U.S. Pacific Basin Agricultural Research Center

2012 Coffee Research Update

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Outline

- Trap design and attractants for CBB
- Flowering synchronization
- Freezing treatment for CBB
- Insect Killing Nematodes
- *Beauveria bassiana against CBB*

Coffee Berry Borer Trapping (Eric Jang, Lori Carvalho)

Trap Types:

Scentry 1= paper trap w/ sloped roof

Scentry 2 = paper trap w/ flat roof. Developed by Scentry Biologicals, Billings, Montana

Bucket 1 = one entry window (15cm tall, 15 cm in diameter, 7.5 X 7.5 cm window; red pepper Krylon Fusion spray paint)

Bucket 3 = three entry windows

Brocap ® = developed by CIRAD and PROCAFE

Scentry 1

Scentry 2

Bucket 1

Brocap

Coffee Berry Borer Trapping

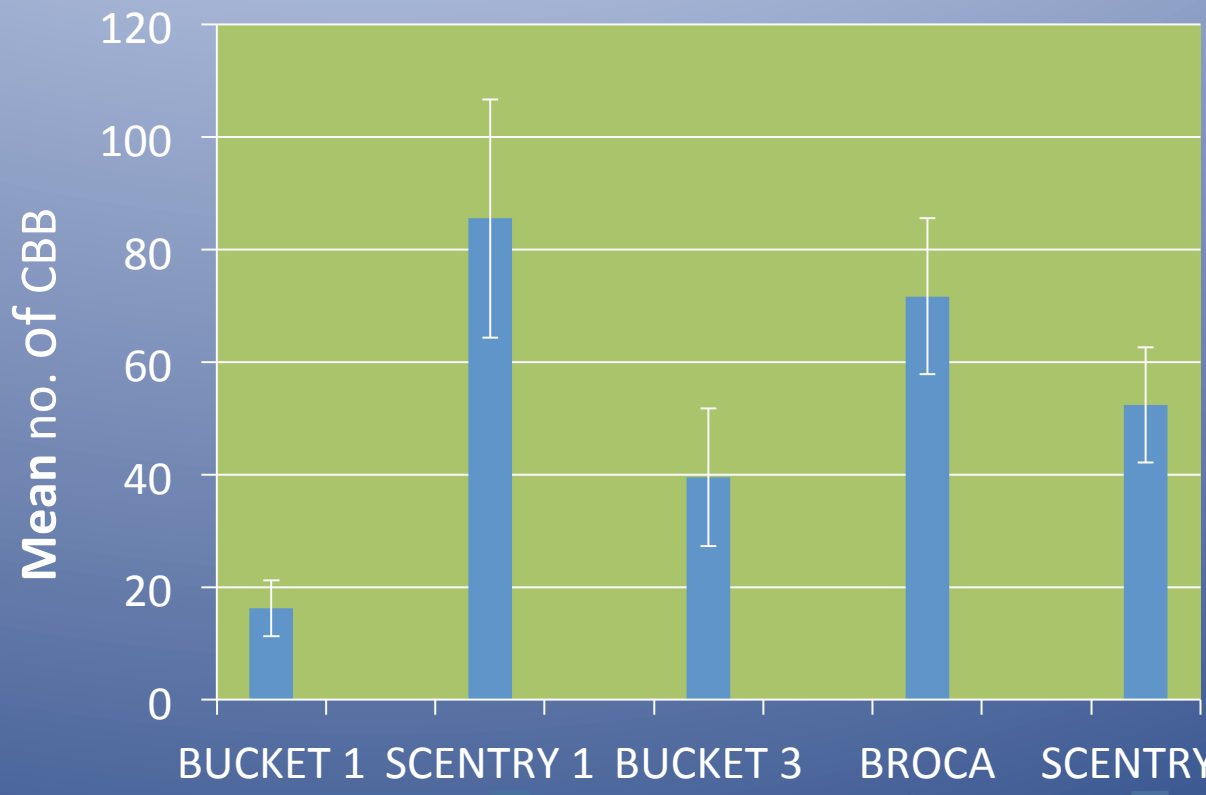
Location: Coffee Farm in Kainaliu. Traps were placed 15 m apart

Lures: Coffee Berry Borer Pouches from Scentry (11g)

Trapping period: April – July 2011

Results :

Scentry 1 and Scentry 2 paper traps did just as well as the plastic Brocap® trap. The bucket traps did not capture as many CBB as the other trap types but trap captures were increased with three entry windows compared to one entry window.



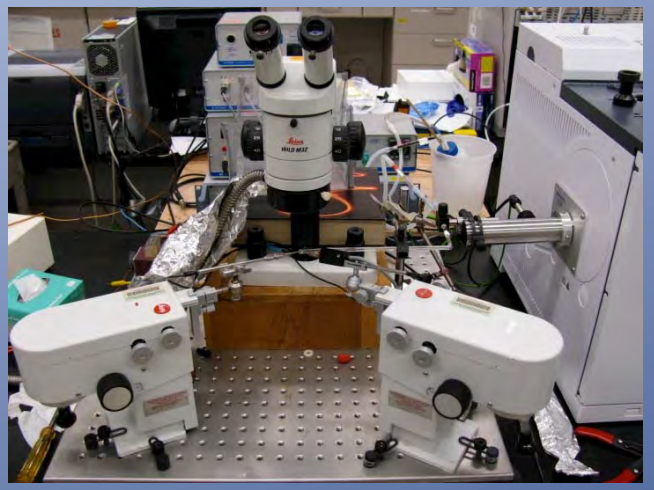
Identifying and developing new attractants using GC-EAD

Eric Jang, Lori Carvalho

Volatile Collection System

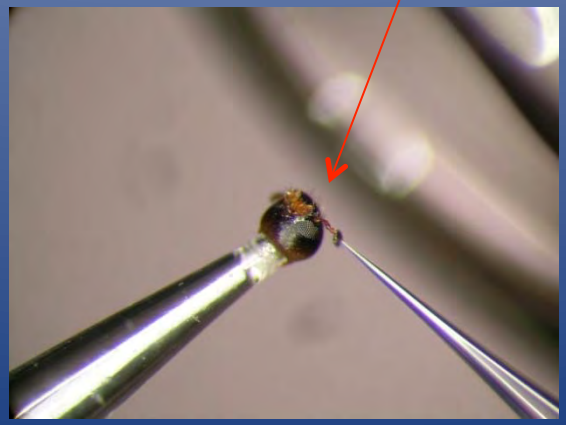
Coupled gas chromatography-electro-antennogram detection analysis . An electro-antennogram is a measurement of what an insect smells.

