

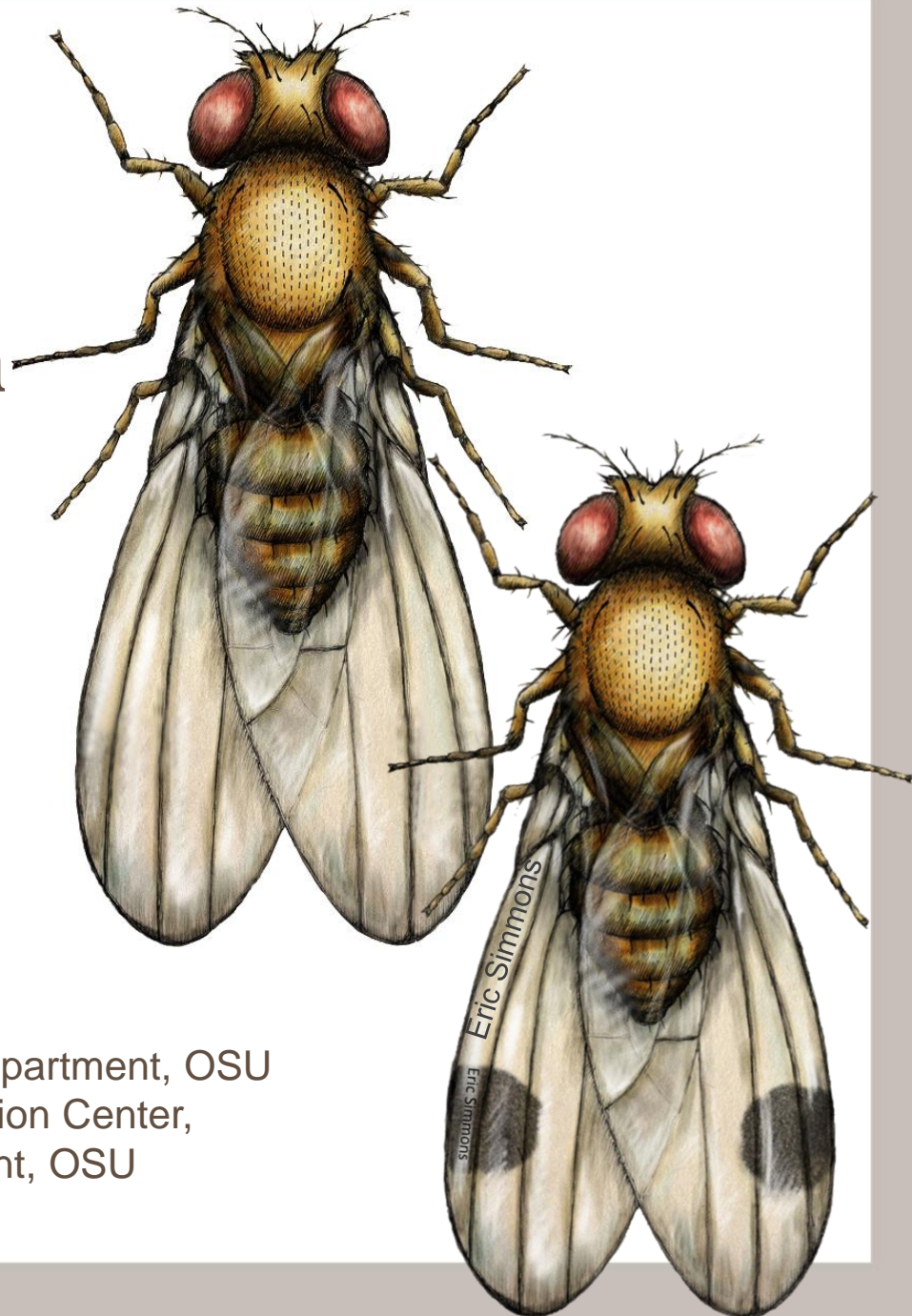
Bait & Trap Design Preferences for *Drosophila suzukii*

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BS Bioresource Research
Pest Biology & Management Option
Entomology Minor

Mentors:

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Horticulture Department, OSU



Thesis Outline

- What is Spotted Wing Drosophila?
- Distribution & Impact
- Management
- Research Objectives
- Materials & Methods
- Results & Conclusions
- Future Research



What is Spotted Wing *Drosophila*?

- *Drosophila suzukii*
- Spotted wing *Drosophila* (SWD) in North America/Europe;
Cherry *Drosophila* in Japan
- New invasive vinegar fly
- Agricultural pest: small & stone fruits
 - Cherries, caneberries, blueberries, strawberries & more!



SWD Identification



Male SWD



Photo courtesy of A. Ohrn, Oregon State University

Field ID of males



Female SWD



Photo courtesy of A. Ohrn,
Oregon State University

Ovipositor

D. suzukii



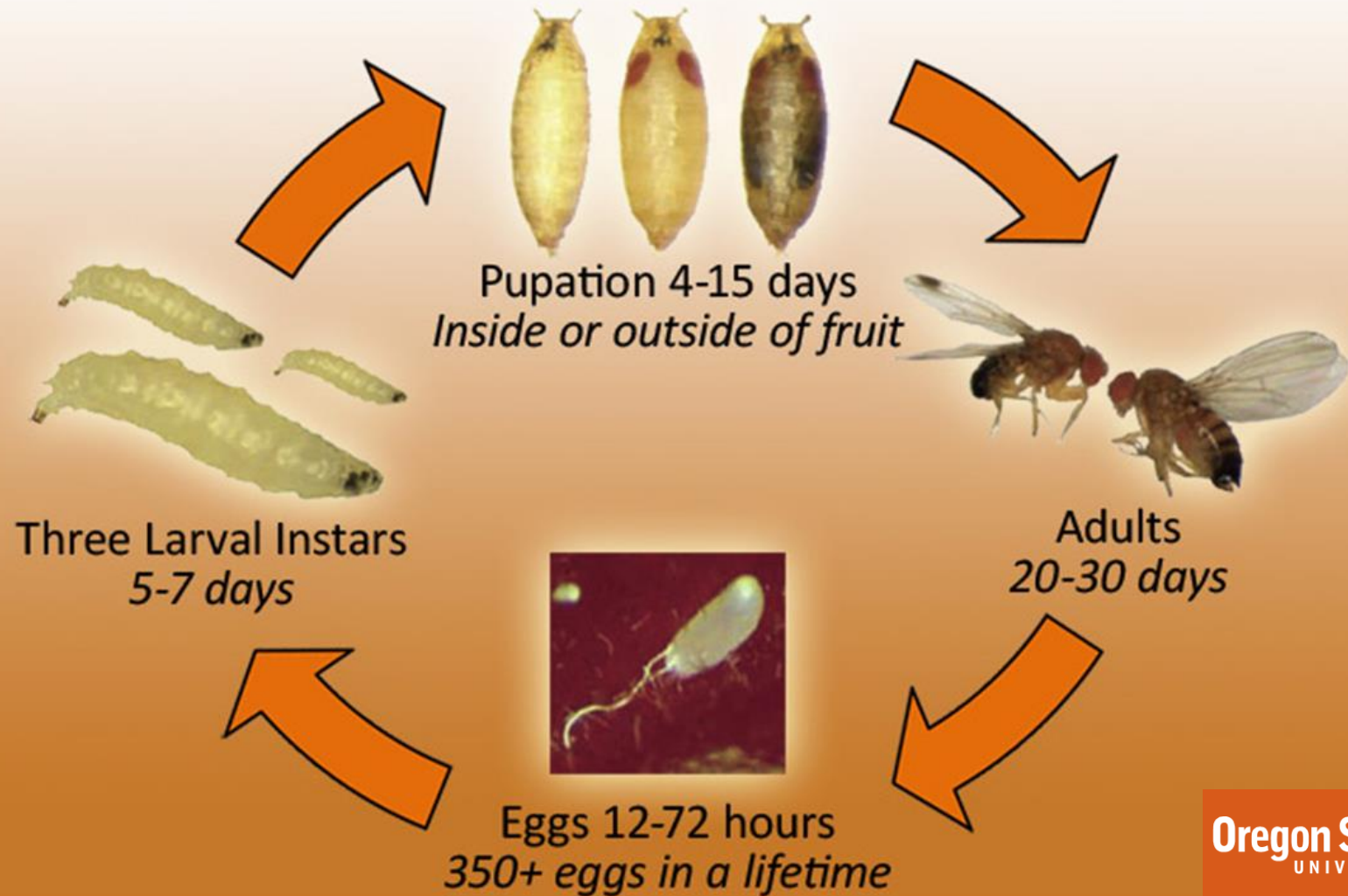
D. simulans



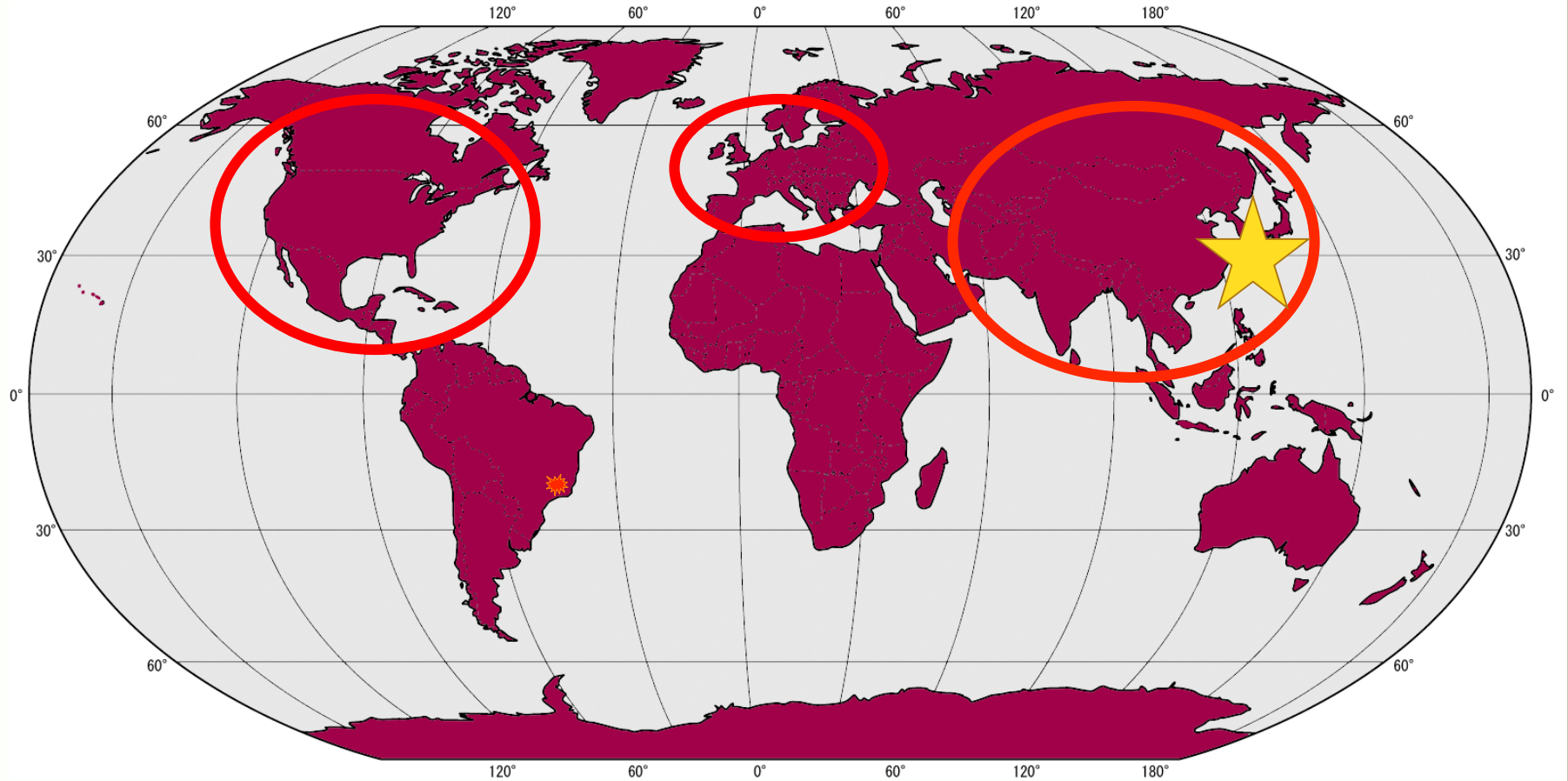
Photos courtesy M. Hauser, CDFA

Life Cycle of the Spotted Wing Drosophila

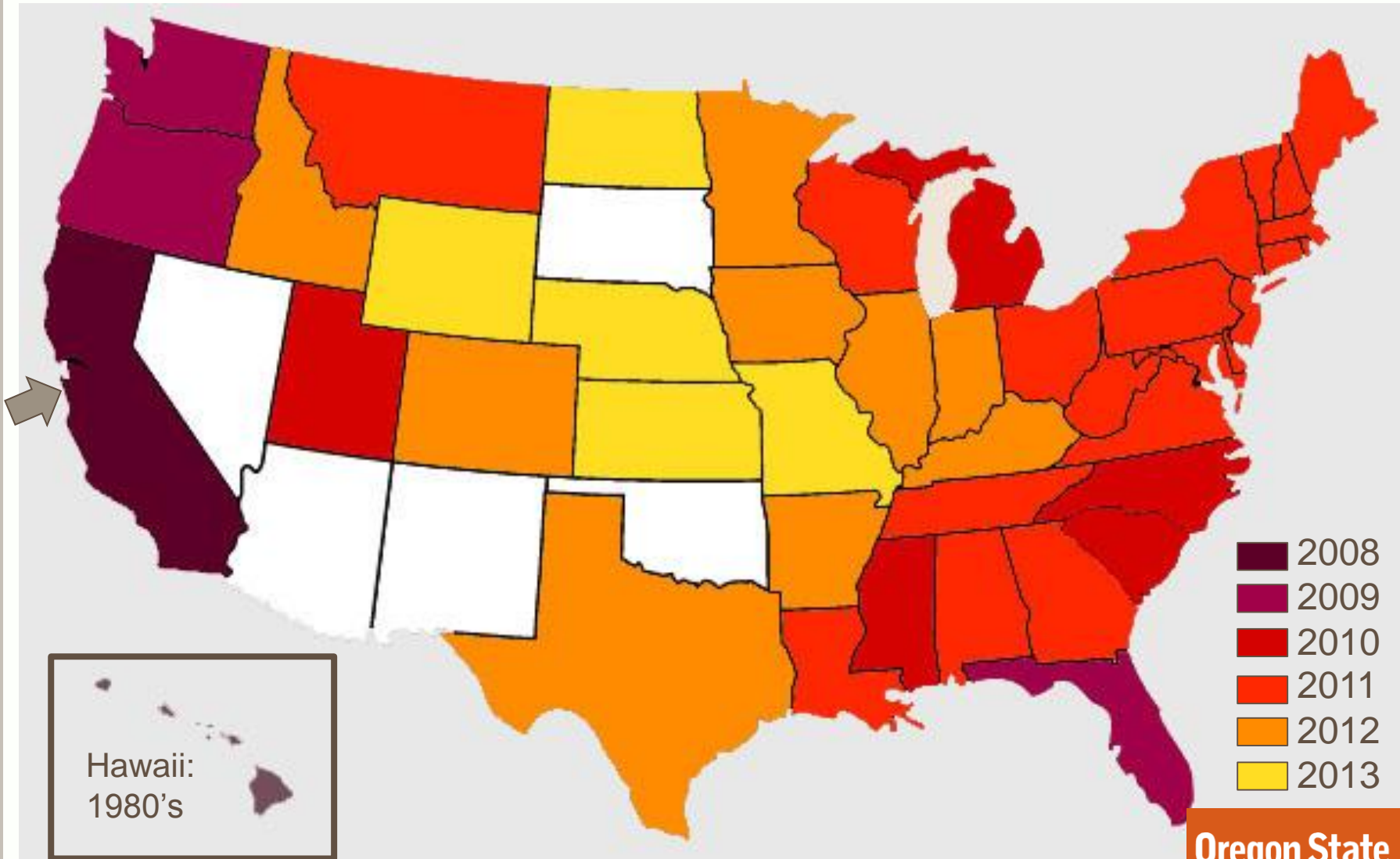
Drosophila suzukii (Matsumura)



Global Distribution



USA Distribution



Why do we care about SWD?



