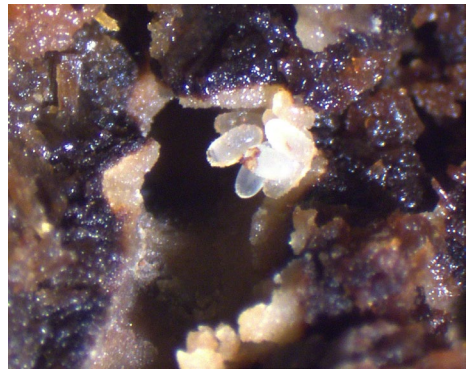
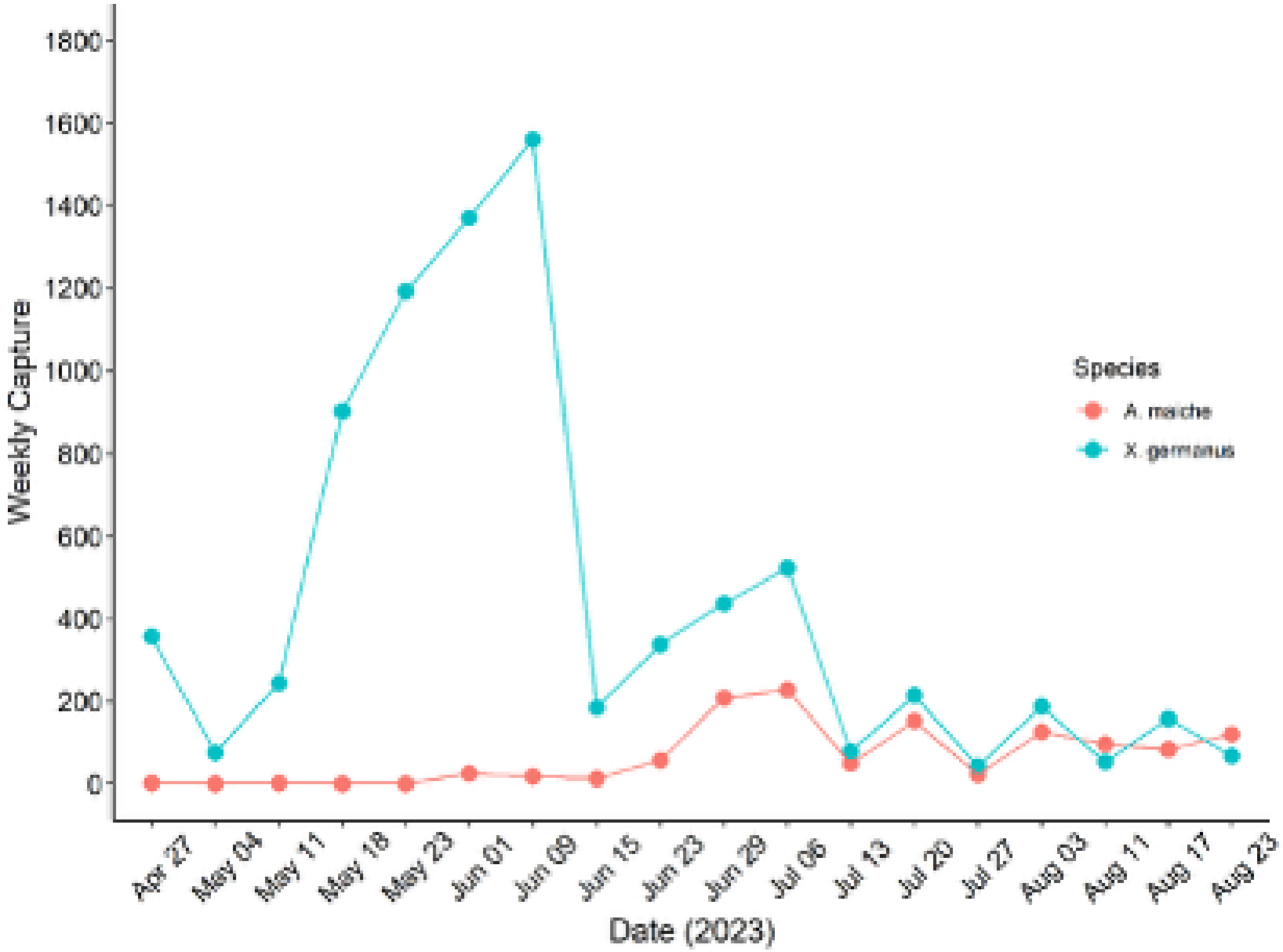
Anisandrus maiche