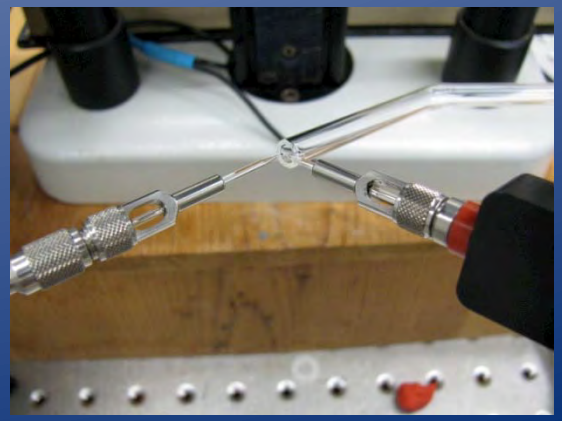
GC-EAD



Trapping of coffee berry odors

Coffee Berry Borer whole- head antennal preparation





Trap captures of coffee berry borer to identified coffee volatiles

Location: Coffee Farm in Kainaliu. Traps were placed 10-15 m apart

Treatments:

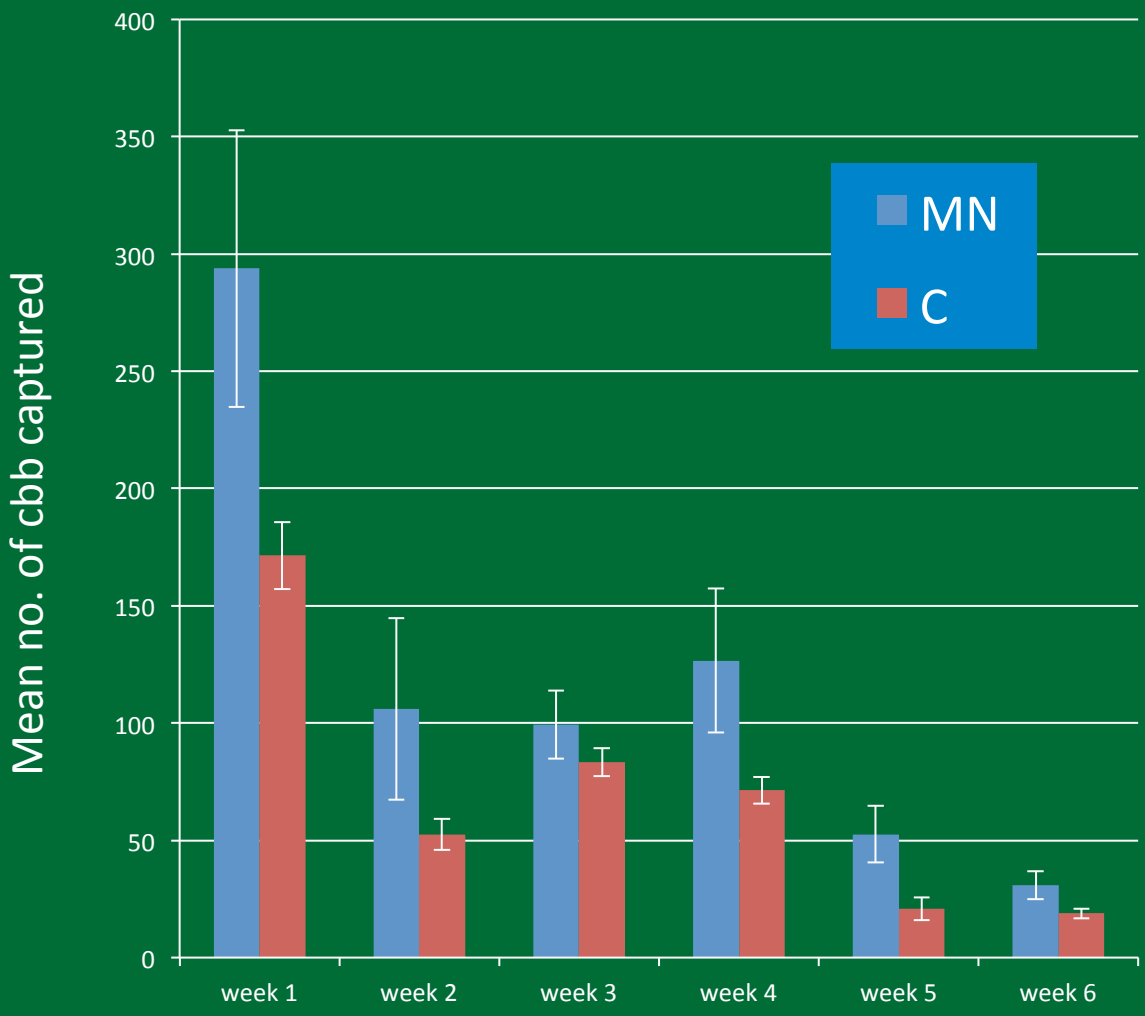
Coffee Berry Borer Pouches from Scentry (C)

Identified coffee volatiles plus CBB pouches (MN)