Photo courtesy E. Beers, Washington State University



Photo courtesy A.J. Dreves, Oregon State University

Why do we care about SWD?





Oregon 2012

- 29,450 acres of blueberries, caneberries, & cherries
- ~\$236.3 million Farm-gate value

USDA-National Agricultural Statistics Service, Non-citrus Fruits and Nuts Summary 2012

Grower Response



Registered Insecticides

- Carbamates: Carbaryl
- Organophosphates: Malathion
- Spinosyns: Entrust, Success
- Pyrethrins/ Zeta-cypermethrin

Dangers of using one tool

- Non target organisms
- SWD Resistance
- Pesticide treadmill

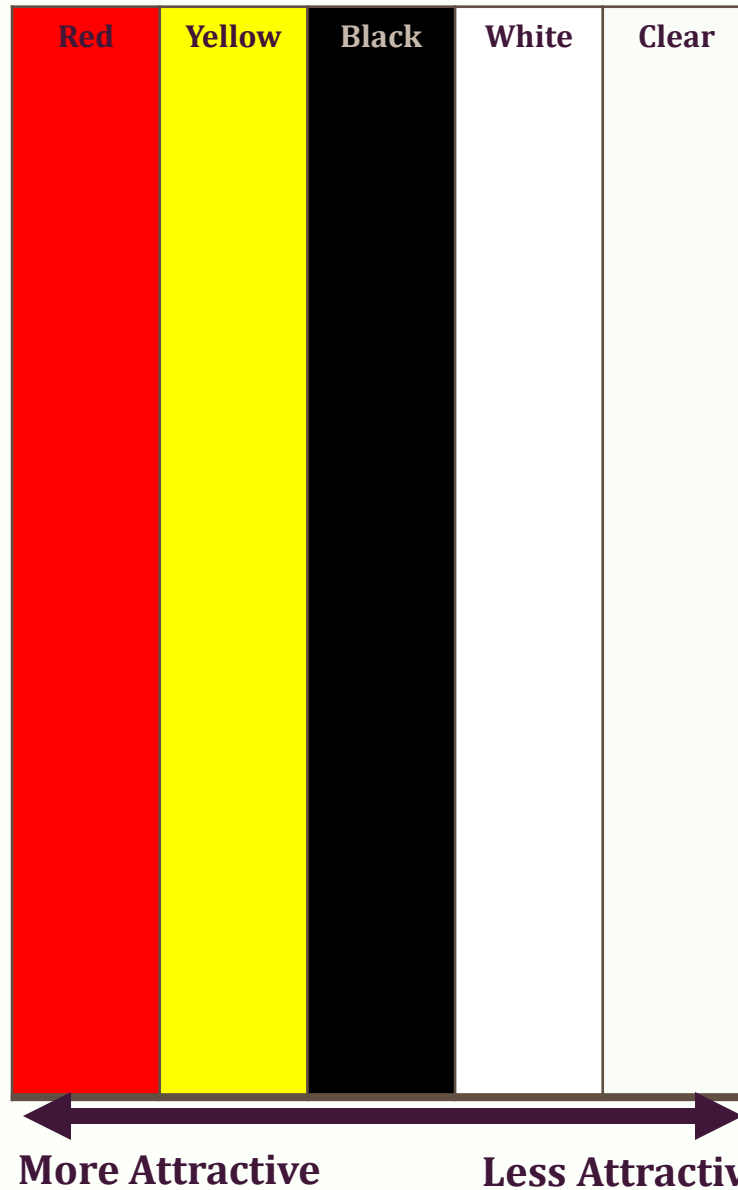


Integrated Pest Management (IPM)

Multiple tool approach

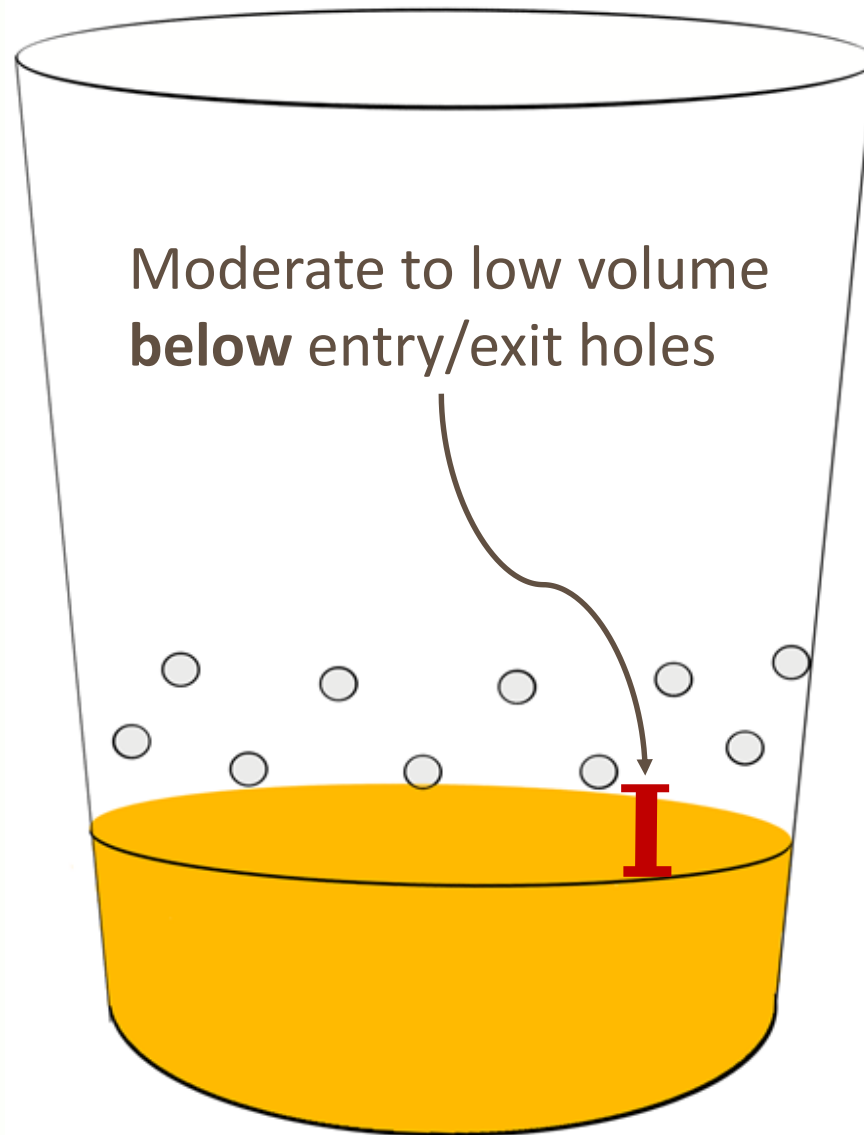
- Harvest frequently
- Mass Trap (Kanzawa 1934, Navarro-Llopis 2008, Broumas et al 2002, Delrio 1989, Wu et al. 1997, Qunsong, Li 2003)
- Attract & Kill (Deyou, Li 2005, McQuate et al. 2005)
- Timing chemical treatments (Havalind & Beers 2012)
- Net plants (Kawase et al 2005)
- **Monitoring** for Presence & Control

Attractive Trap Attributes



Basoalto et al. (2013)
Lee et al. (2012, 2013)
Maimon & Straw (2008)

Attractive Trap Attributes



Marek 2012

Research Objectives

Contribute to the development IPM tools for *D. suzukii*, including detection and eradication



1. Test **Baits**
 - a) High captures
 - b) Specificity to SWD
 - c) Female appeal
2. Improve **Trap Design** for monitoring adult presence

- 
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- Bait**

- Trap Design

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Site 1: Blueberry, cultivar Spartan





Chinking Vinegar

BioLure®

S. cerevisiae

Suzukii Trap®

H. uvarum

Apple Cider Vinegar (5%) Control

Torula Yeast Pellet

Cha-Landolt

Not pictured: Monterey Insect Bait

- 9 baits; 10 m
- 4 replications; 40 m
- 160 – 175 mL bait
- Serviced & rotated weekly

Standard Bait



Apple Cider Vinegar

Unofficial Standard Bait



Saccharomyces cerevisiae

+



Sugar

A better yeast?