Ambrosiella cleistominuta

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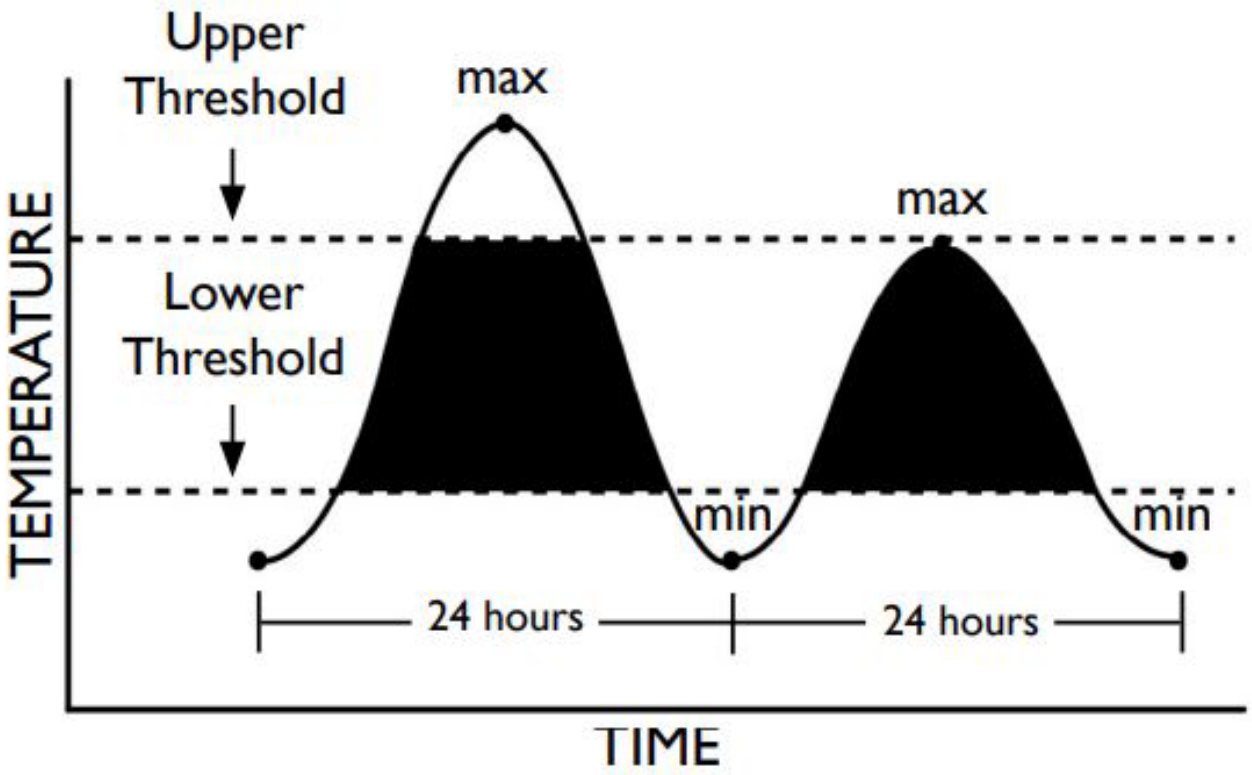
Apr 27
May 04
May 11
May 18
May 23
Jun 01
Jun 09
Jun 15
Jun 23
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 11
Aug 17
Aug 23
Date (2023)
Species
A. maiche
X. germanus

Can we predict flights to optimize application timings?



Progress on development of a model to predict Black Stem Borer flight

Bihourly Trapping Study by Sandra Lizarraga

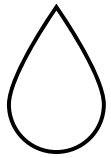
Five clear sticky trap baited with an Ethanol lure

ibutton sensor to track temperature and humidity

Time Groups (EDT)