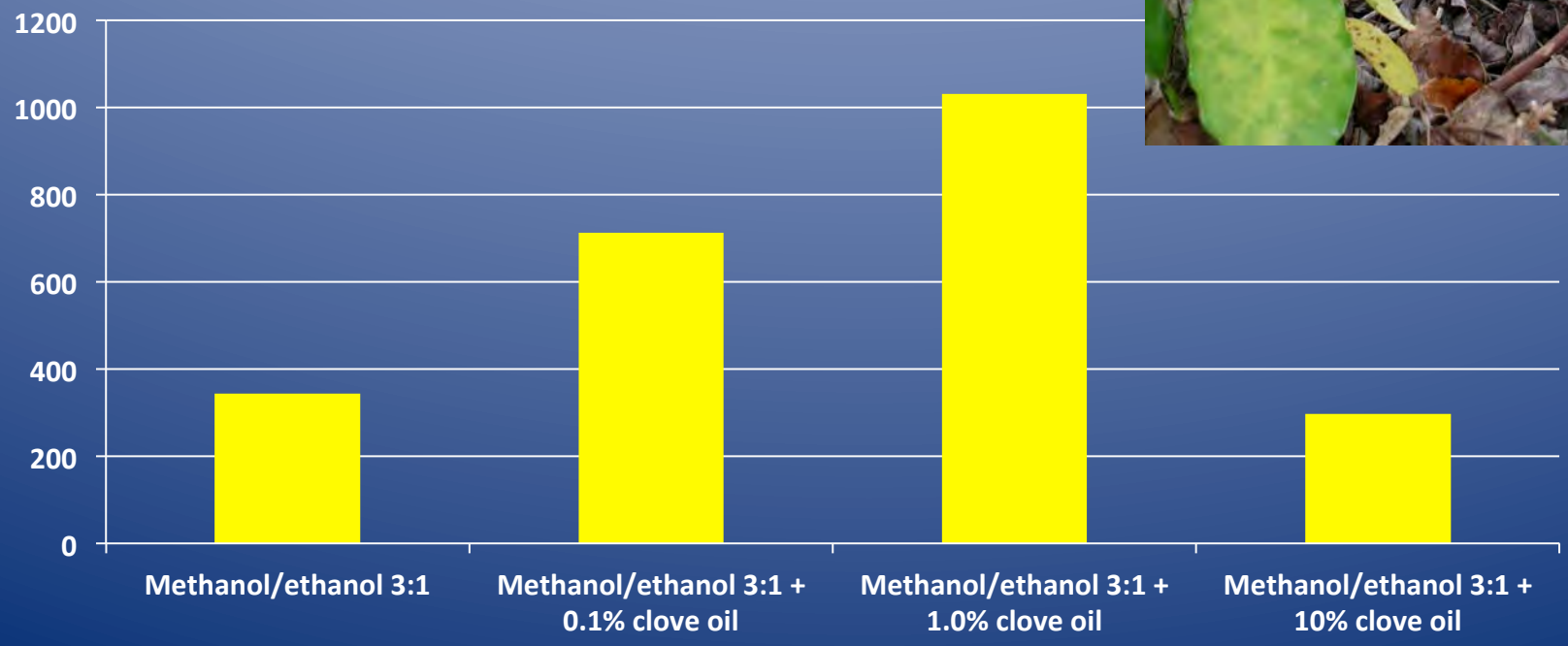
Trapping period: May-June 2012

Results :

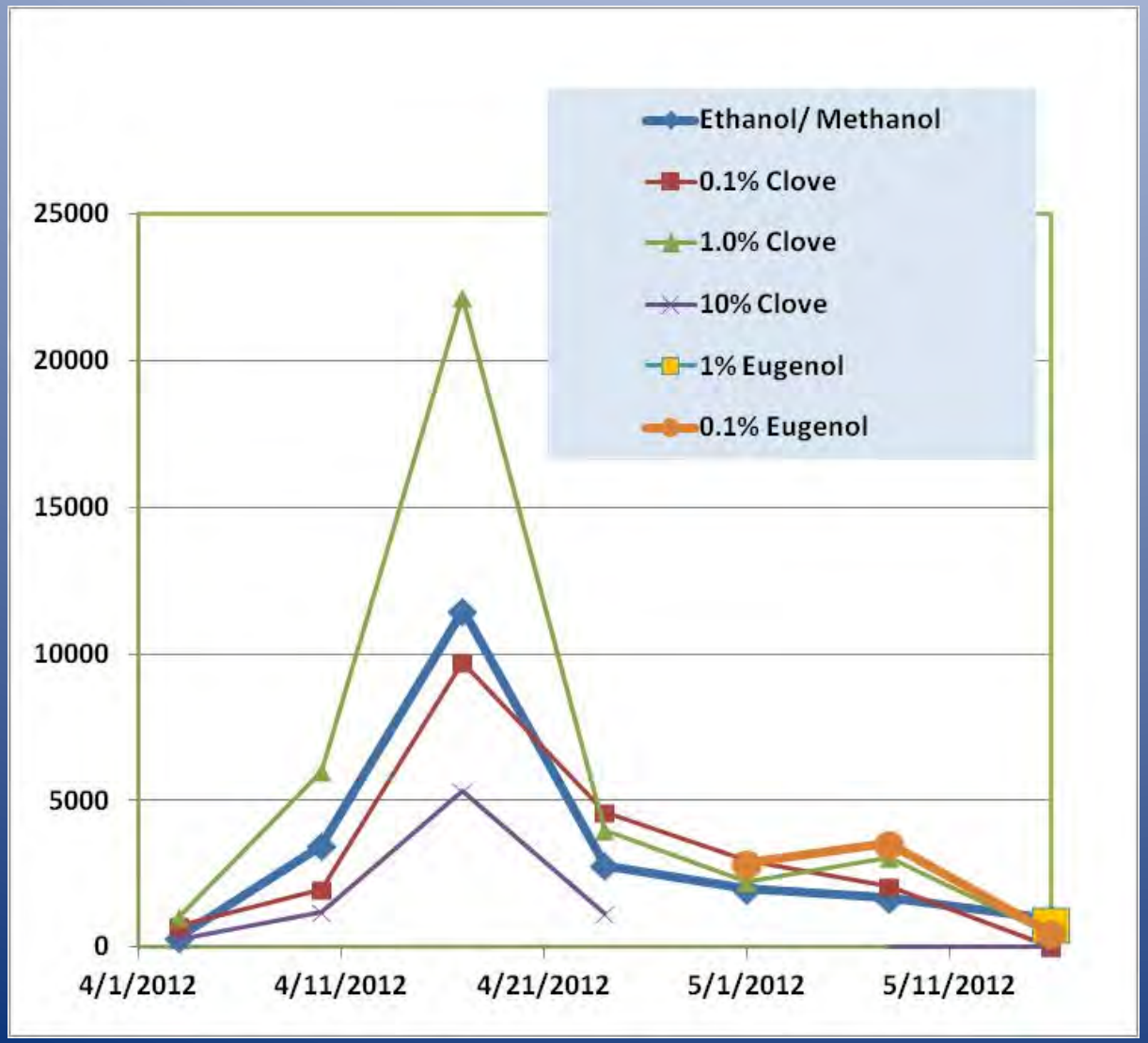
There is a variable amount of increase in trap captures with the addition of coffee volatiles. Further evaluations are continuing.