Hanseniaspora uvarum

Hanging lure with drowning solution



“Cha-Landolt” Bait

Commercial Baits



Suzukii Trap® bait



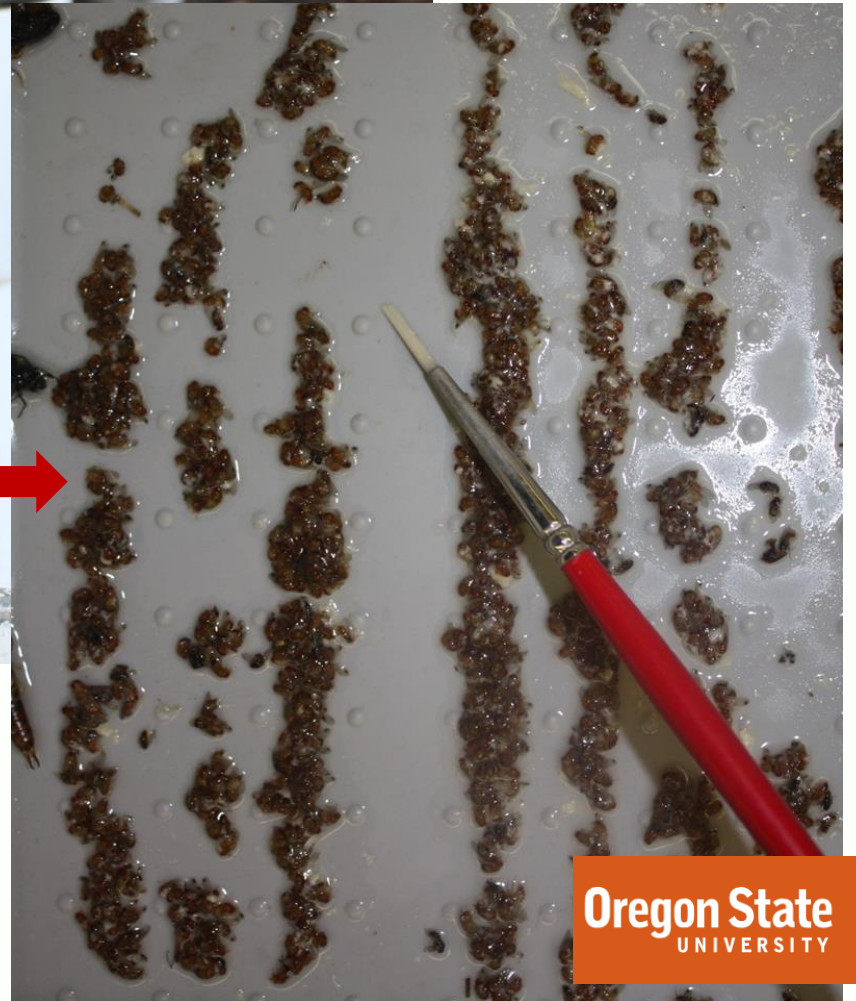
Torula Yeast Pellets

Not Pictured: BioLure®, Monterey Insect Bait®

Chinkiang Vinegar

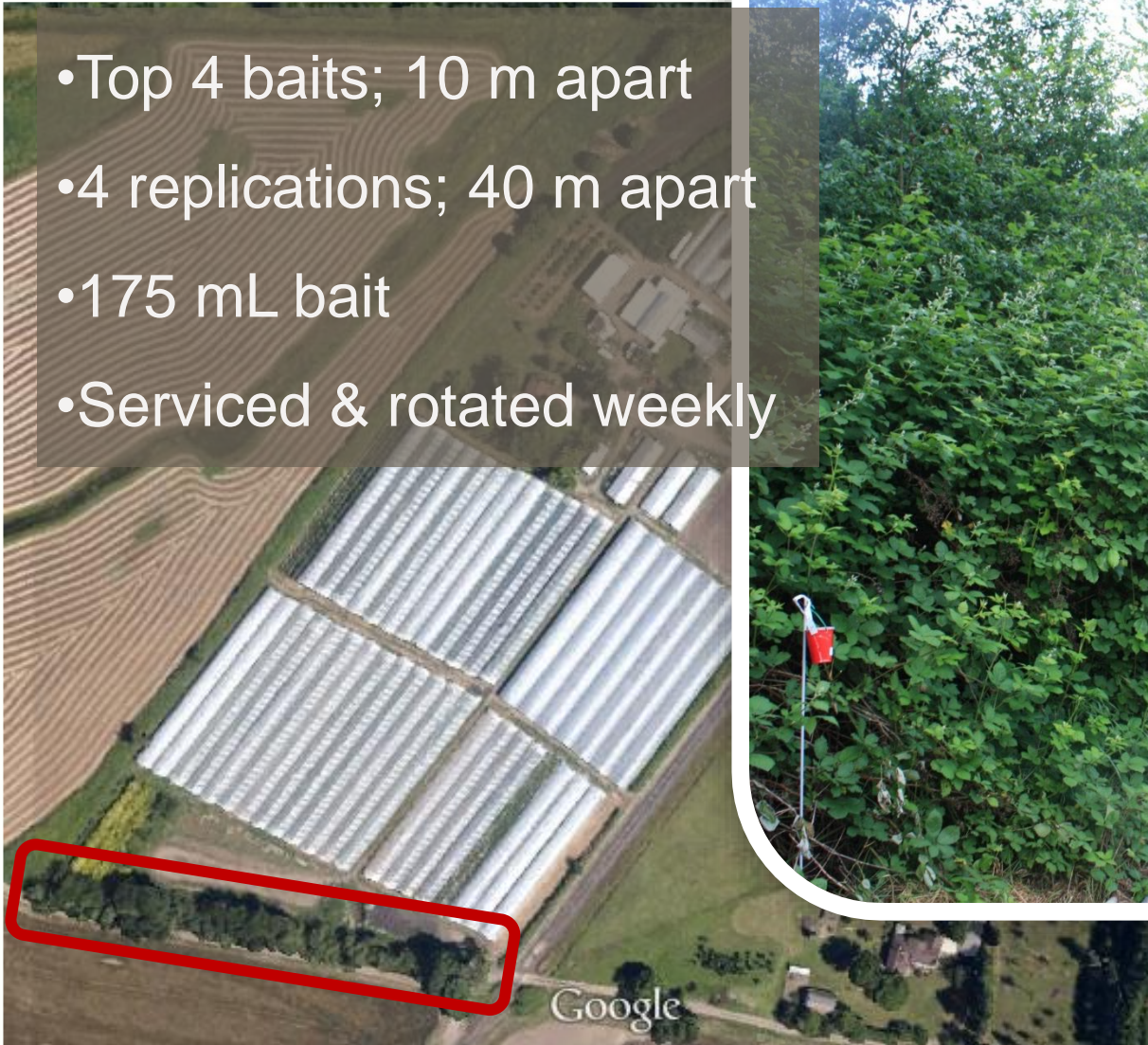


Chinkiang Vinegar



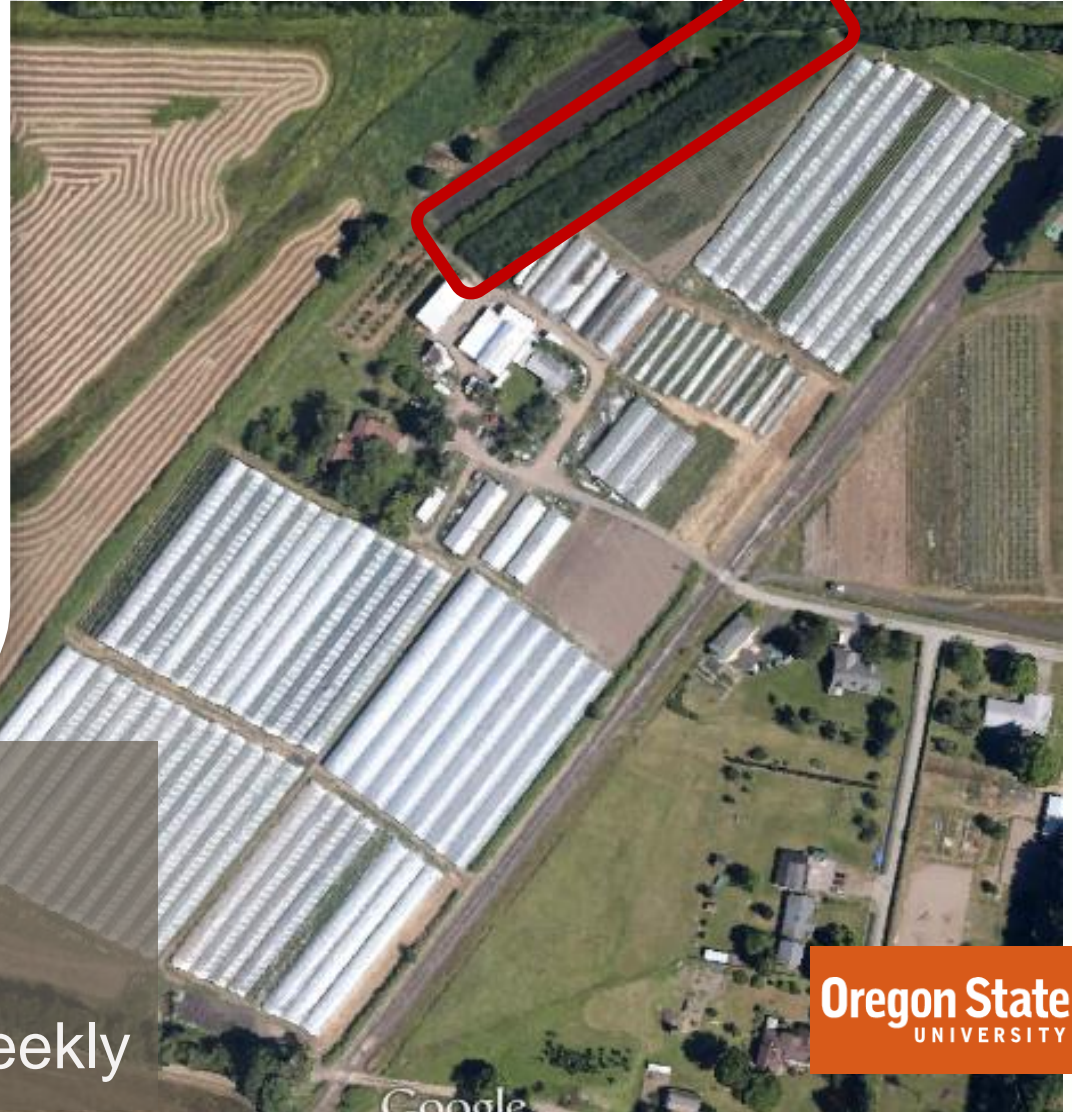
Site 2: Wild Himalaya blackberry

- Top 4 baits; 10 m apart
- 4 replications; 40 m apart
- 175 mL bait
- Serviced & rotated weekly



Site 3: Early Burlette Cherry

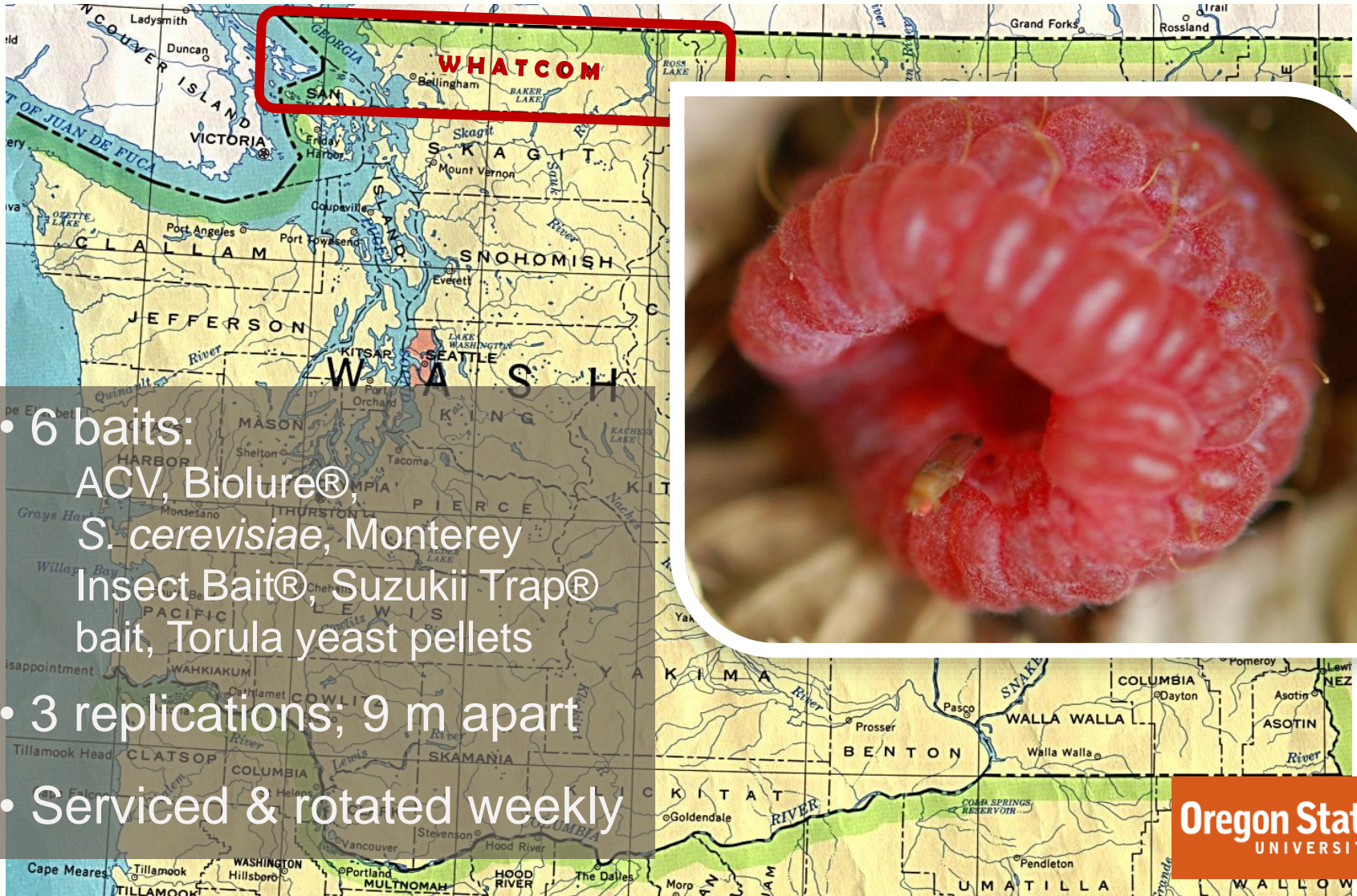
Jana Lee, USDA-ARS Hort Research Unit, Corvallis OR



- 9 baits
- 4 replications
- Serviced & rotated weekly

Site 4: Raspberry

Colleen Burrows, WSU Whatcom County Extension, WA



- 6 baits:
ACV, Biolure®,
S. cerevisiae, Monterey
Insect Bait®, Suzukii Trap®
bait, Torula yeast pellets
- 3 replications; 9 m apart
- Serviced & rotated weekly

- 
- What is Spotted Wing Drosophila?
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Bait

- **Materials & Methods**

 - **Trap Design**

 - Results & Conclusions
 - Future Research

Site: Wild Himalaya blackberry





Standard
"Clear 10-
Hole©"

"Dreves Side
Mesh©"

"Clear 20-
Hole©"

"Squatty
Botty©"
fly trap

Red
"6 Hole©"

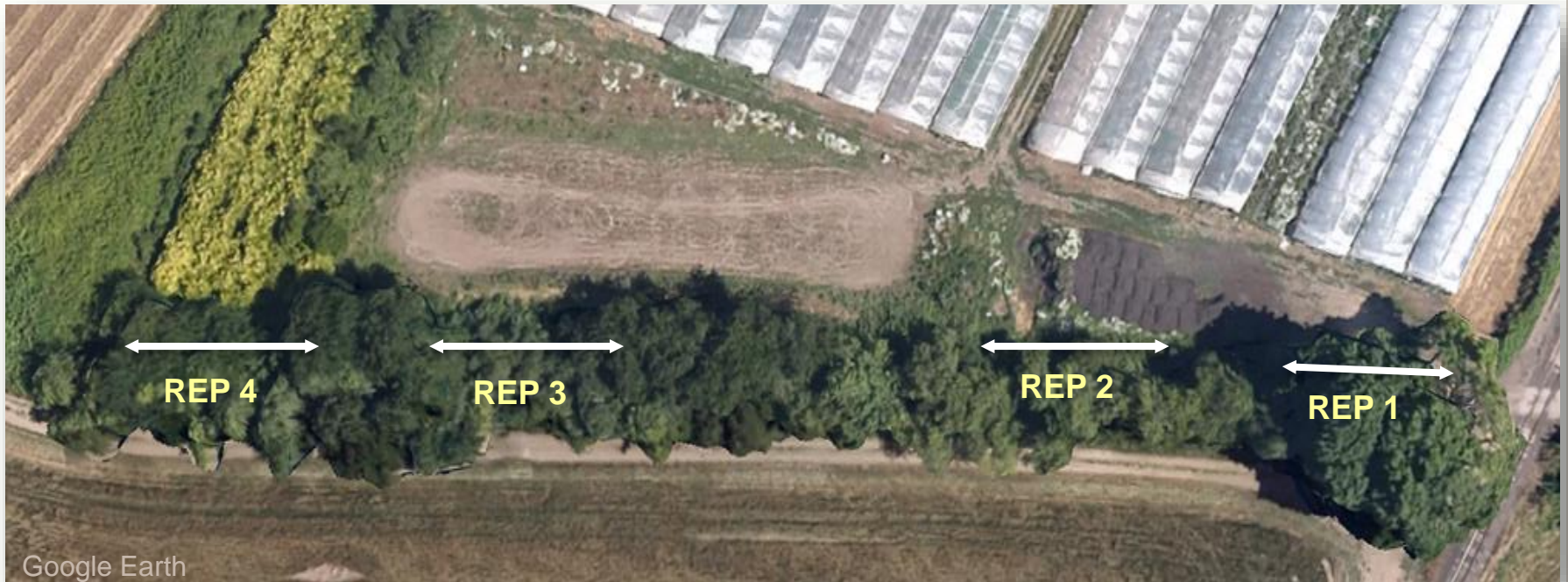
Red
"Lucky
13©"

CAPtiva
"Red Zorro"

MultiLure®

- 8 trap designs; 3 m
- 4 replications; 40 m
- *S. cerevisiae* yeast/sugar/water bait

Close-up of Wild Himalaya blackberry



- 
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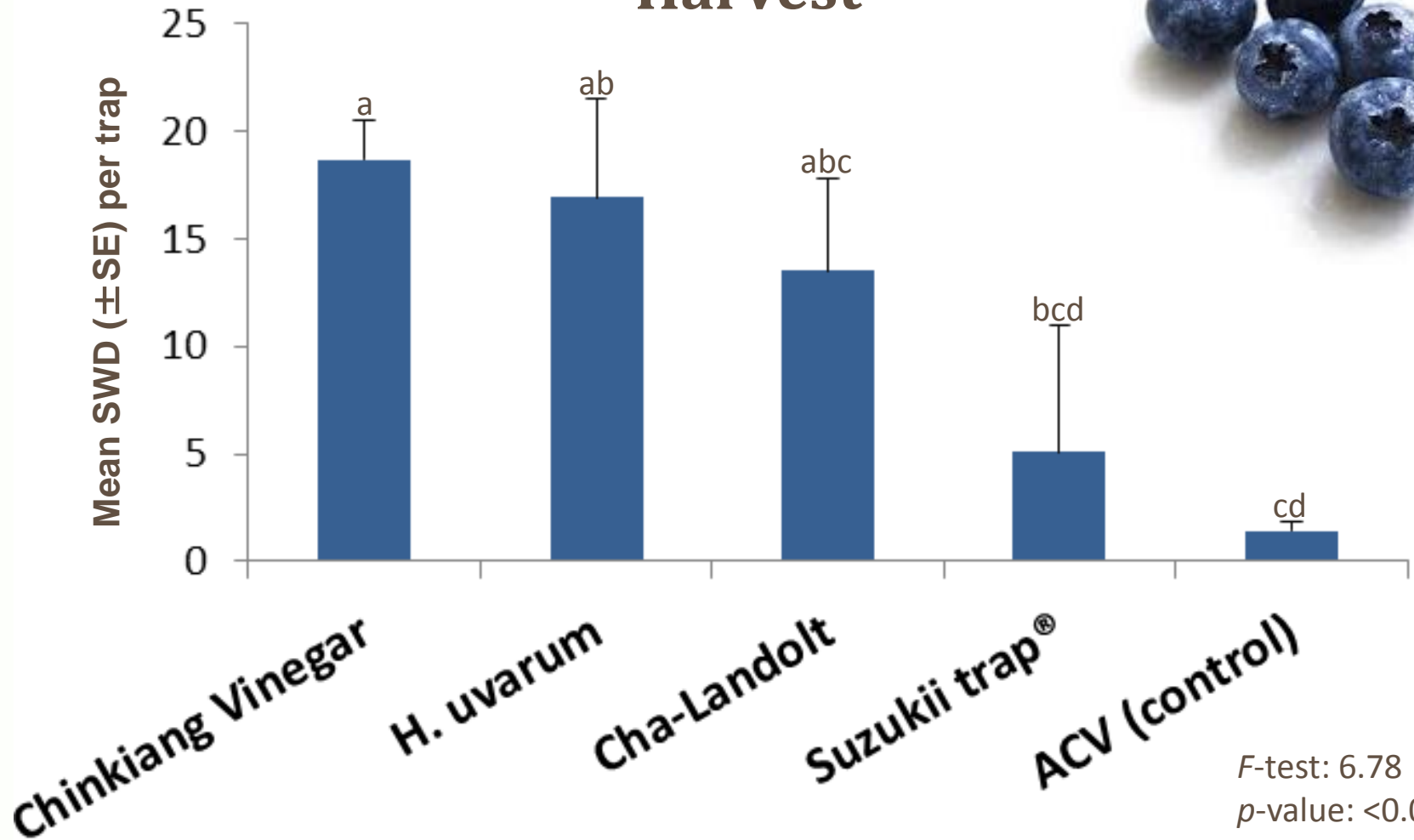
- **Results & Conclusions**