8-10	10-12	12-2	2-4	4-6	6-8
AM		PM			

Predicting beetle flight based on environmental factors



Relative humidity

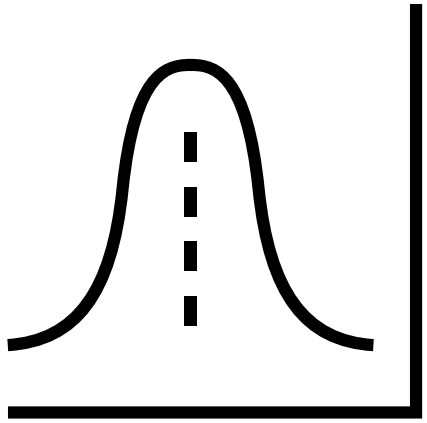
Temperature

Time of day

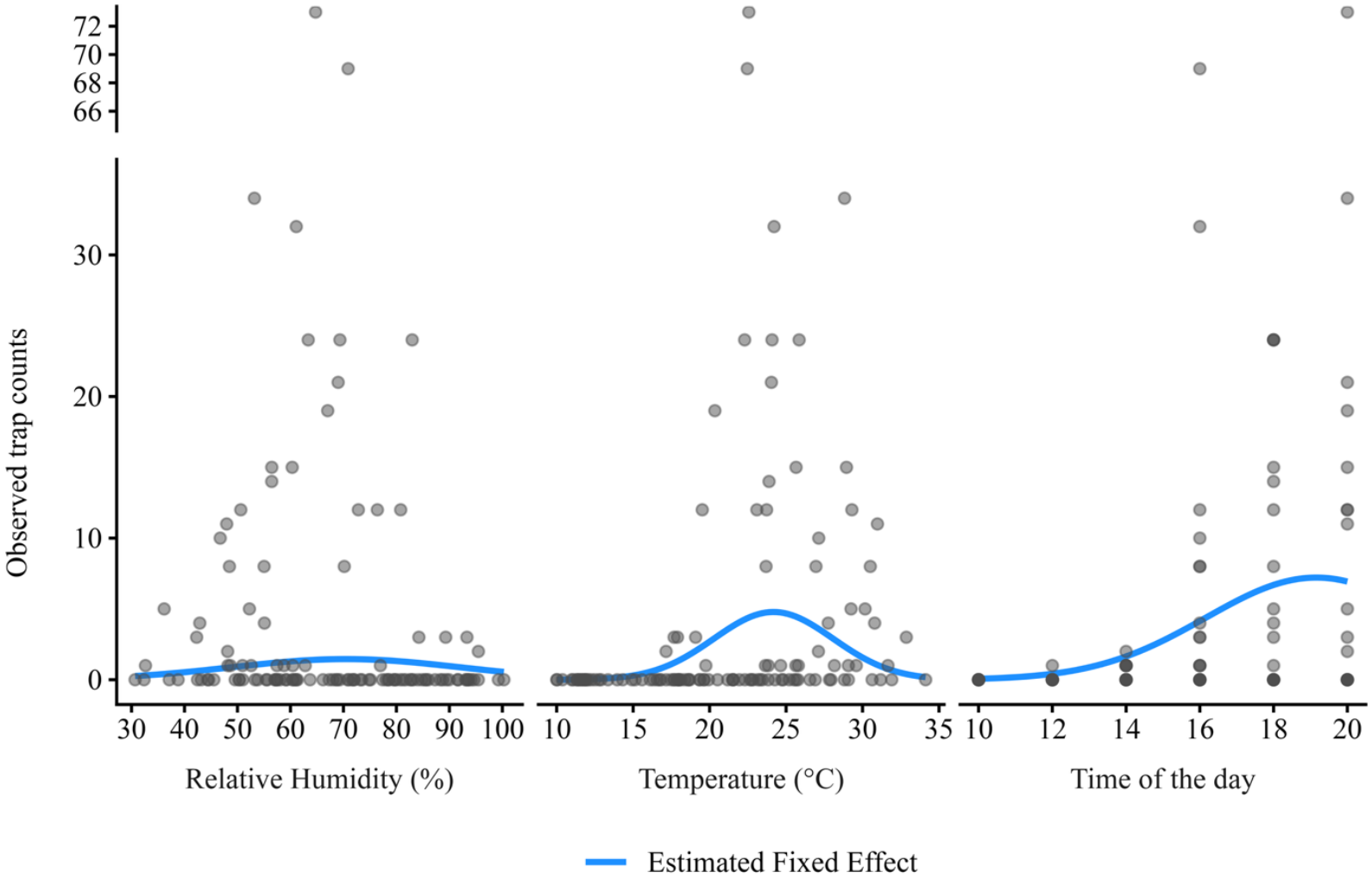
Victor Alves
PhD candidate of
Plant Pathology at
UC Davis

Predictive Model

A Bayesian model that estimates the optimal environmental conditions for beetle flight using bell-shaped response curves