Number of CBB borers caught in 5 milk-jug traps over 7 days (Captain Cook)



Number of CBB caught in 5 milk jug traps per week



Control of Coffee Flowering to reduce CBB levels in field – Tracie Matsumoto

Without sanitation coffee berries will always be present in this field

Gibberellic Acid promotes uniform flowering

Untreated Control Trees

GA_3 Treated Trees

Research on Freezing as a Potential Quarantine Treatment for Green Coffee

- Some growers/processors in the CBB-infested area want an alternative to methyl bromide treatment for export of green coffee to custom roasters on other islands.
- Freezing was hypothesized as a treatment which would kill beetles without affecting quality

Research on Freezing as a Potential Quarantine Treatment for Green Coffee

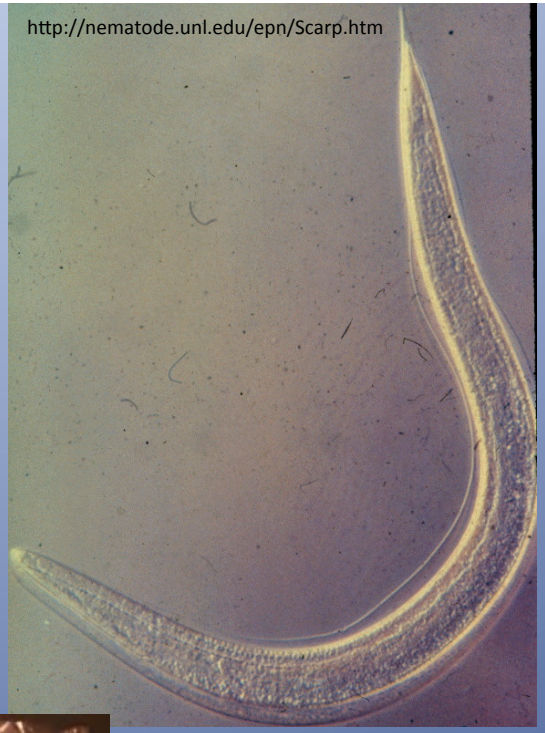
1. Cherries frozen for 1-5 days at different temperatures
2. Cherries dissected to determine survival of beetles
3. >15,000 beetle life stages were counted (eggs, larvae, pupae, adults)
4. No survival after exposure to negative 15 degrees C for 48 hours

Research on Freezing as a Potential Quarantine Treatment for Green Coffee

- Data were analyzed statistically to extrapolate what freezing temperature-time combinations would ensure quarantine security (defined as survival of one beetle in a million)
- For this level of security, -15 degrees Celsius for 5 days is required.
- Clock should not be started until warmest spot in the mass of coffee gets to -15 degrees C
- HDOA is planning on setting up Treatment Facility
- Dave Ledgard of Dawson Taylor Coffee Roasters (Idaho) is organizing blind cupping tests on Kona coffee

Entomopathogenic Nematode: *Steinernema carpocapsae*

- Roxana Cabos, Robert Hollingsworth, Jessica Manton



Mass-produced by Becker Underwood (product name: Millenium)

Nematodes are mixed with water, sprayed on crops. Commonly used to control caterpillar pests, but also infect CBB (especially larvae) when sprayed onto coffee cherries held at high humidity

Nematodes go through life cycle in 8 days at 20 degrees C.

Juveniles burst from dead insect and seek out new hosts.

0.25 Billion Nematodes (in 3x5" bento container)

Nematodes wiggling after spilling out of dead CBB larva and adult beetle

First nematode field test was a bust

	Nematodes applied directly to coffee berries (SE)	Nematodes applied to mulch and coffee berries (SE)	Water applied to coffee berries (SE)
Test 1 - Laboratory			
Adults	26.57% (3.33%)	N/A	1.56% (1.56%)
Larvae	23.73% (0.96%)	N/A	0.00% (0.00%)
Test 2 - Field			
Adults	6.66% (3.10%)	12.01% (2.54%)	3.82% (3.29%)
Larvae	18.72% (5.17%)	19.07% (8.13%)	1.25% (1.09%)

Table 1. Percent mortality (SE) in two experiments applying *Steinernema carpoca* to *Hypothenemus hampei* in coffee berries

Nematode results

- Target is CBB in fallen cherries.
- Is not yet a recommended control method (we used unrealistically high rates)
- Possibly can increase success using different adjuvants
- Other commercially available nematode species (currently prohibited in Hawaii) are “hunters” and would likely provide better control

Beauveria bassiana is by far the most important entomopathogen for CBB, and considered the most important natural enemy generally.