 - Bait**

 - Trap Design

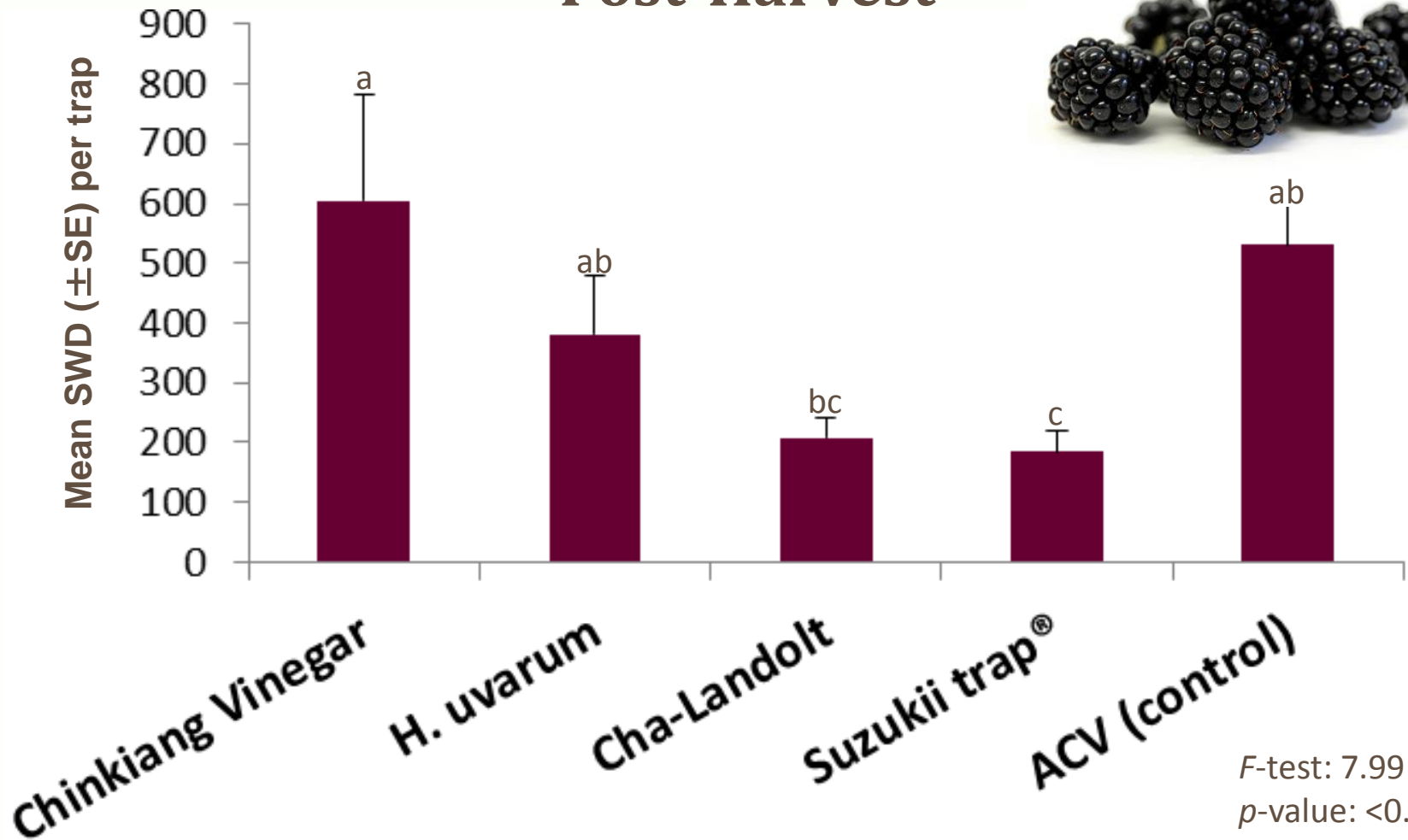
- Future Research

2013 Bait Results in Blueberry Harvest



F-test: 6.78
p-value: <0.0001

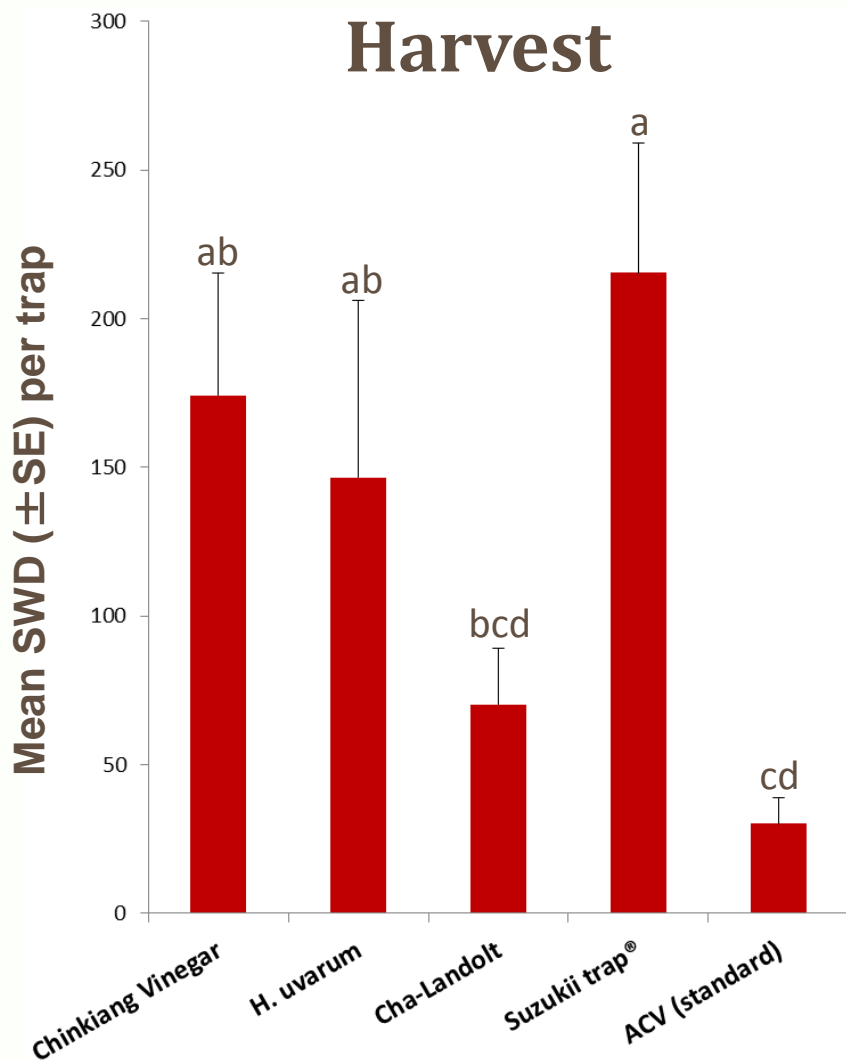
2013 Bait Results in Blackberry Post-Harvest