Results

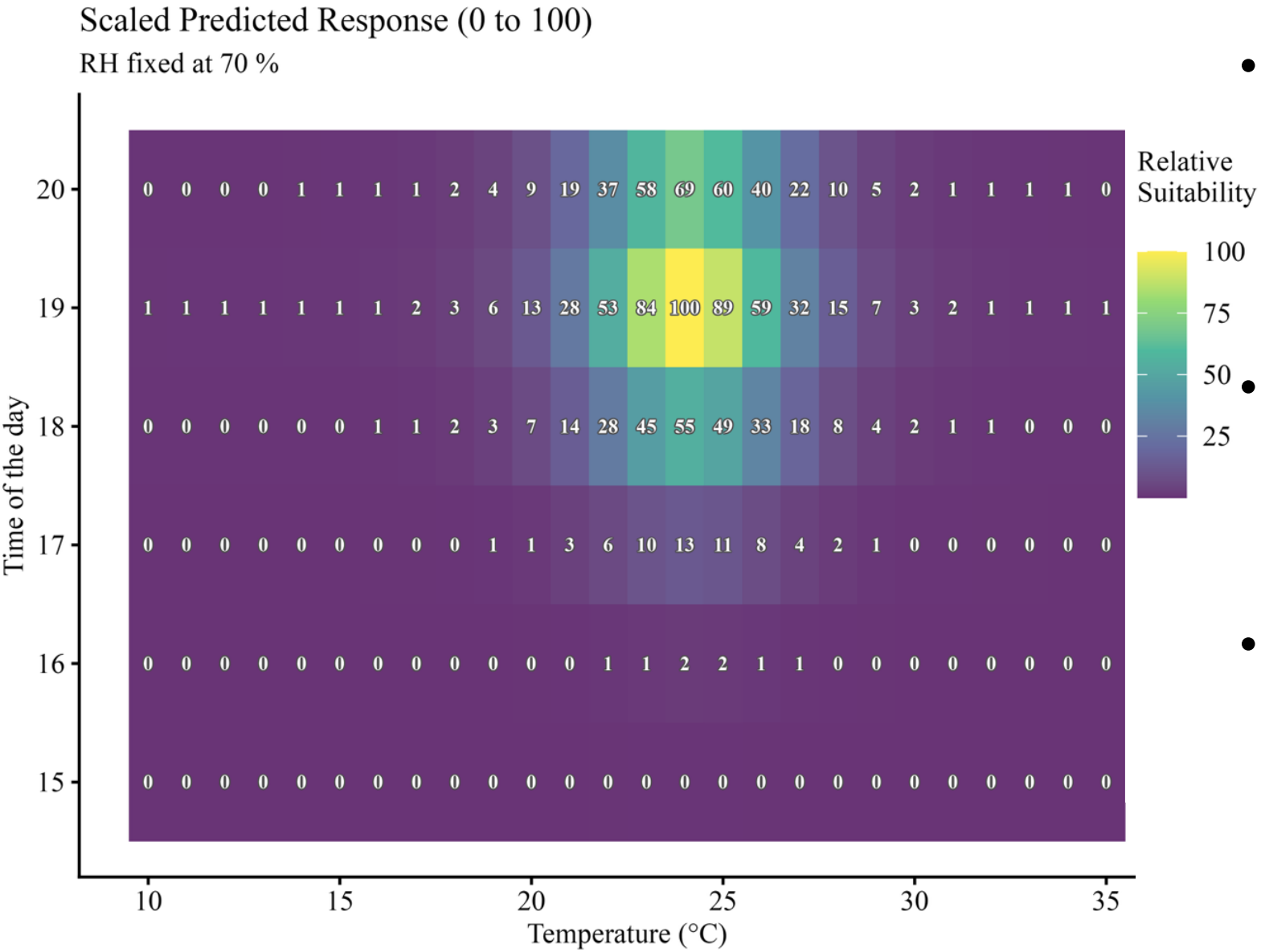


Optimal relative humidity was estimated at **70.45%**

Activity peaked at a temperature of **75.5F**

Peak time of the day was determined to be at **7:00 PM**

Results



- Establishes the first temperature- and time-based flight prediction framework for BSB
- Enables targeted monitoring by improving prediction of first peak flight periods
- Optimizes timing of preventative management actions