Beetles killed by *Beauveria bassiana*

Field Plot: Greenwell 1

Beauveria persistence (Lisa Keith), Strain Identification (Tracie Matsumoto) and Efficacy (Robert Hollingsworth)

Beauveria bassiana

- Goal: determine the persistence of the GHA strain in the environment and how this persistence translates to CBB control

Treatment field being sprayed April 25, 2011

Persistence studies

10 trees

3 trees

Spray rate = 1.5 qt/acre

Control; “no spray”

Field Sample (Tree 6)

- Lisa Keith

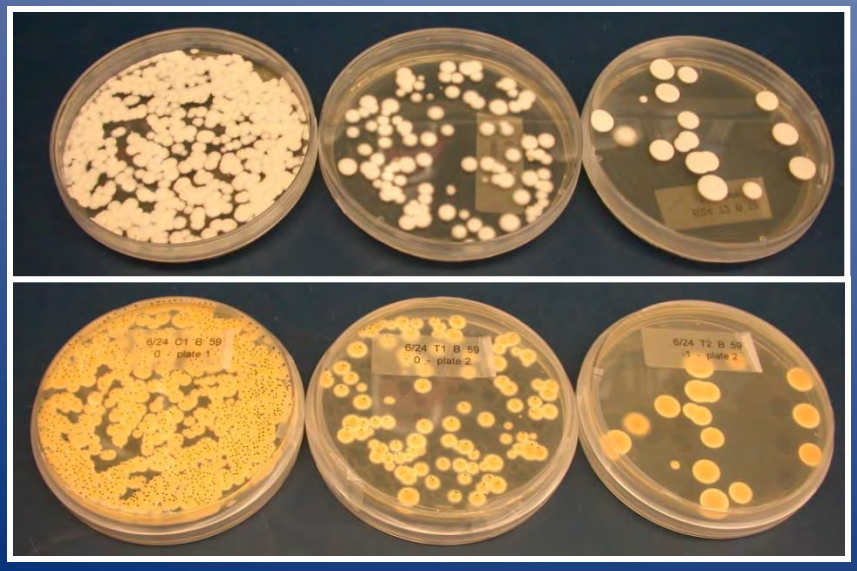
high

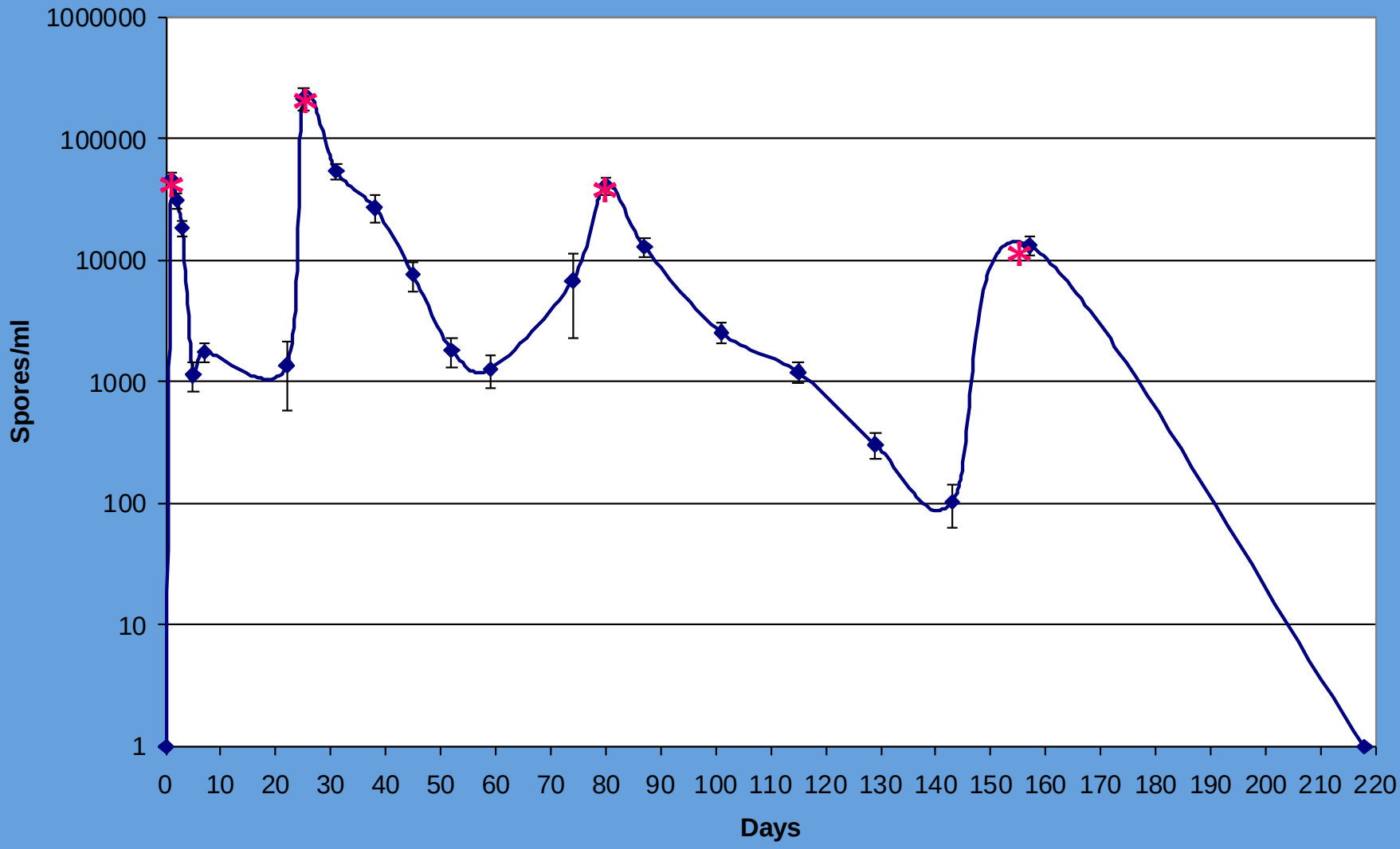
middle

low

1 sample = 15 berries
5 berries/branch

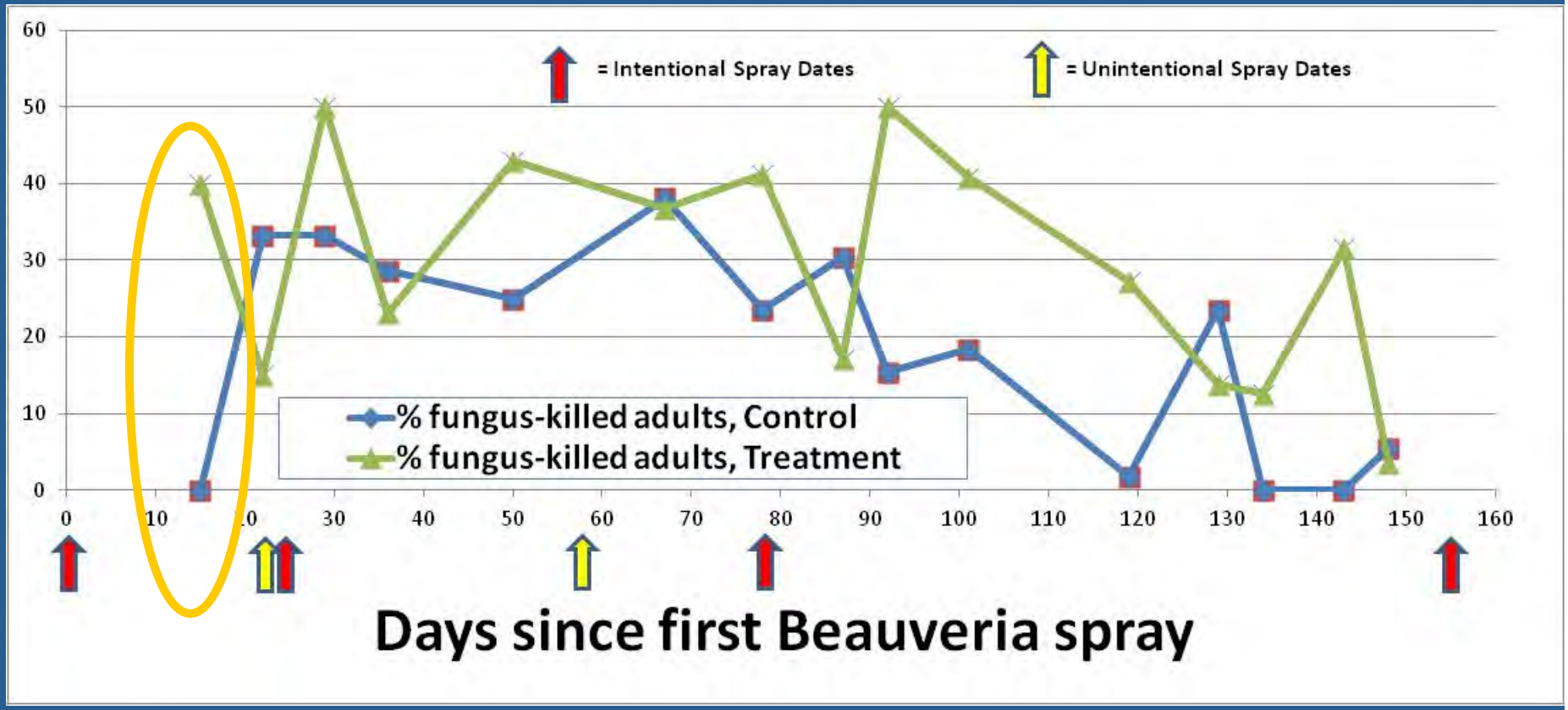
Laboratory Results - Lisa Keith





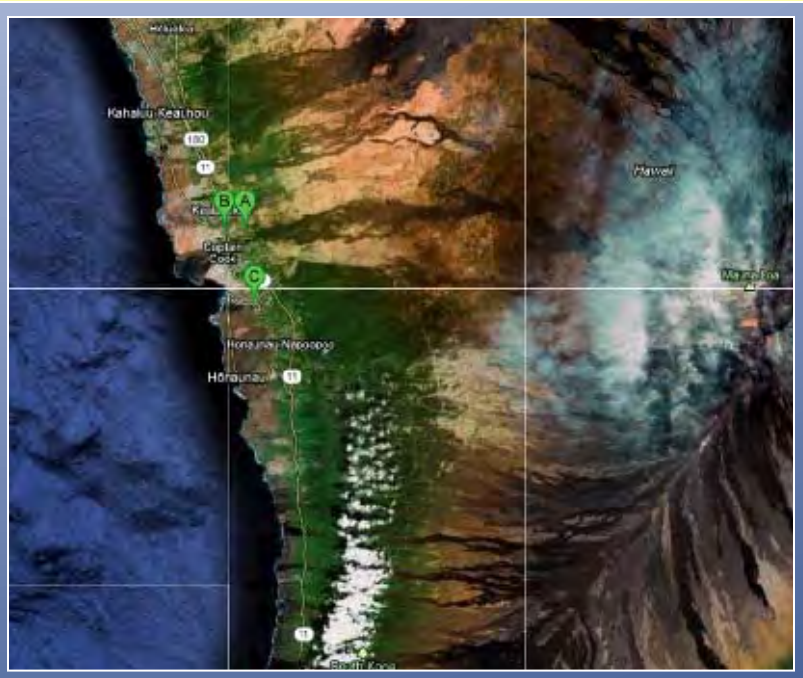
15 berries randomly selected from 3 branches/tree/time point; washed with 1x wt/vol water + Silwet; diluted, plated & counted * = spray dates

Intentional sprays: Treatment side only
Unintentional sprays: Both Treatment and Control portions of field



Year 2

- Repeating Year 1 field trial
- Added two additional fields, testing effect of frequency of *Beauveria* application (2 versus 4 sprays) on persistence, efficacy and yield



Elevations:

A. ~1700 ft

B. 1639 ft

C. 535 ft

Farms (left to right): Greenwell, Konawaena, Napoopoo

Experiment: Wailele Farm

- How well does *Beauveria bassiana* control CBB when sprayed on coffee trees prior to infestation?
  - When sprayed:
    - At the BioWorks recommended rate (7 ounces per acre)
    - At 21 ounces per acre
    - With an attractant essential oil component
    - With a repellant essential oil component

Methods

- All infested berries were removed prior to spray
- Trees sprayed with essential oils first
  - Backpack sprayer
- *Beauveria* applied using mist blower
- All newly infested berries were harvested 2, 4, and 6 weeks following spray
- Determined the percentage of adult beetles with obvious signs of *Beauveria* infection