F-test: 7.99
p-value: <0.0001

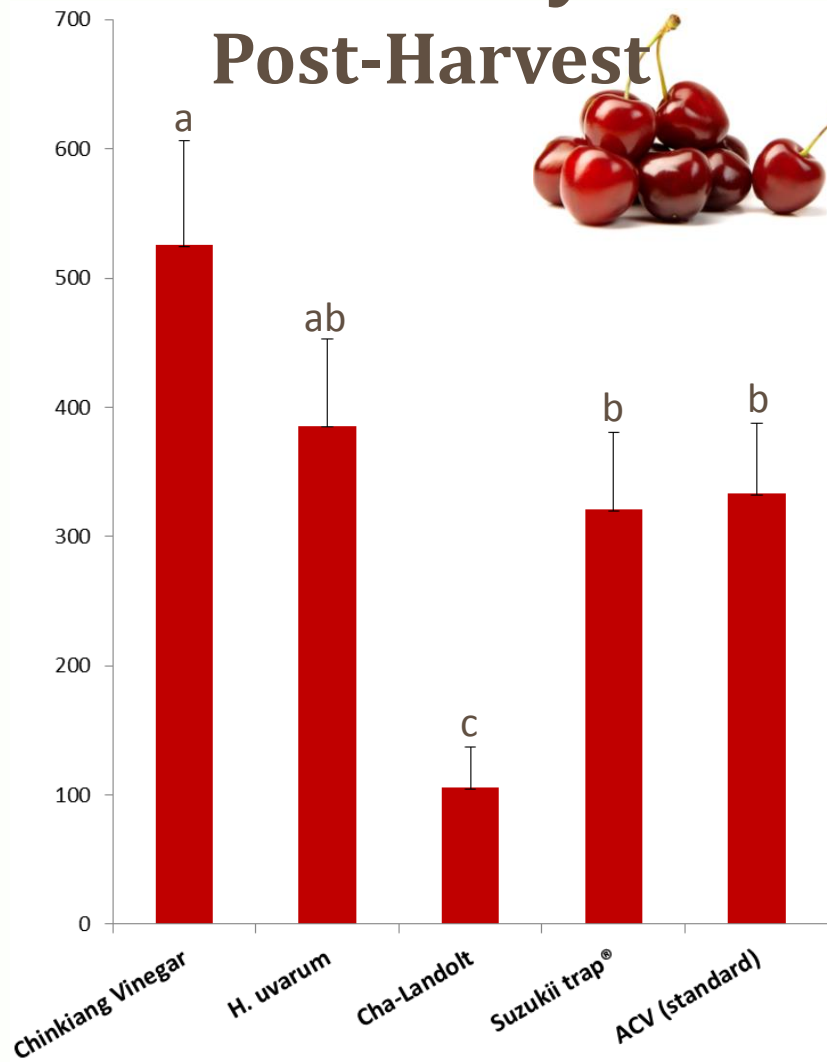
2013 Bait Results in Cherry

Harvest



F-test: 11.44
p-value: <0.0001

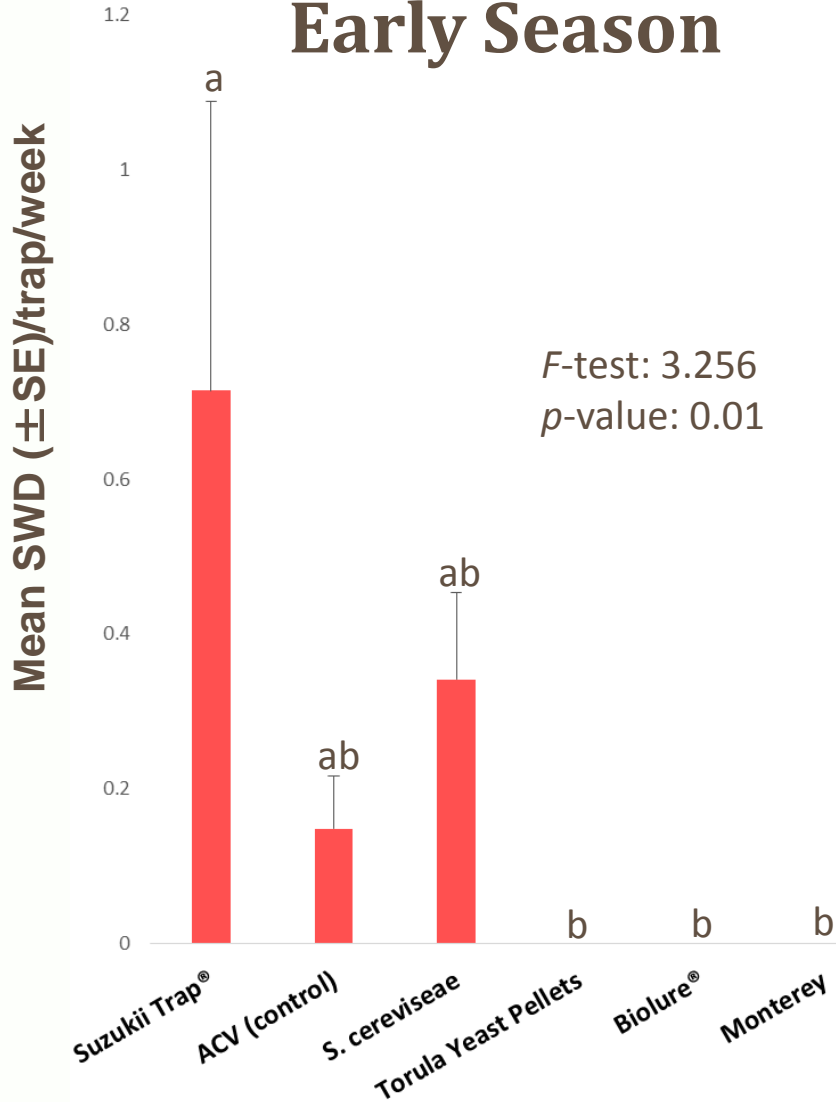
Post-Harvest



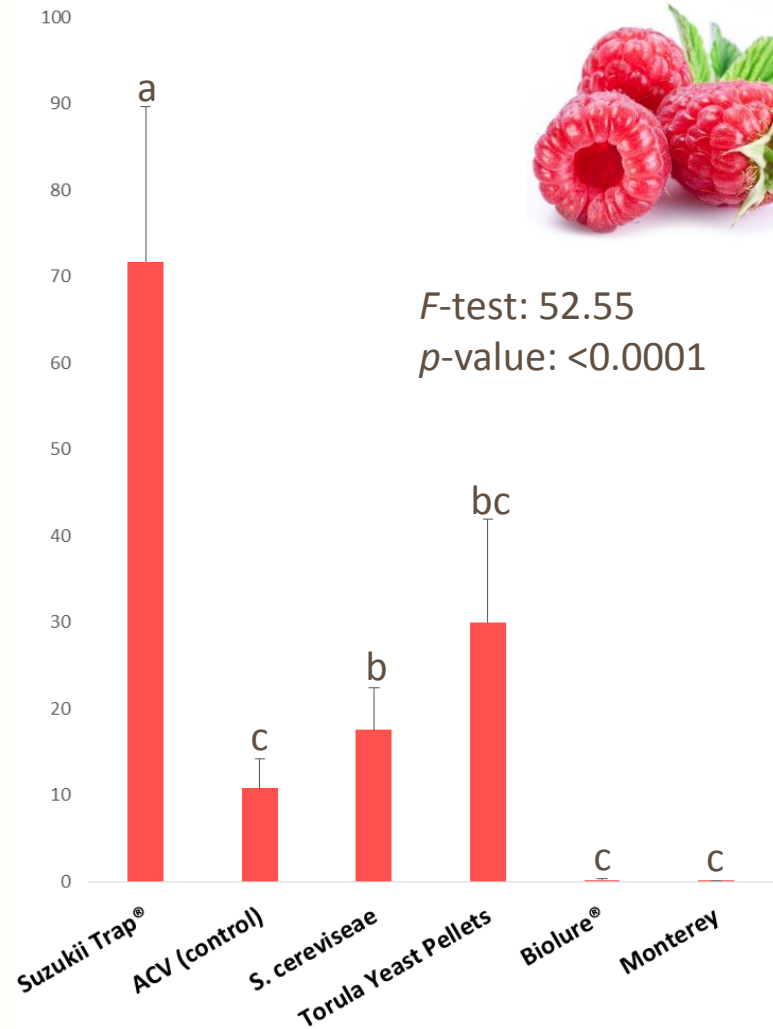
F-test: 10.23
p-value: <0.0001

2013 Bait Results in Raspberry

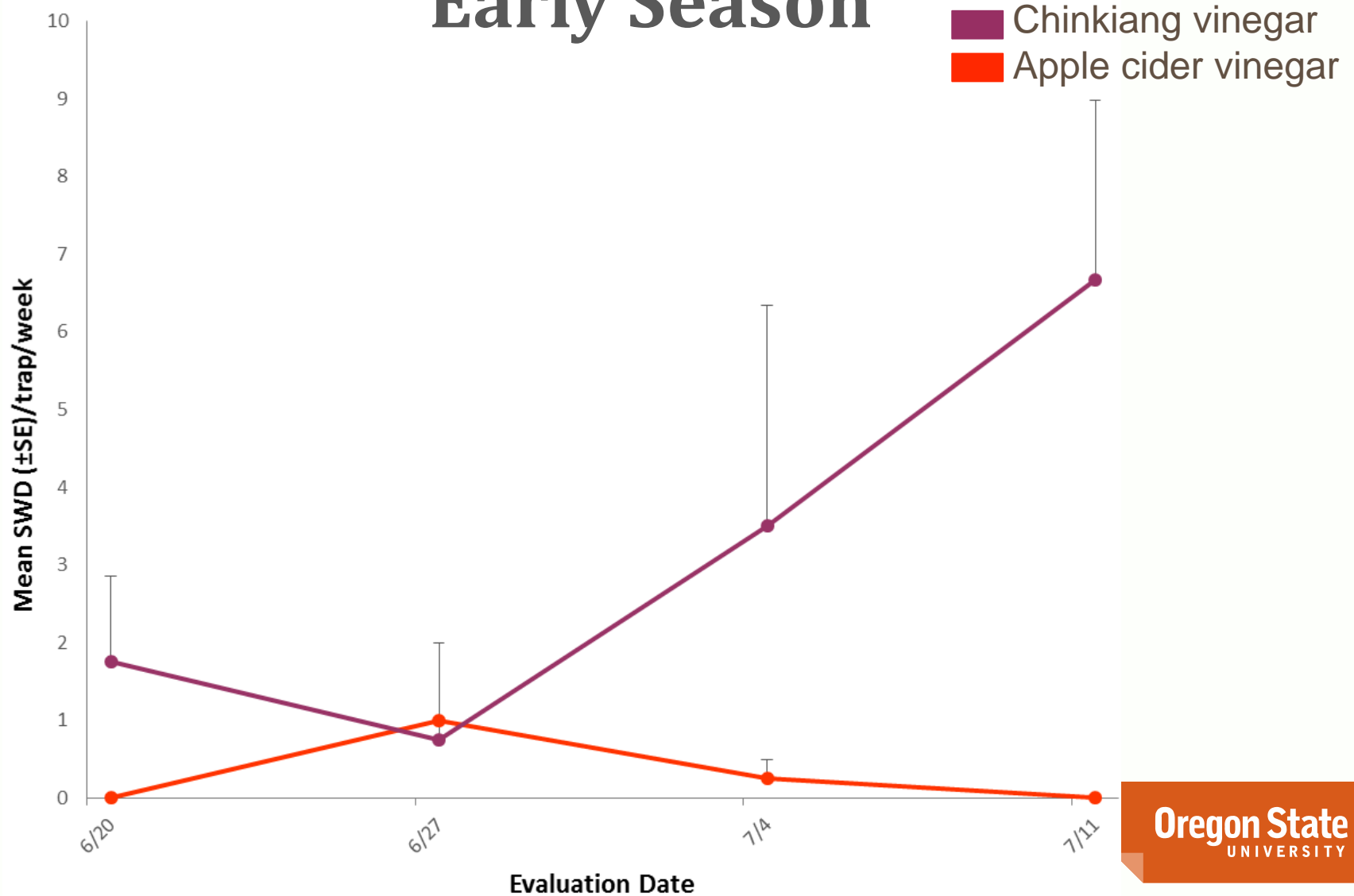
Early Season



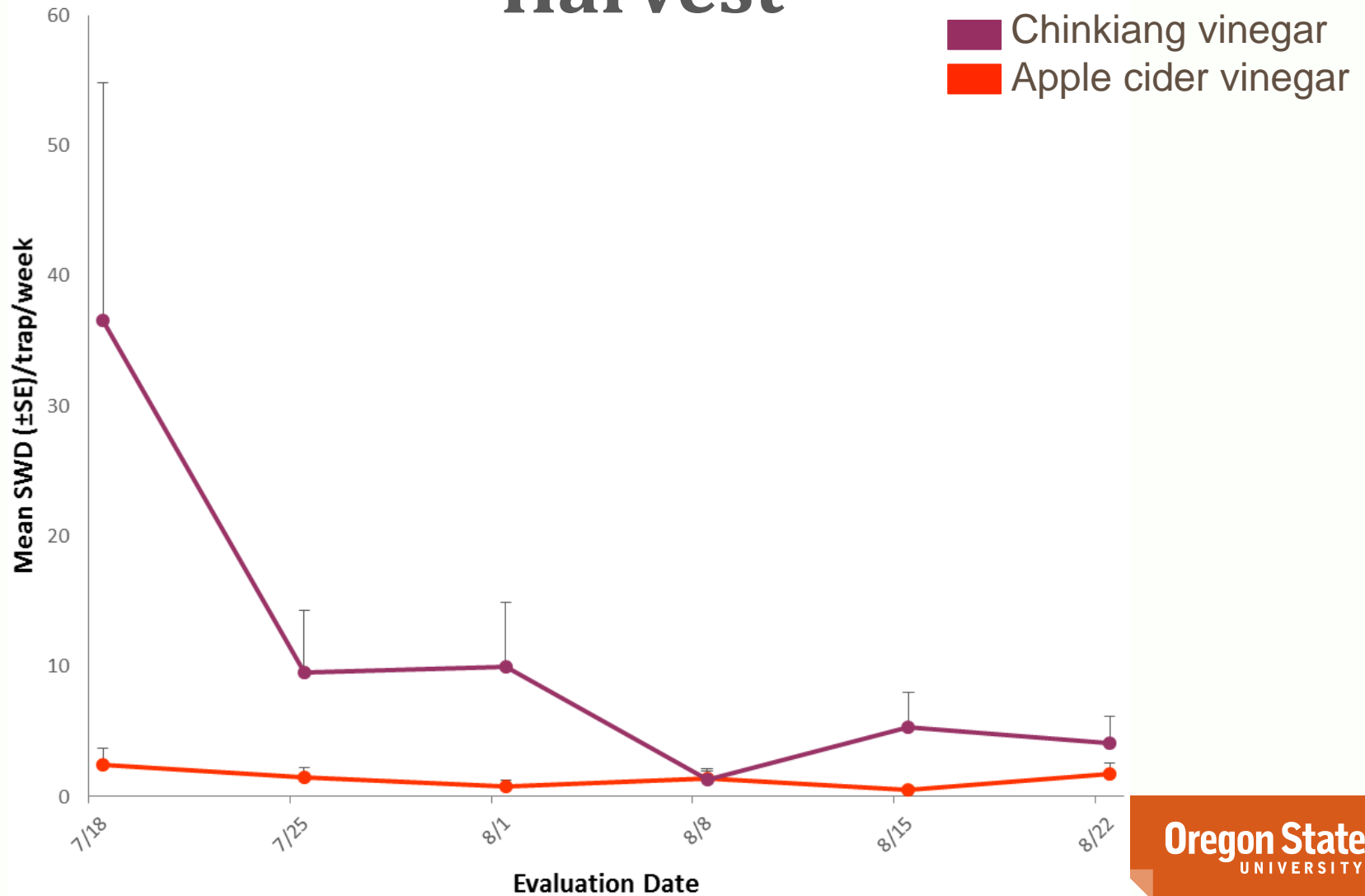
Harvest



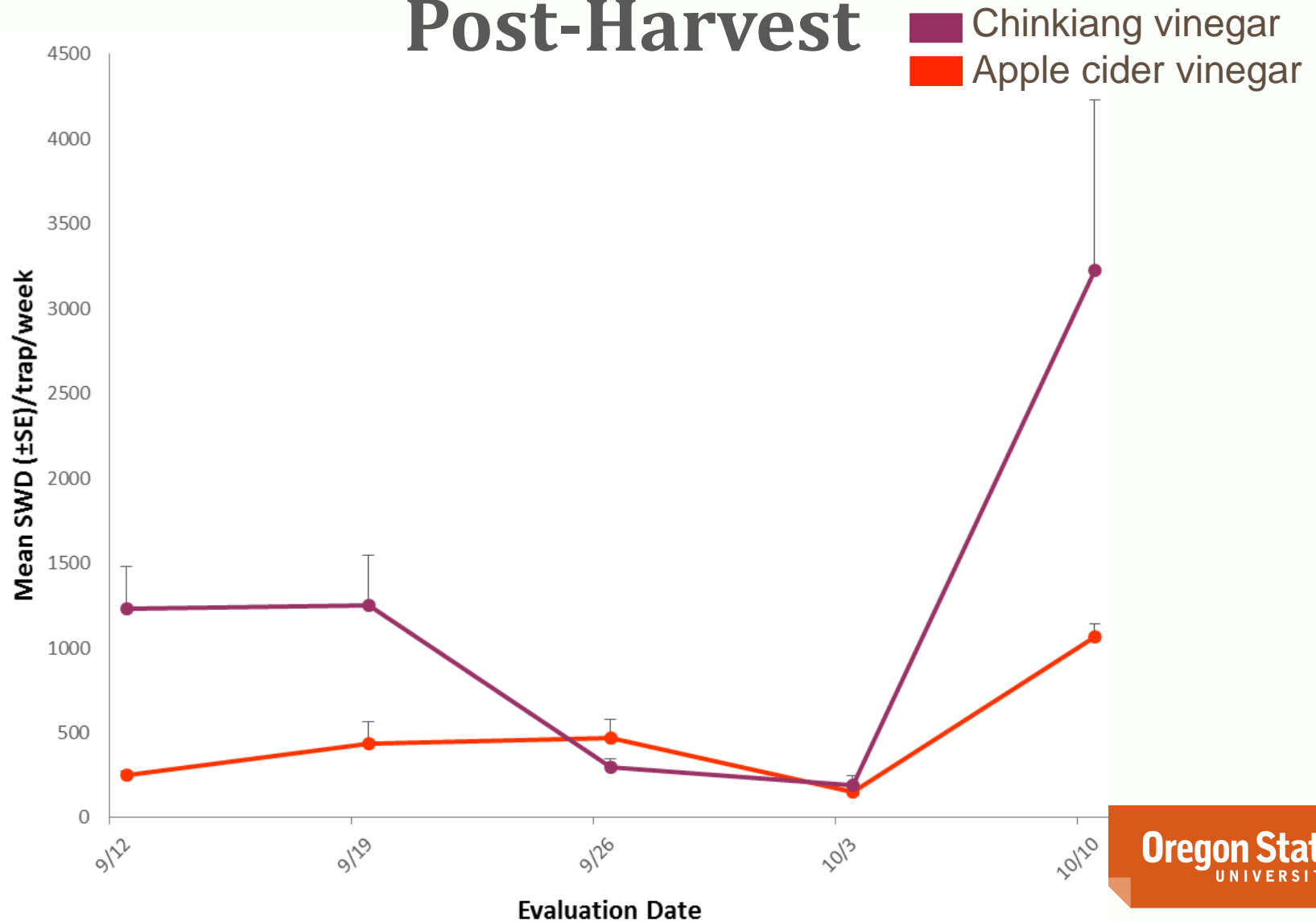
Vinegar Comparison: Early Season



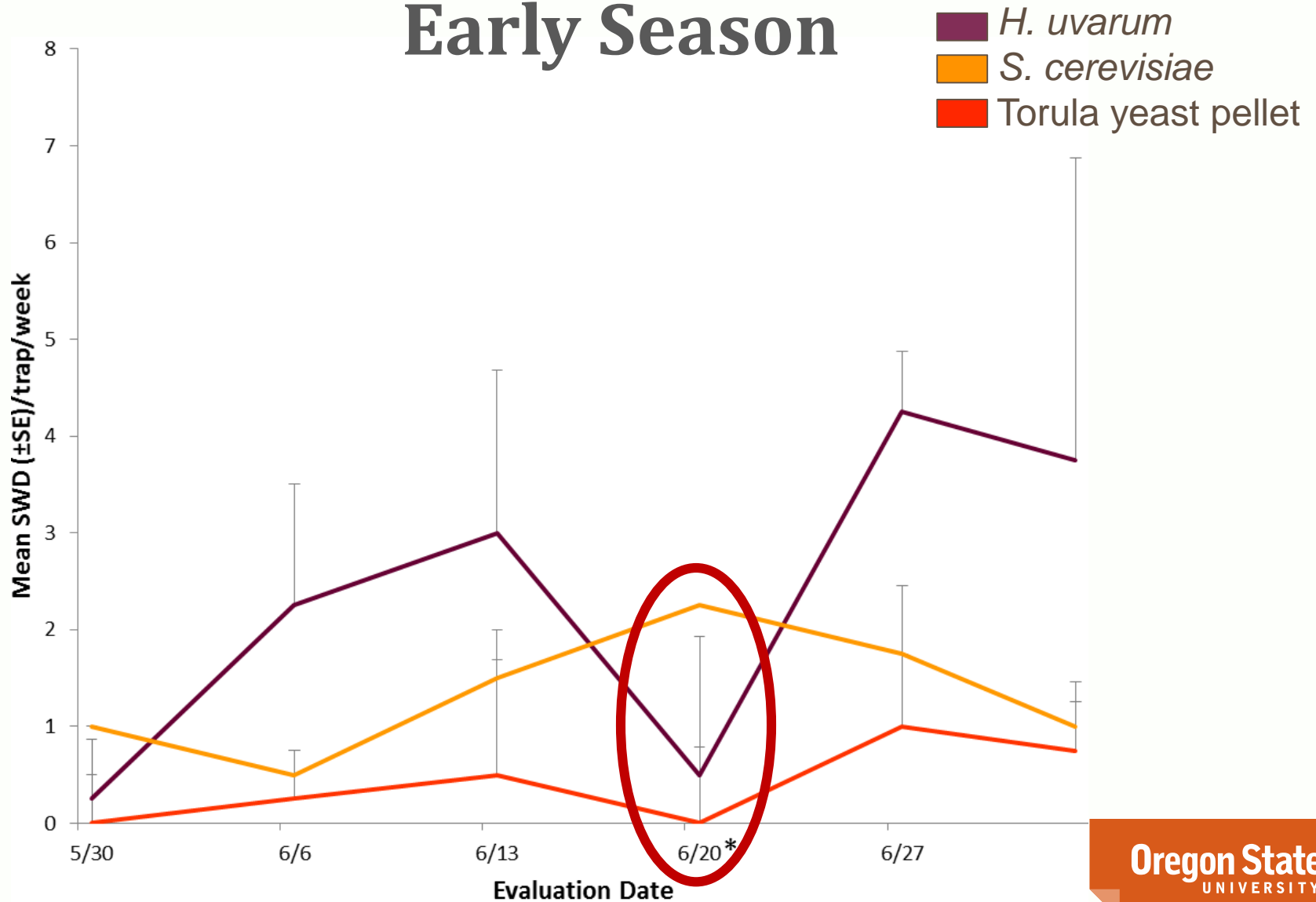
Vinegar Comparison: Harvest



Vinegar Comparison: Post-Harvest

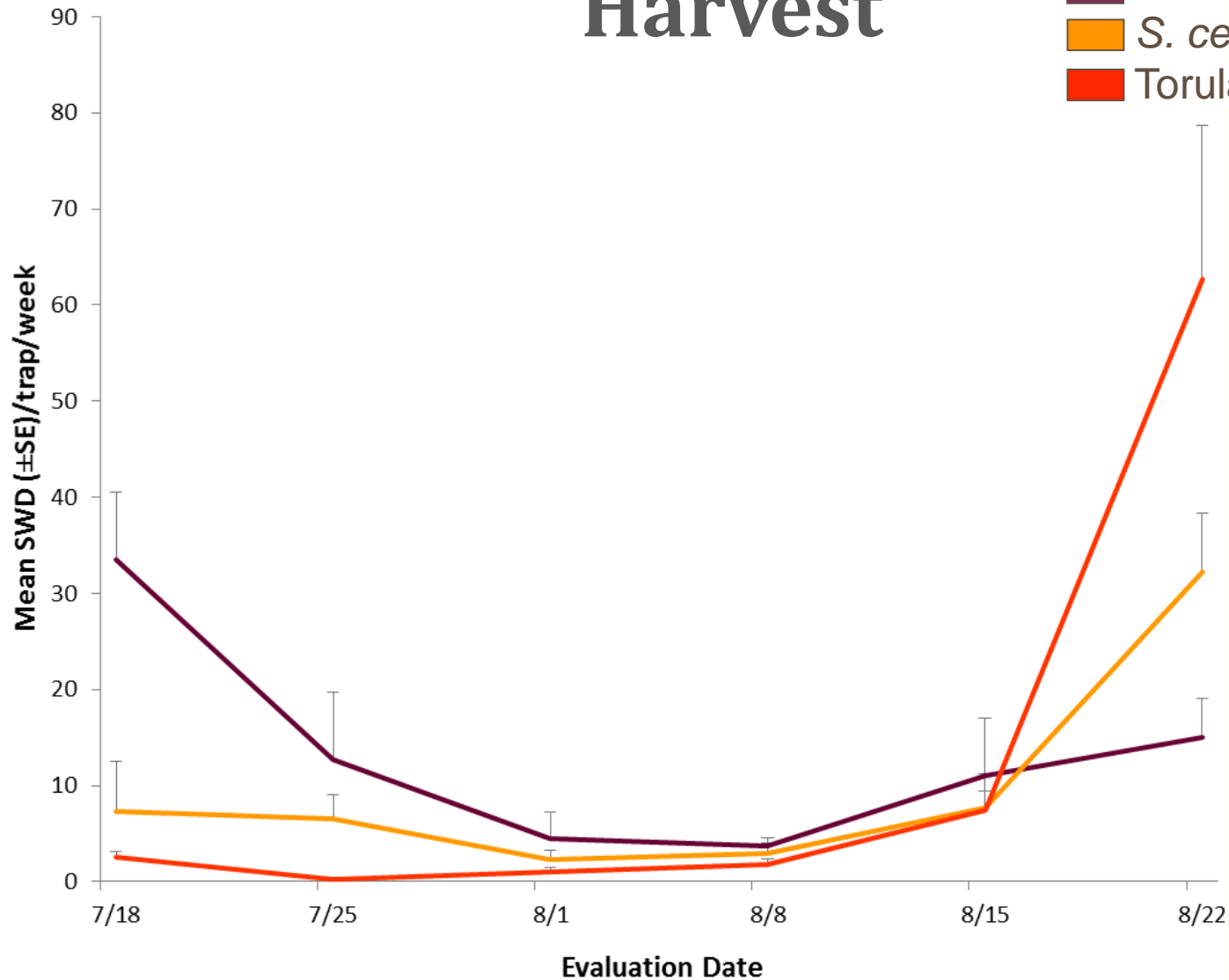


Comparison of Yeast Bait: Early Season

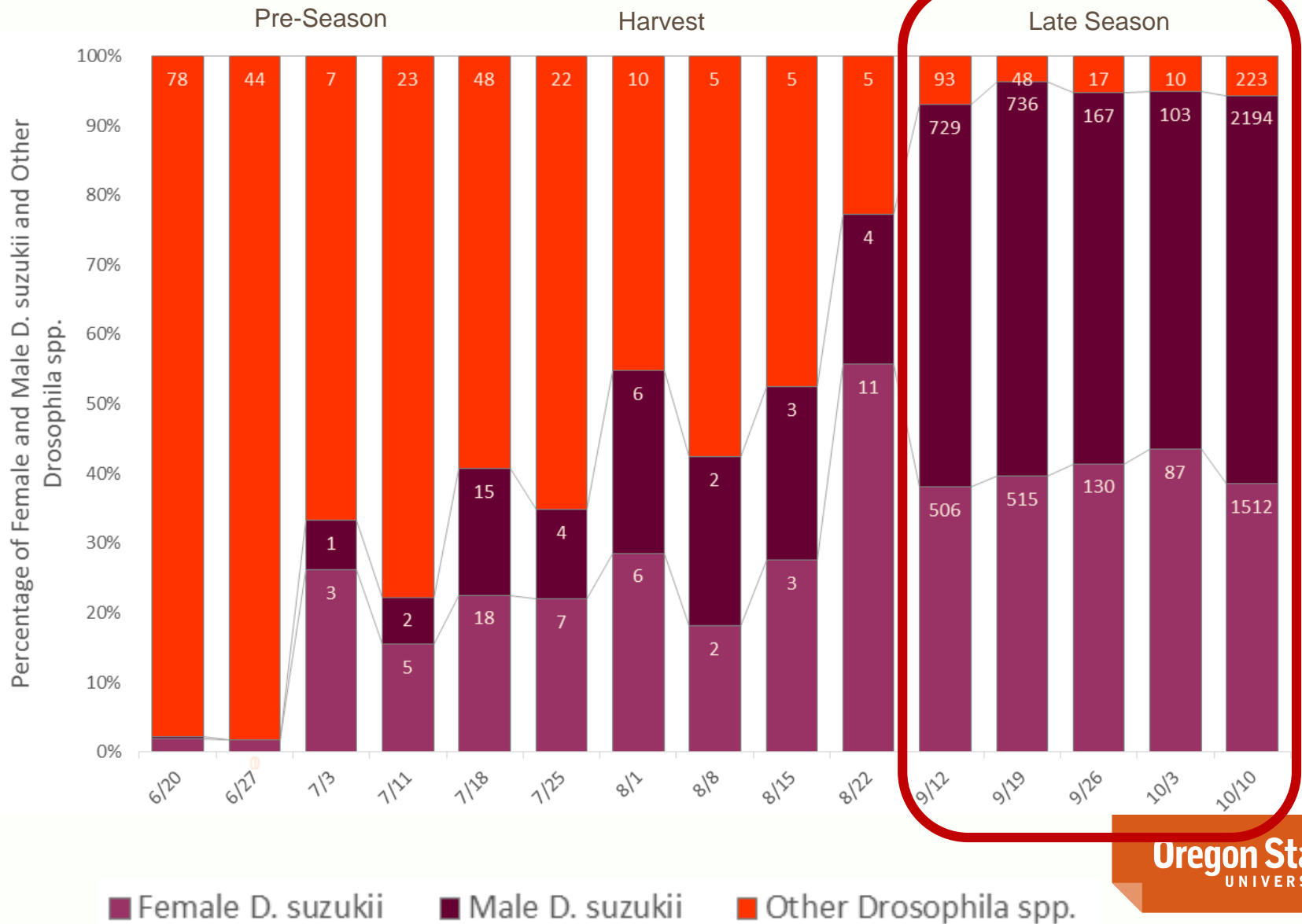


Comparison of Yeast Bait: Harvest

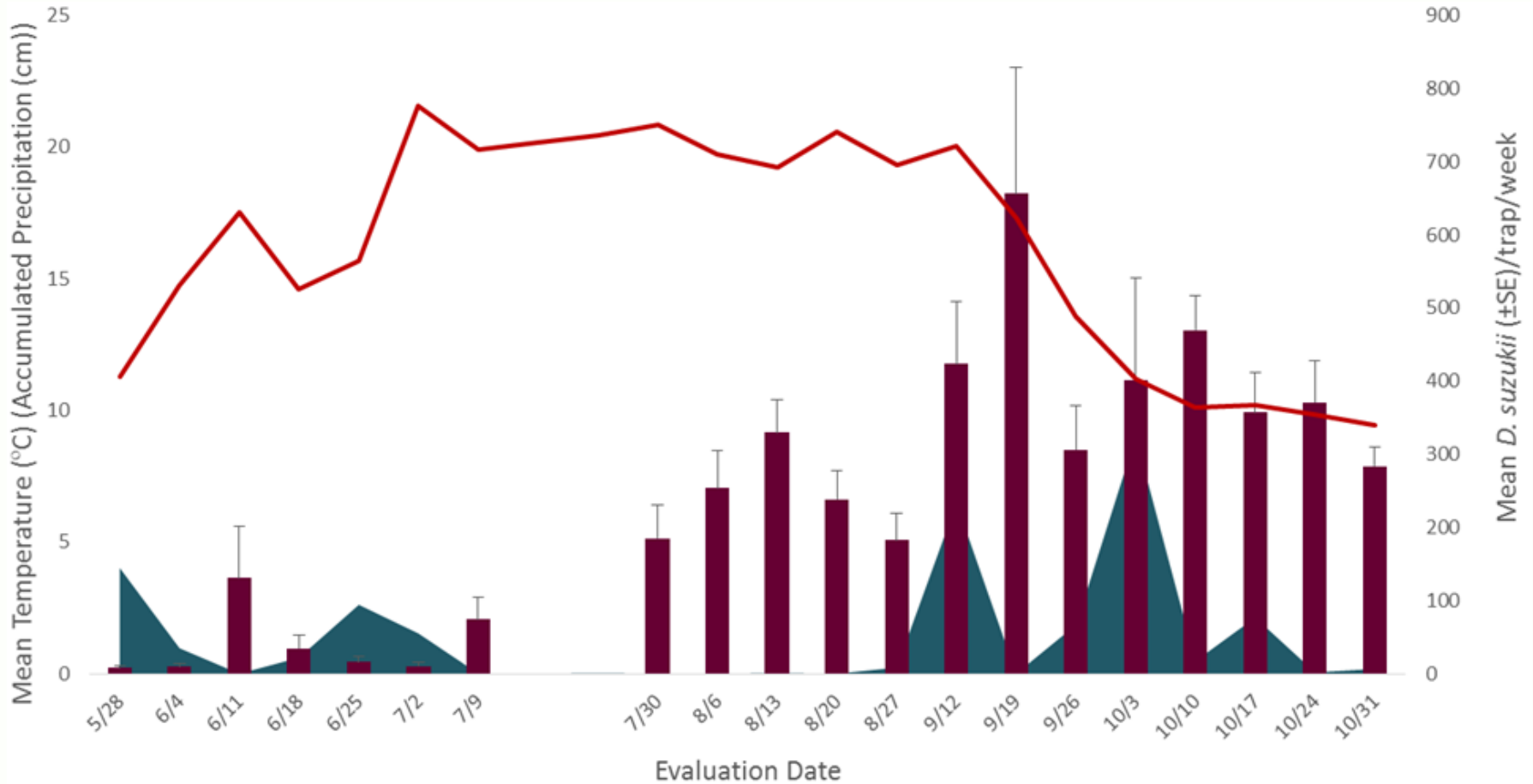
- *H. uvarum*