Key findings

- Developed a predictive flight scale for *X. germanus*

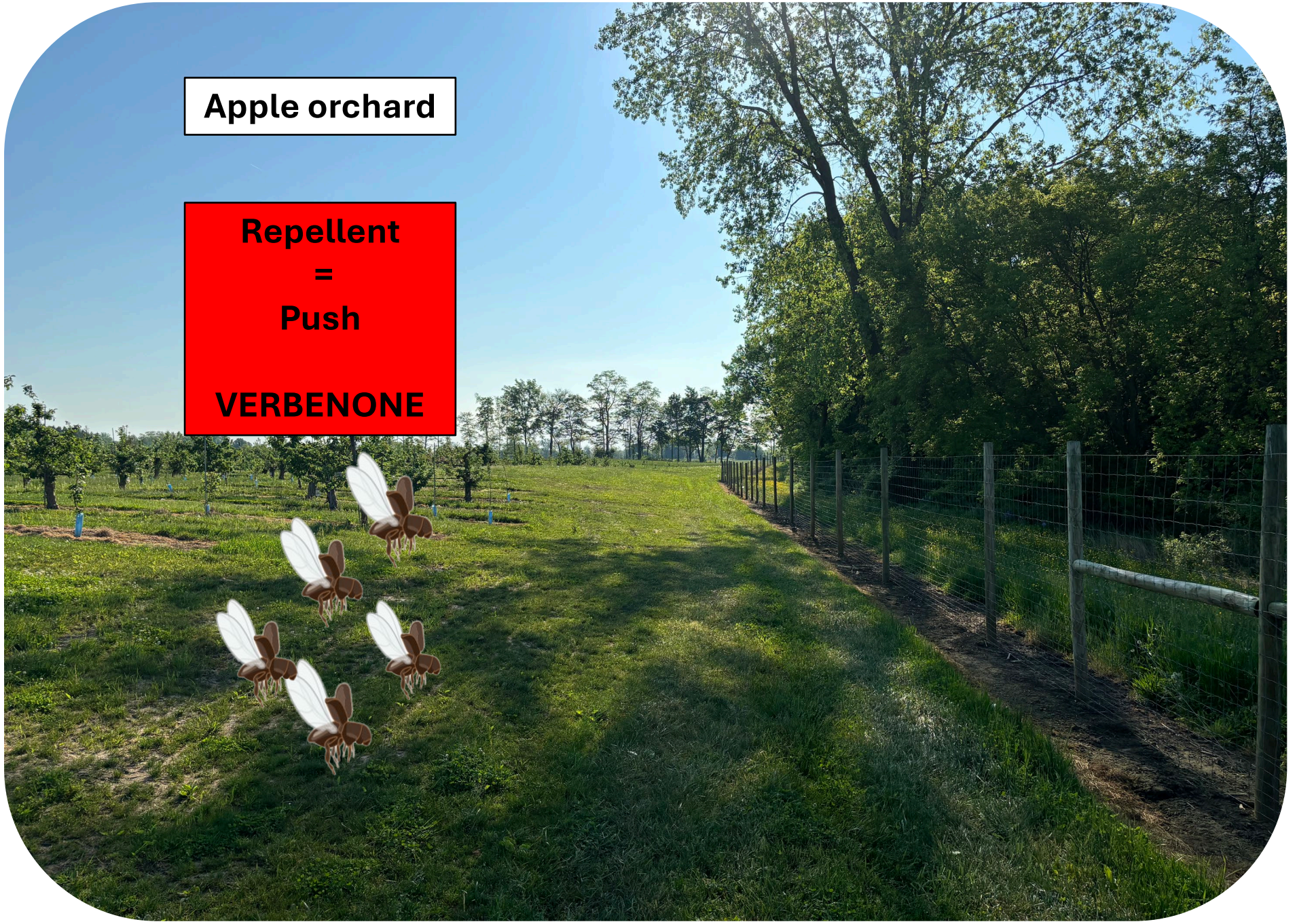
Implications for apple growers

- Improves decision-making through localized monitoring
- Precision insecticide applications timed with risk

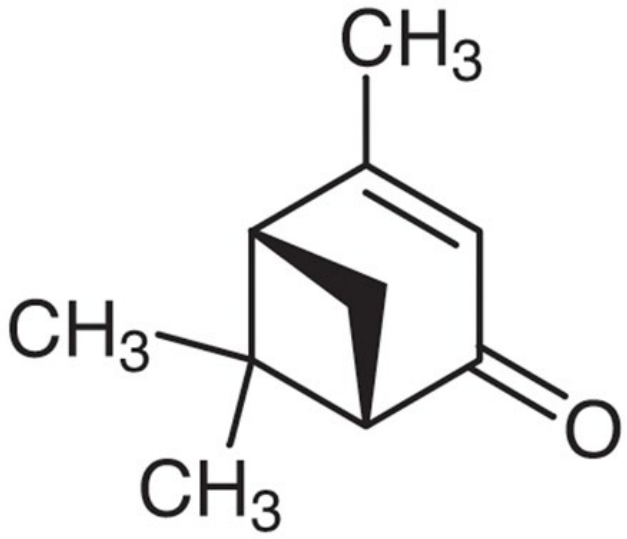
Future Directions

- Expand and refine the model with additional field data
- Get model onto NEWA or some other applet for use