Treatments

T1 - Low Rate *Beauveria* + 0.1% EcoSpreader

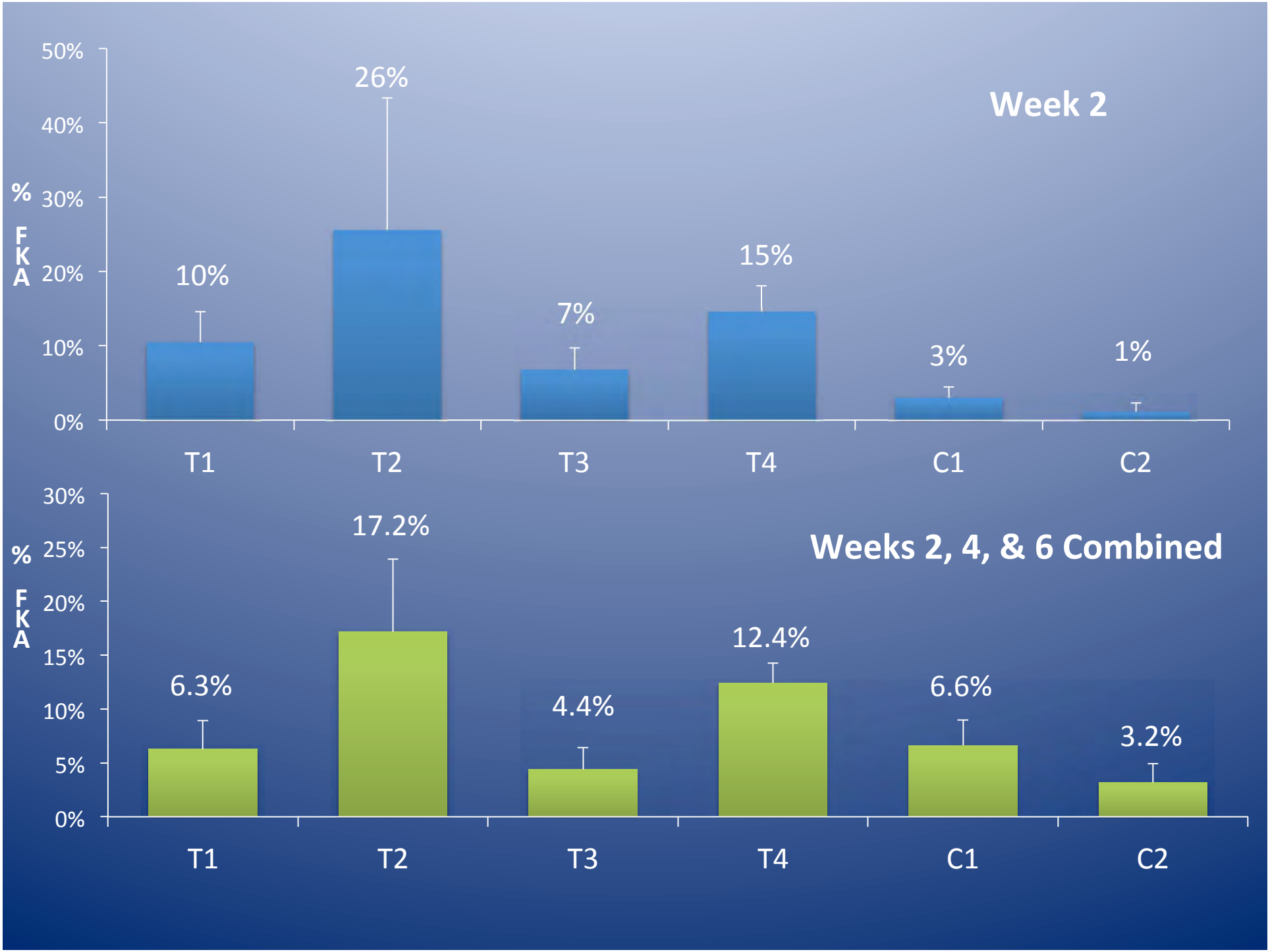
T2 - High Rate *Beauveria* + 0.1% EcoSpreader

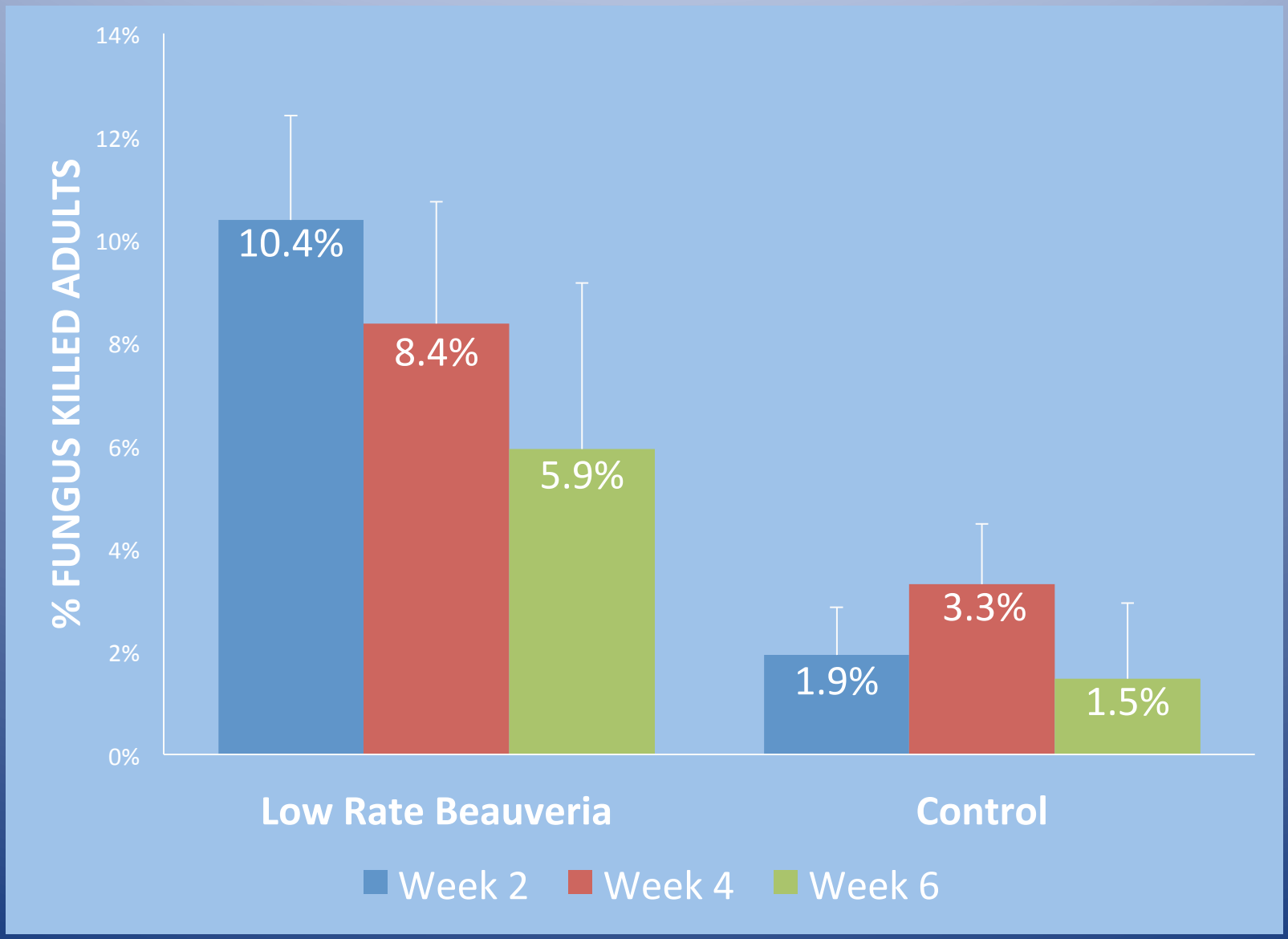
T3 – Low *Beau*+ 0.1% EcoSpreader+ 0.1% Eugenol