- *S. cerevisiae*
- Torula yeast pellets



Chinkiang Vinegar



Weather



Sum of Precipitation

Mean *D. suzukii*: Clear 20

Mean Temp

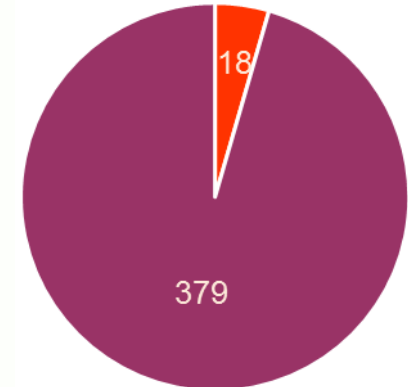
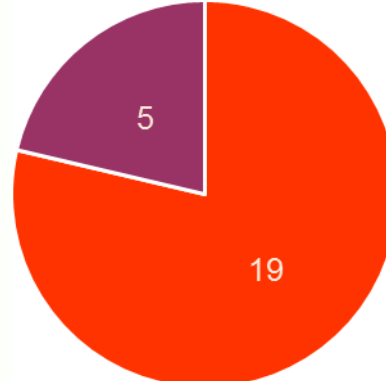
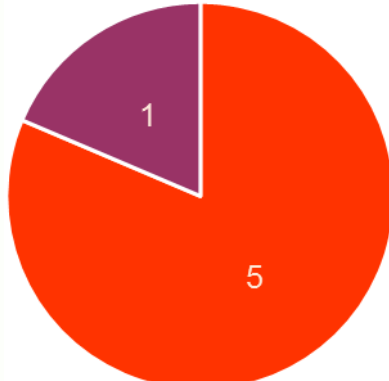
Commercial Specificity to SWD

Pre-Season

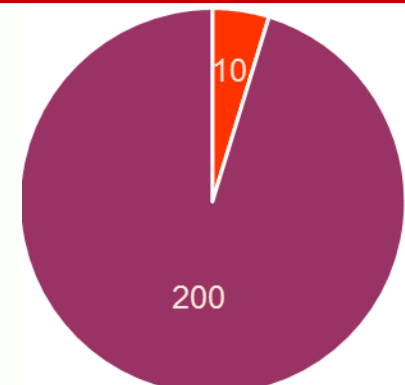
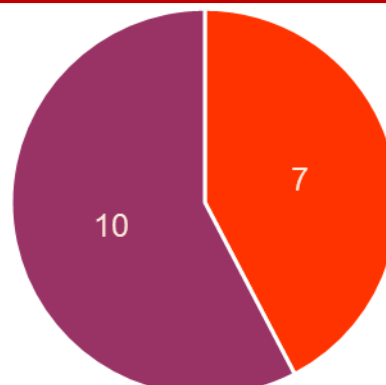
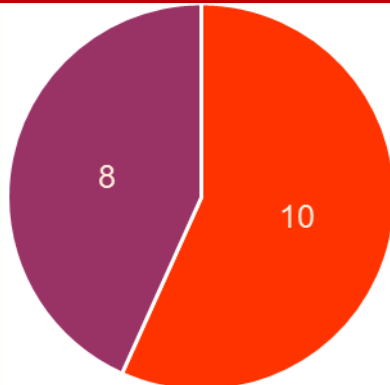
Harvest

Late Season

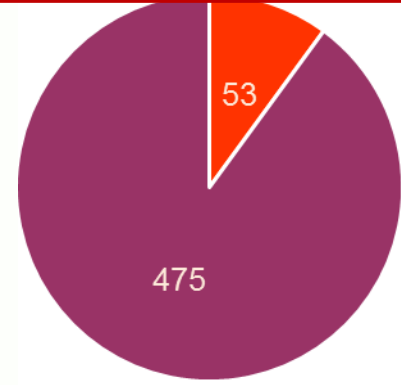
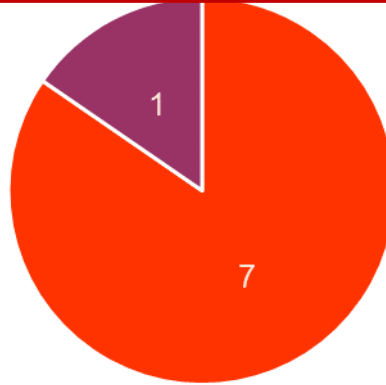
Suzukii
Trap®




Cha-
Landolt



Apple
Cider
Vinegar



- 
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Bait

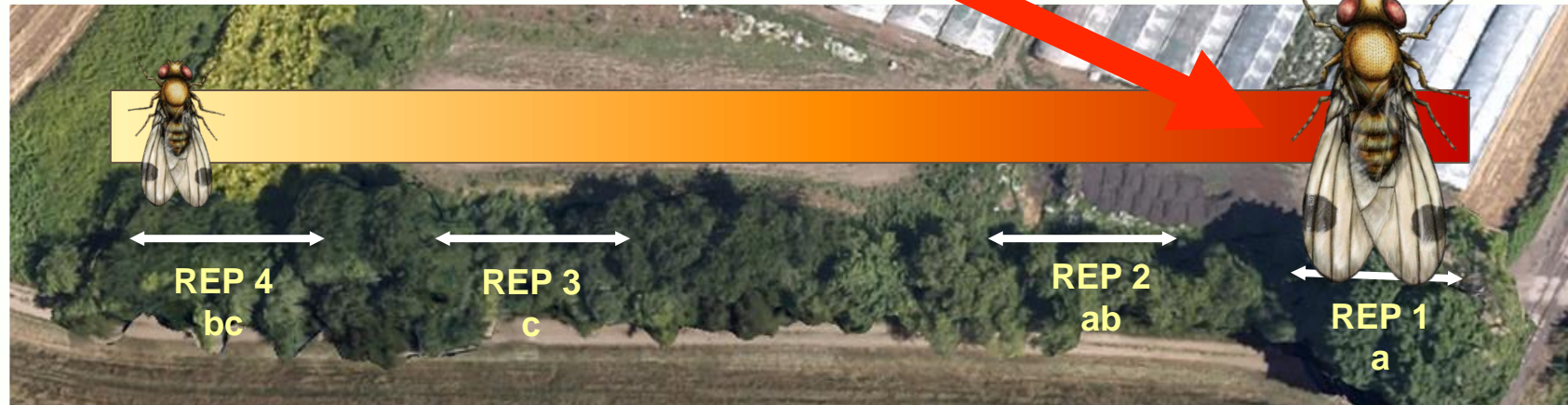
- **Results & Conclusions**
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Early Season **Hot Spot**