2025 Results of Verbenone Trial


Apple orchard
Repellent
=
Push
VERBENONE

Verbenone as a repellent



- Produced in **pine trees** as as a response to stress and/or insect attack

- Used as a **repellent** against multiple beetles including ambrosia beetles

Overlap in response to semiochemicals across key pest species

Xylosandrus germanus (BSB)

Ethanol +

Verbenone −

Anisandrus maiche

Ethanol +

Verbenone −

Xylosandrus crassiusculus

Ethanol +

Verbenone −

Attraction = +

Repellent = −

Comparing commercially available verbenone products

Verbenone sachets

- 100 g of verbenone
- 15 sachets ($147 USD)
- ¼-acre plots
- 8 weeks of coverage

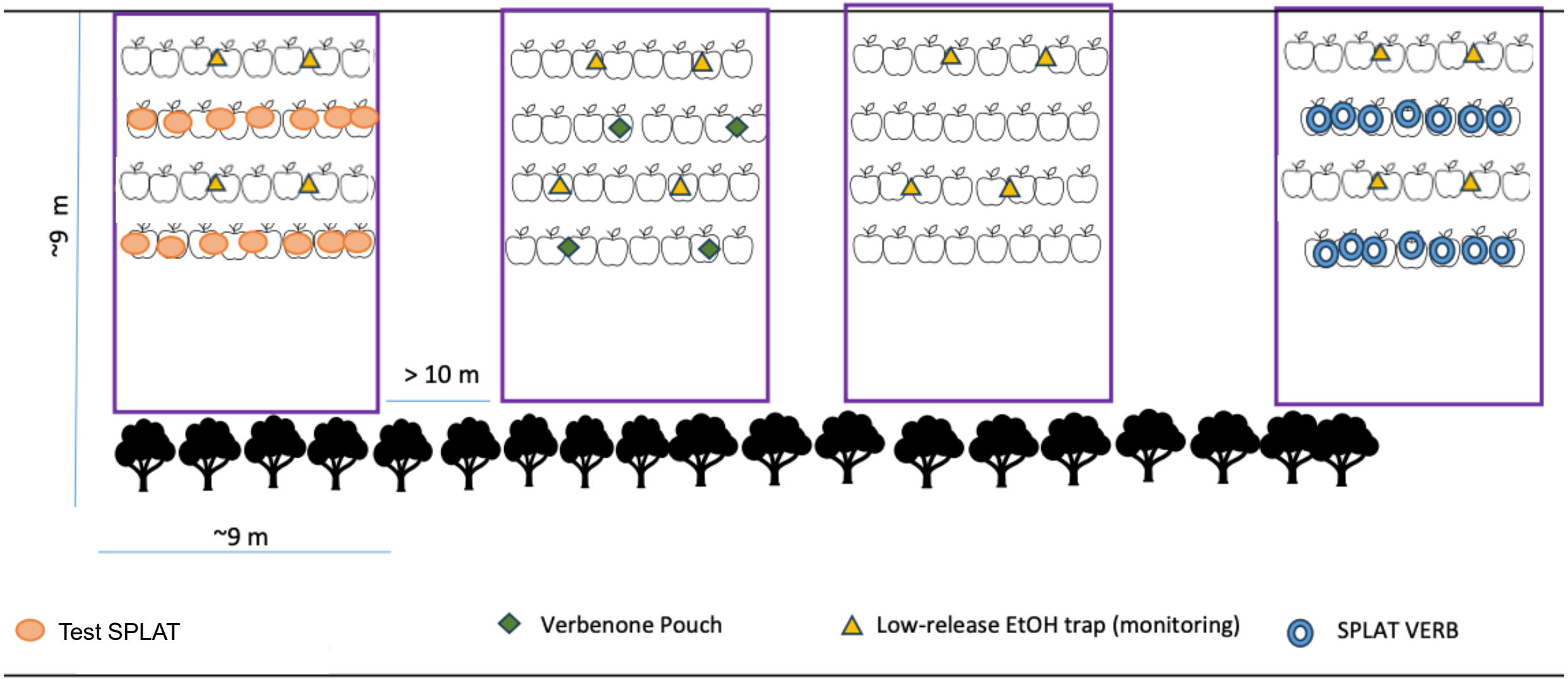
SPLAT Verbenone

- 700 g of verbenone
- 1 canister ($122 USD)
- 1-acre plot
- 12-16 weeks of coverage
- State-by-state regulations
- Food-safe, biodegradable