T4 - Low *Beau*+ 0.1% EcoSpreader+ .5% Caryophyllene

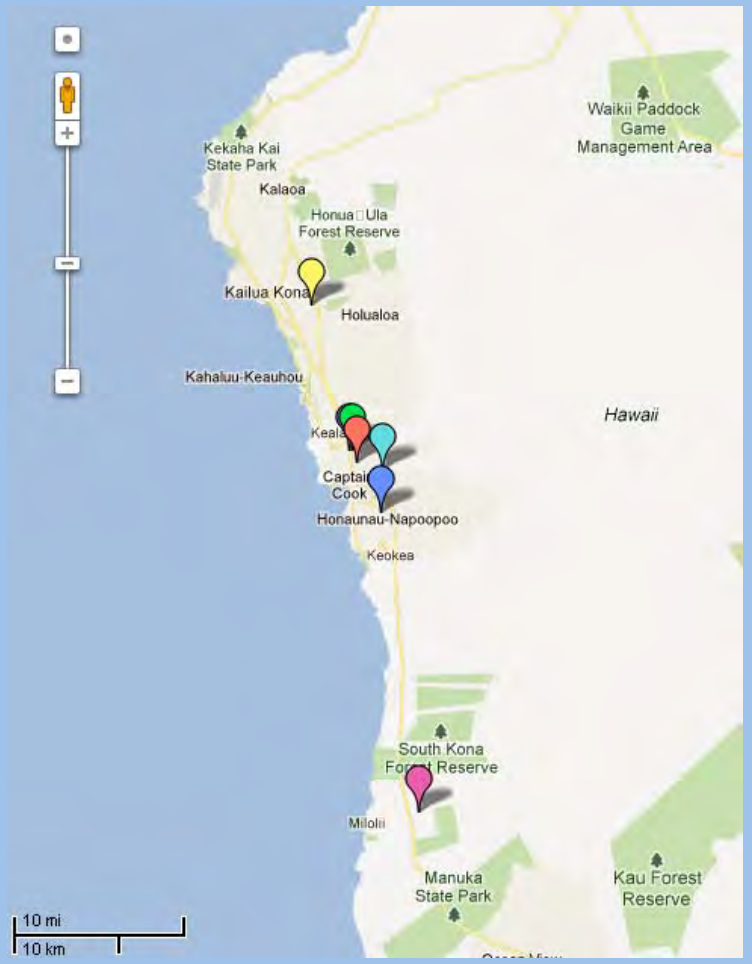
C1 - H_2O Only

C2 - 0.1% EcoSpreader Only


Week 2
% FKA
50%
40%
30%
20%
10%
0%
10%
26%
7%
15%
3%
1%
T1
T2
T3
T4
C1
C2
Weeks 2, 4, & 6 Combined
% FKA
30%
25%
20%
15%
10%
5%
0%
6.3%
17.2%
4.4%
12.4%
6.6%
3.2%
T1
T2
T3
T4
C1
C2


% FUNGUS KILLED ADULTS
14%
12%
10%
8%
6%
4%
2%
0%
10.4%
8.4%
5.9%
1.9%
3.3%
1.5%
Low Rate Beauveria
Control
Week 2
Week 4
Week 6

Collection and Characterization of "Native" Beauveria prior to release of GHA



Location	Elevation (ft)	Similar to Beauveria Isolated from Host/ Country
1	2157	CBB/Nicaragua
2	1775	CBB/Nicaragua
3	1239	CBB/Nicaragua
4	2361	NA/Korea
5	1775	CBB/Nicaragua
6	1598	CBB/Nicaragua
7	701	Banana Stemborer/Brazil

PBARC Plans going forward

- Continue research with attractants and repellents
- Continue research measuring persistence of *Beauveria* and effects on yield and efficacy
- Carry out nematode survey which might lead to deregulation of a hunter species
- Compare efficacy of different strains of *Beauveria* separately and in mixtures using molecular methods for strain identification

Jessica Manton

Glenn Asmus

Fran Calvert and
Izabella Zobova

Shannon Costa

John Ross

Mahalo to:

Dole Foods Hawaii – Dan Nellis and Michael Conway
Greenwell Farms - Tommy Greenwell and Pepe Miranda
Kauai Coffee – Wayne Katayama and Greg Williams

Coffee Flowering
Darsen Aoki

Hawaii Coffee Growers Association
HARC – Dr. Chifumi Nagai
Valent Bioscience – Dan Leep and Johnny Lopez

"Native" Beauveria
Angelica Tangalin
Mariel Mogote