F = 29.4; df = 3; p value: <0.0001

Late Season **Shift**

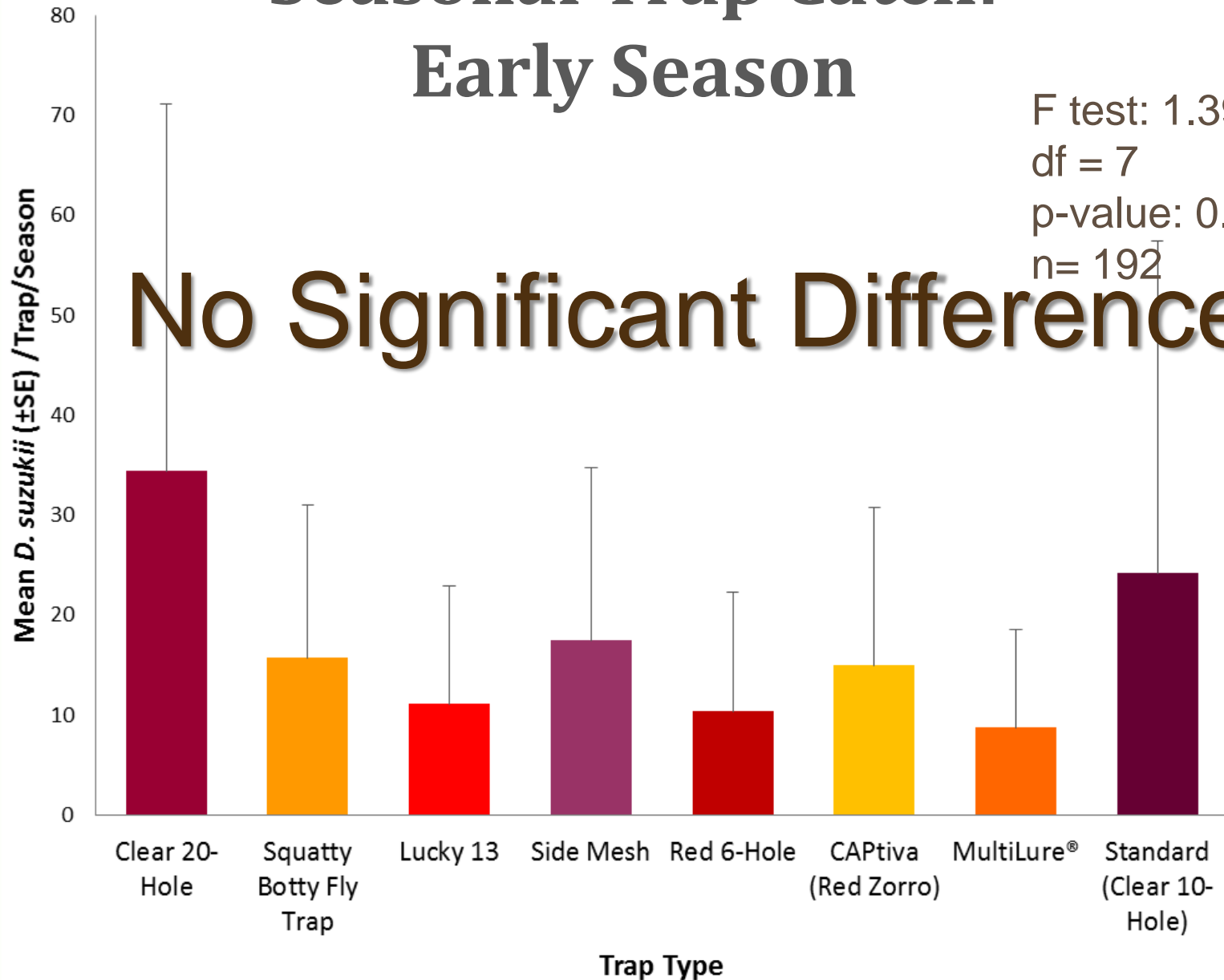


F = 9.08; df = 3; p value: <0.0001

Seasonal Trap Catch: Early Season

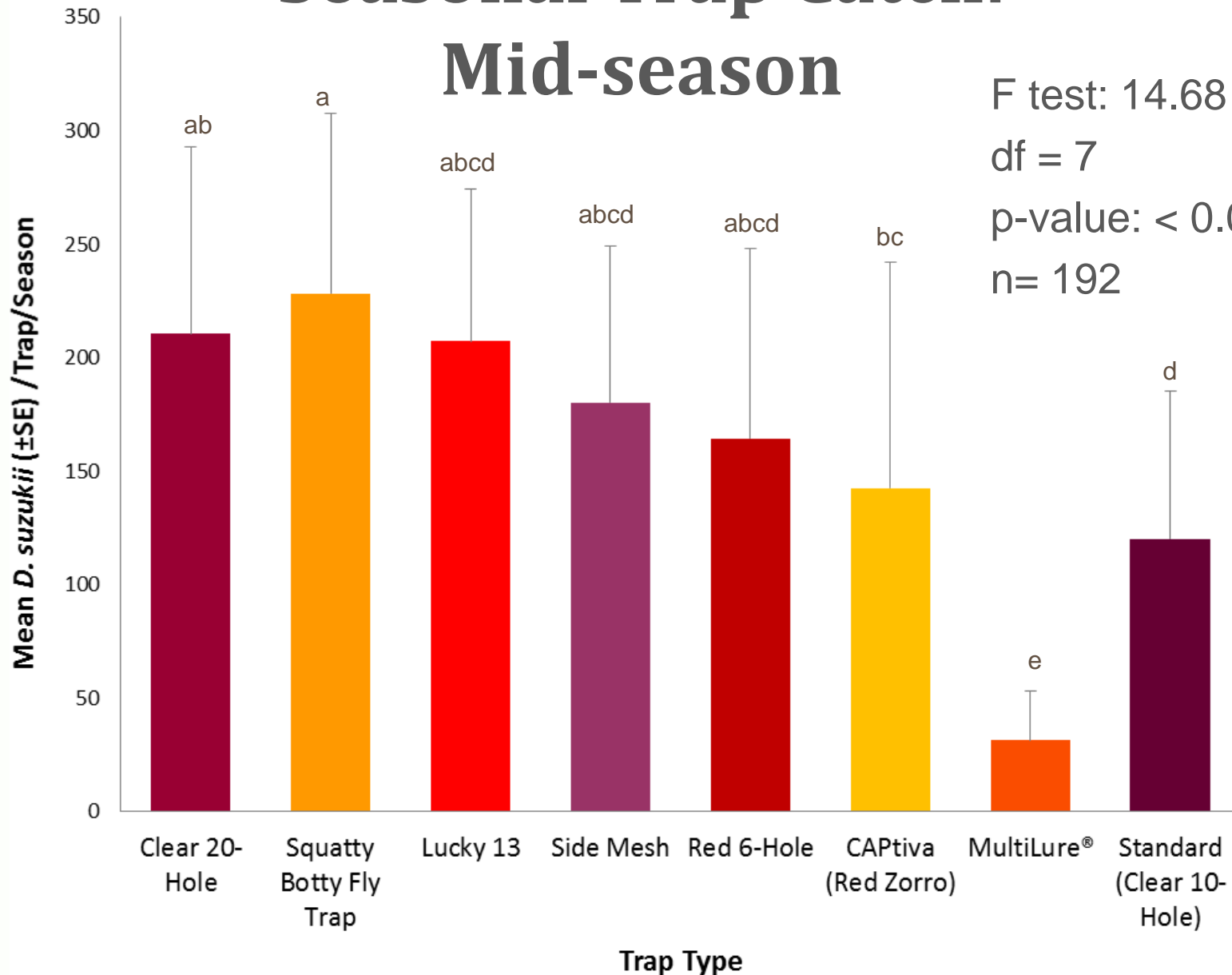
F test: 1.39
df = 7
p-value: 0.0741
n = 192

No Significant Difference

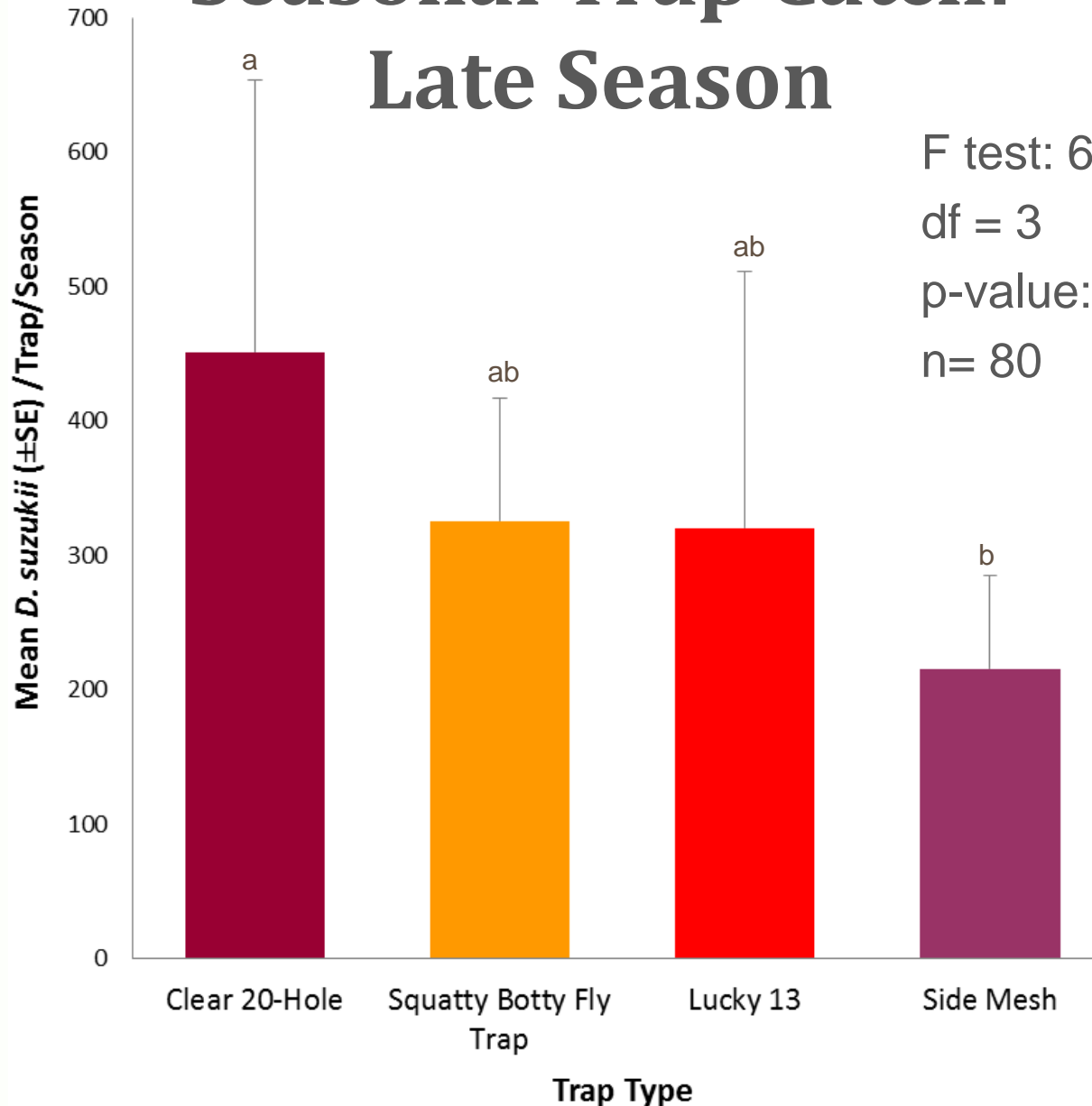


Seasonal Trap Catch: Mid-season

F test: 14.68
df = 7
p-value: < 0.0001
n= 192



Seasonal Trap Catch: Late Season



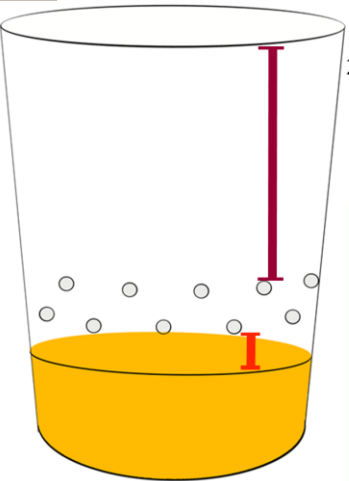
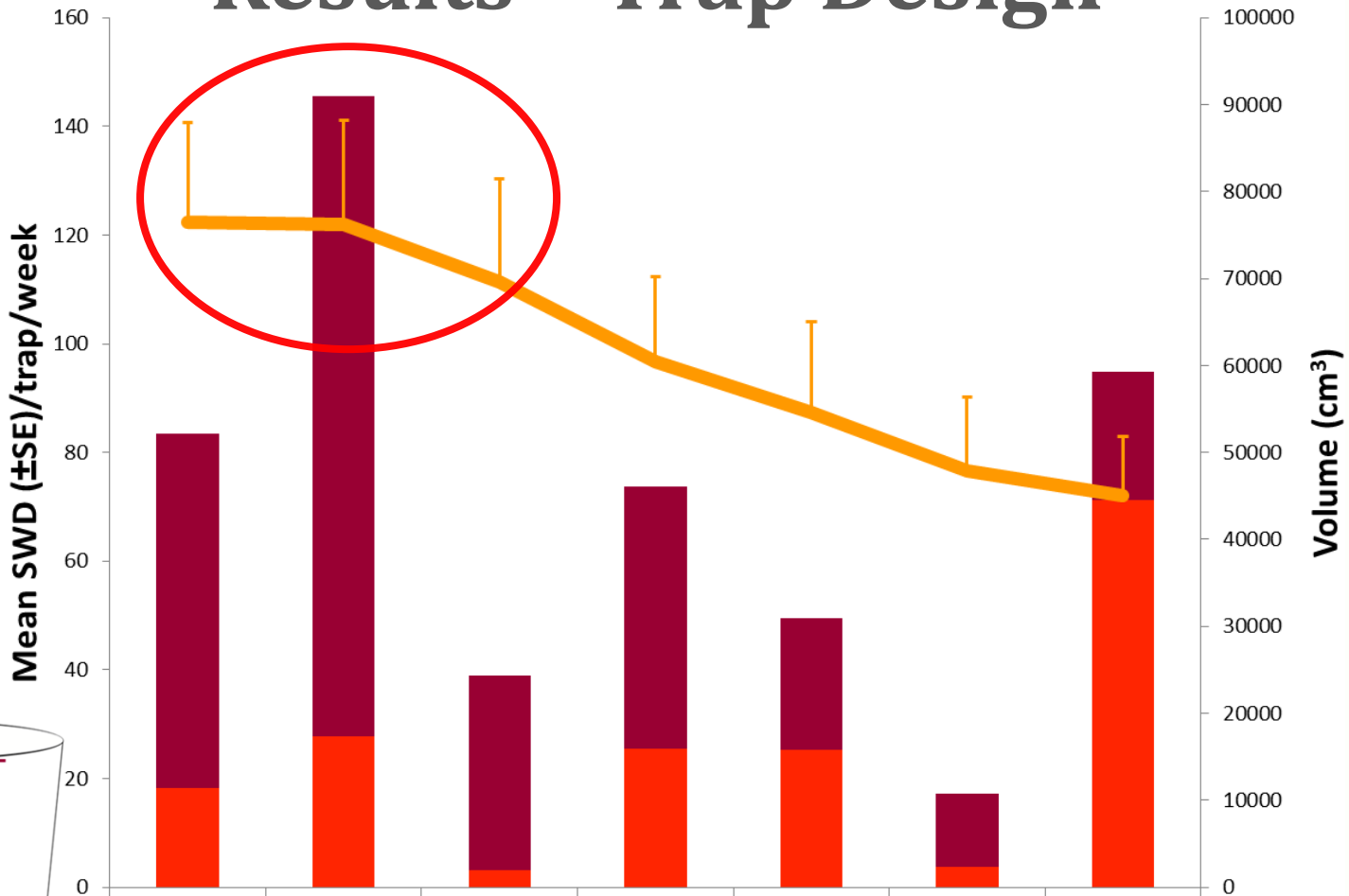
F test: 6.73

df = 3

p-value: <0.0004

n= 80

Results - Trap Design



Clear 20-Hole



"Squatty Botty" Fly Trap



Red "Lucky 13"