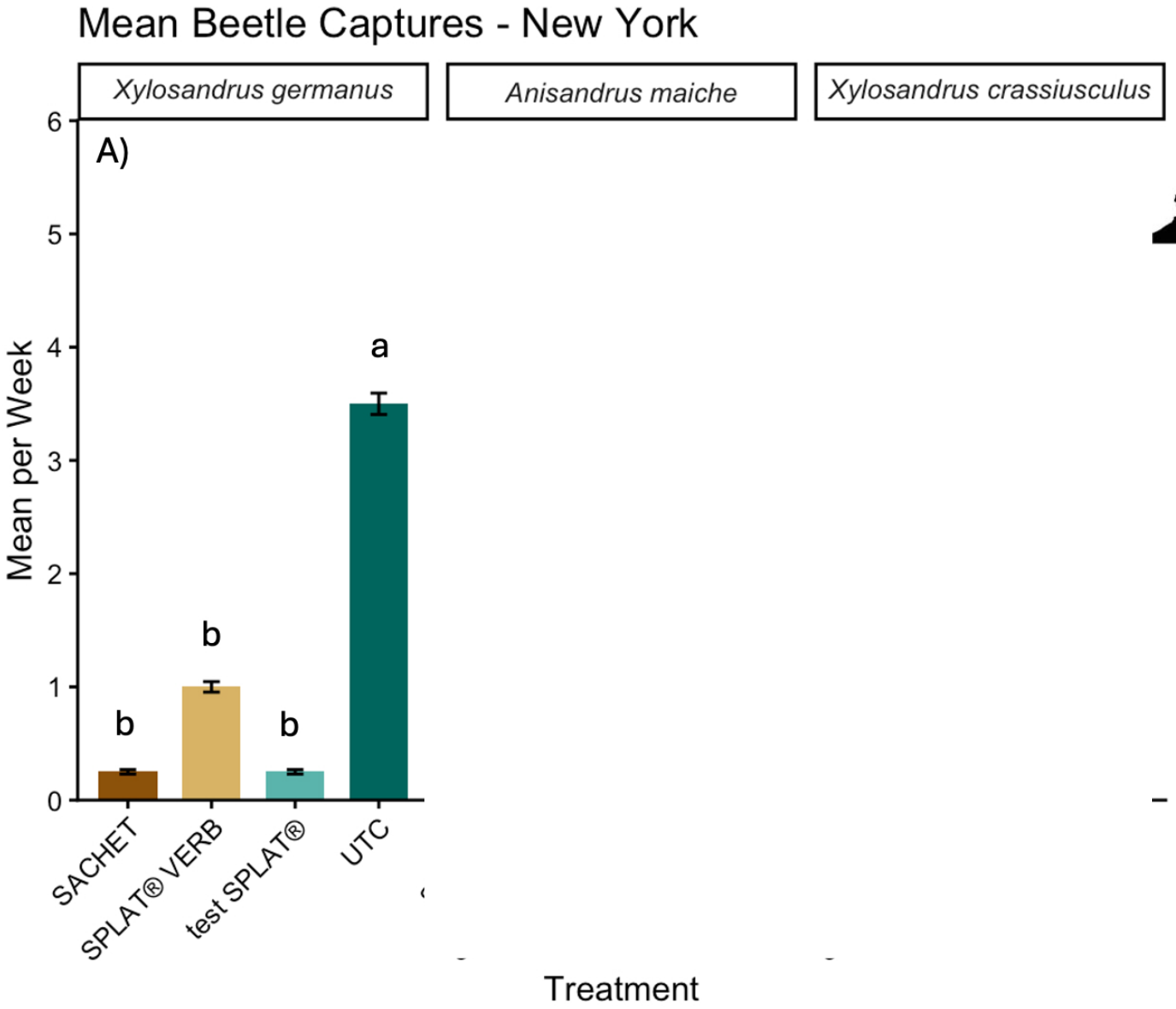
Test SPLAT

- New SPLAT product
- Currently non-commercial
- Designed for extended field longevity

Comparison of commercially available verbenone dispensers



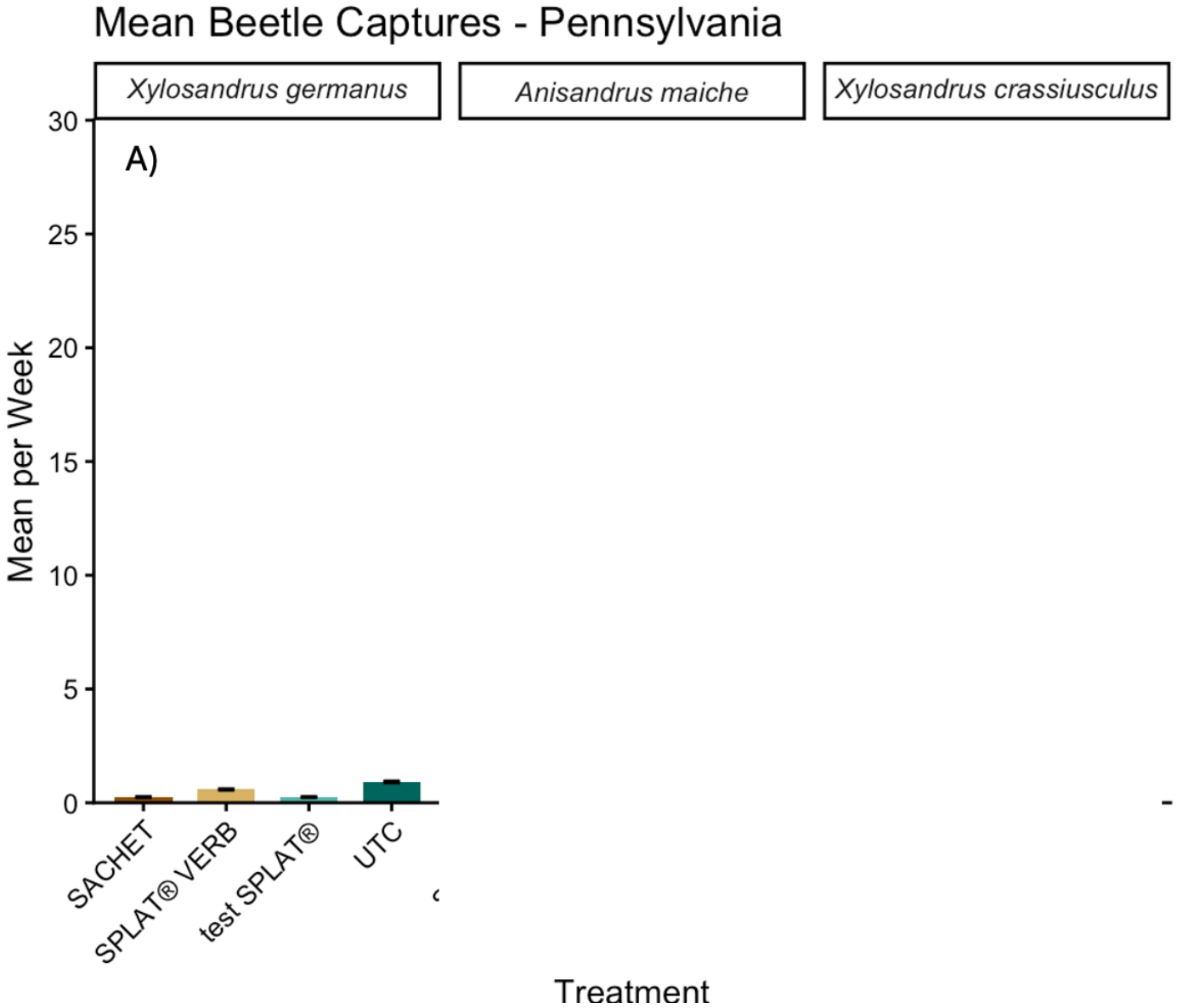
Species	New York
X. germanus	60
A. maiche	95
X. crassiusculus	1



Treatment
- SACHET
- SPLAT® VERB
- test SPLAT®
- UTC

All verbenone formulations were successful in reducing ambrosia beetle populations

Species	Pennsylvania
X. germanus	24
A. maiche	91
X. crassiusculus	838



Treatment
- SACHET
- SPLAT® VERB
- test SPLAT®
- UTC

All verbenone formulations were successful in reducing ambrosia beetle populations even under high beetle pressure

Key Finding

- All verbenone dispensers reduce ambrosia beetle capture in treated blocks

Future Directions

- Assess longevity of verbenone and phytotoxicity

Thank You

Questions?