Dreves



Red 6-Hole



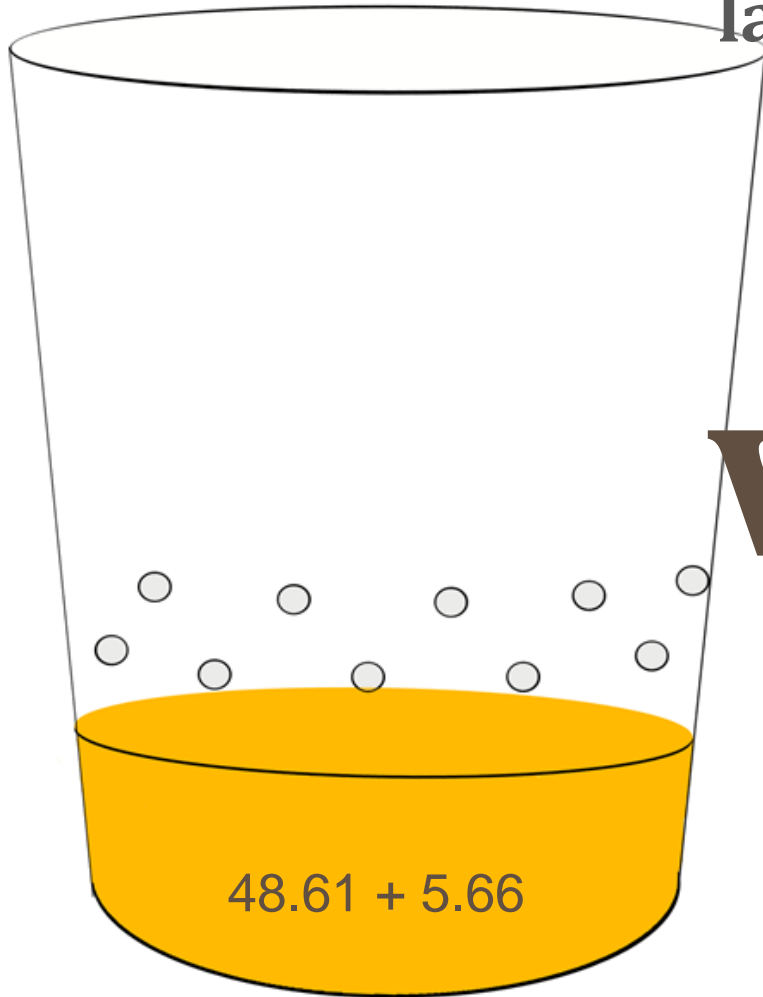
CAPTiva (Red Zorro)



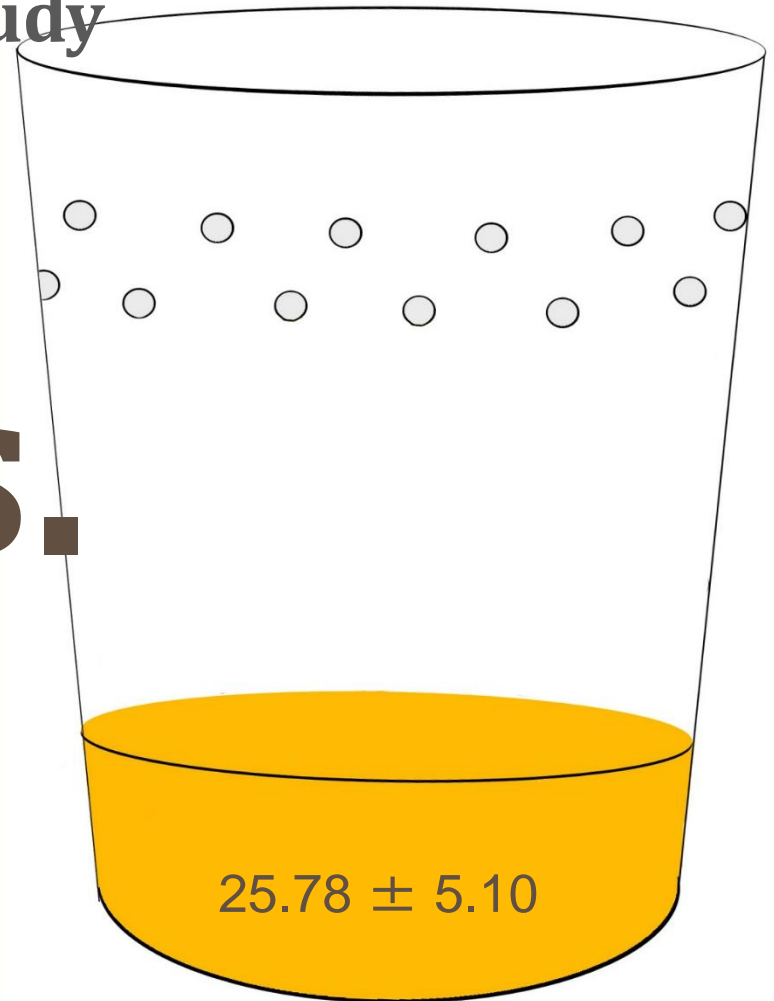
Standard (Clear 10-Hole)

Clear 20-Hole Volume

lab study



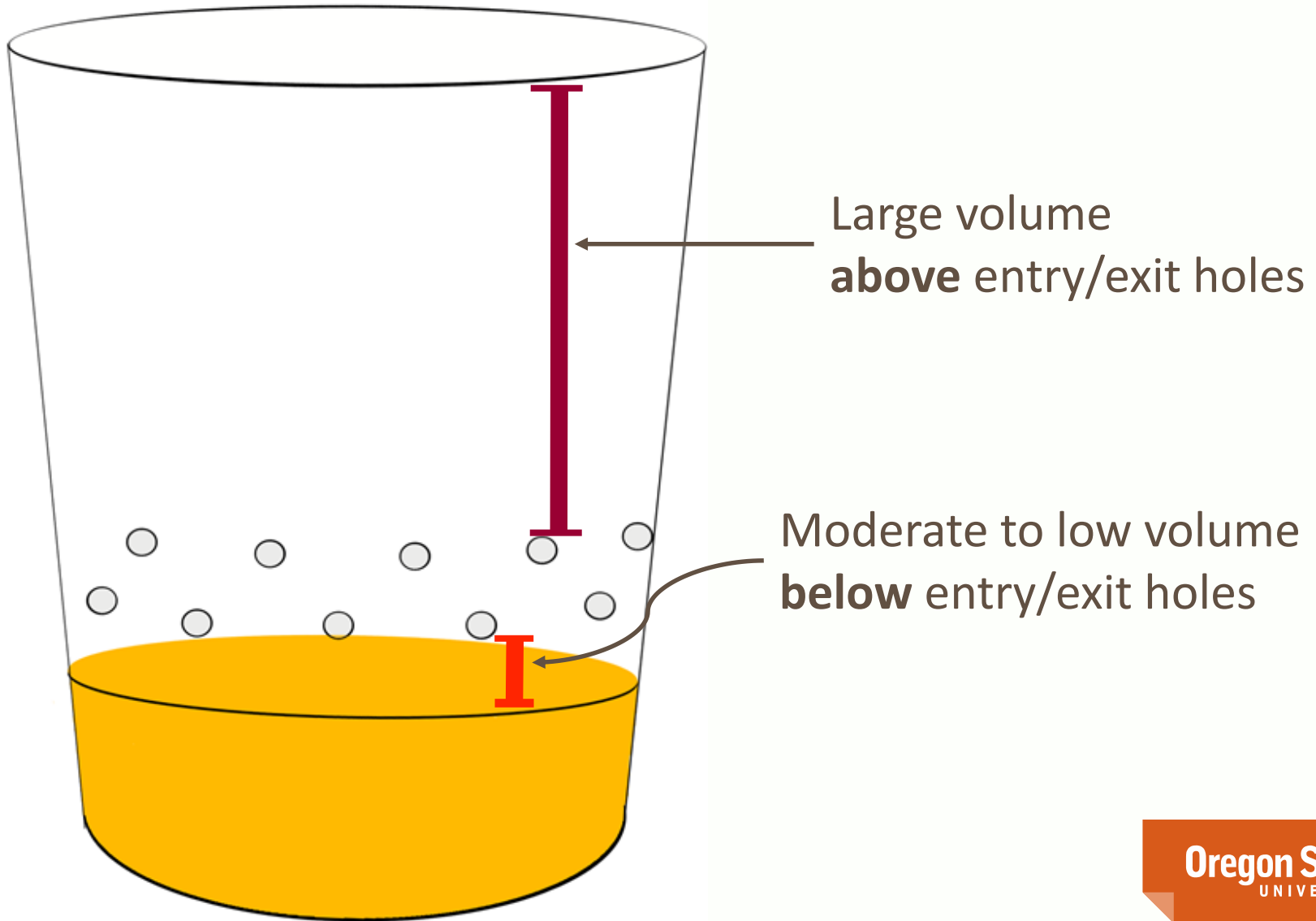
VS.



F value: 9.69

p-value < 0.00037

Attractive Trap Design Attributes

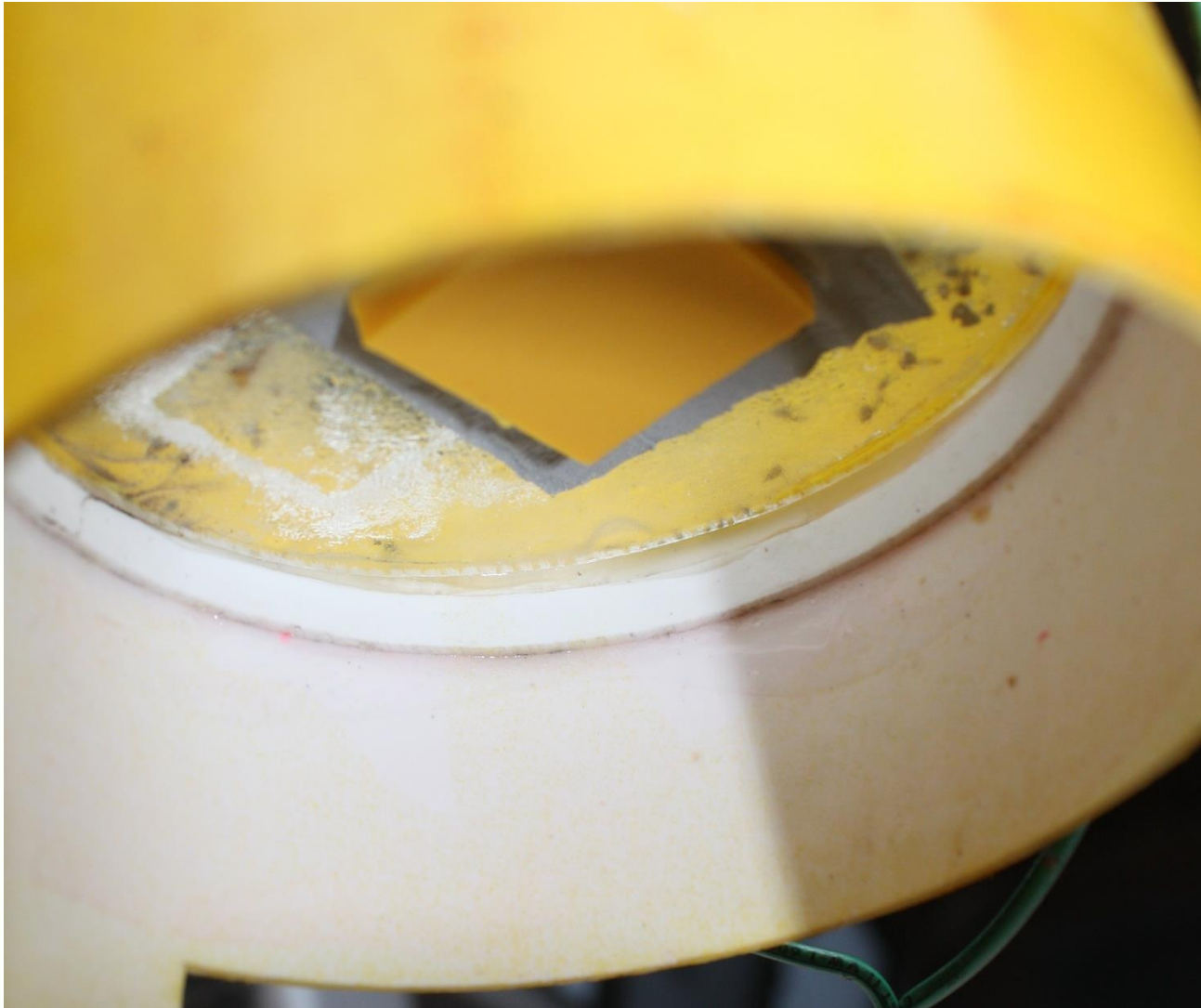


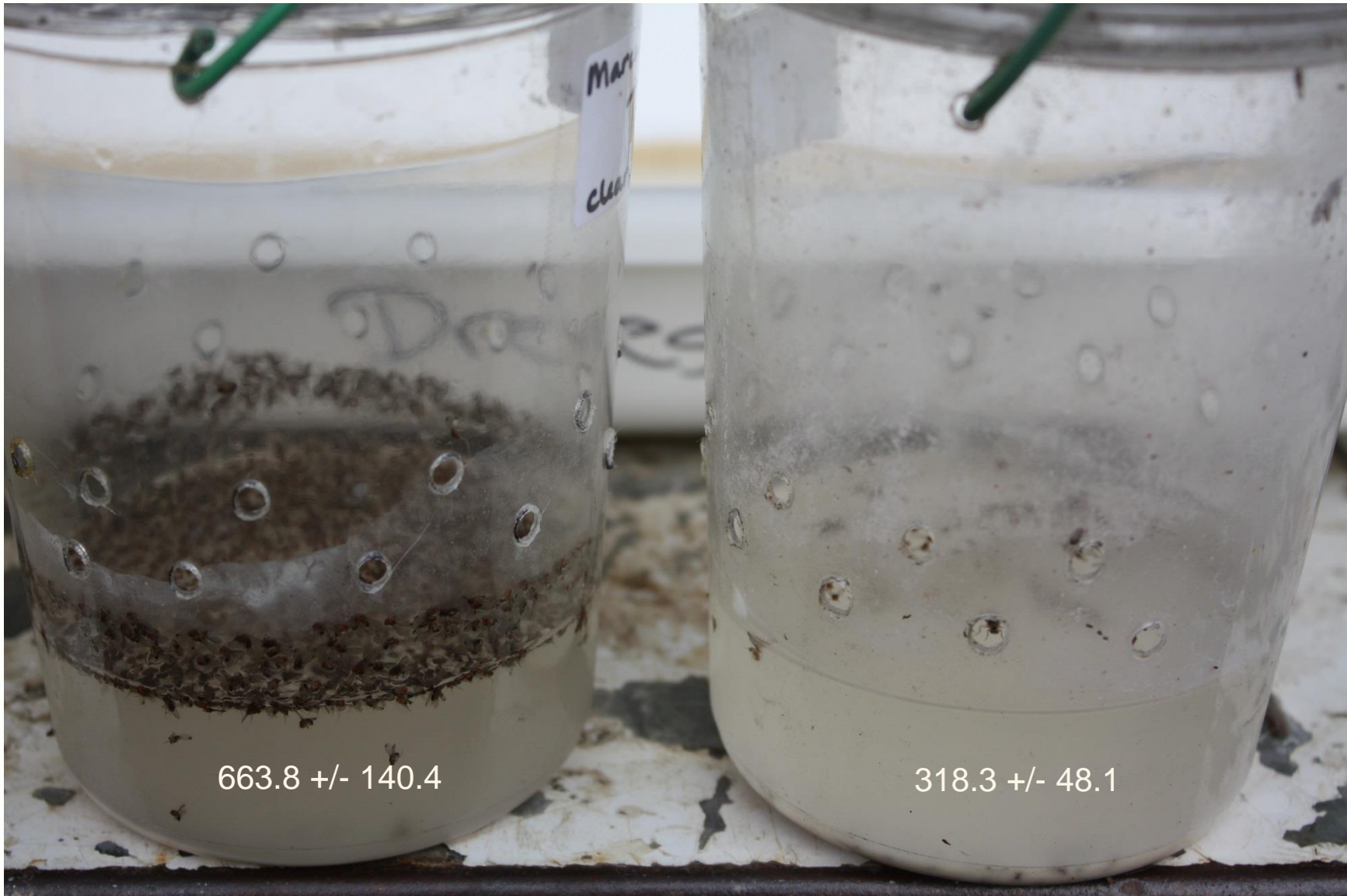
A problem with the attractive trap designs



Not Dead!

Addition of Killing Agent



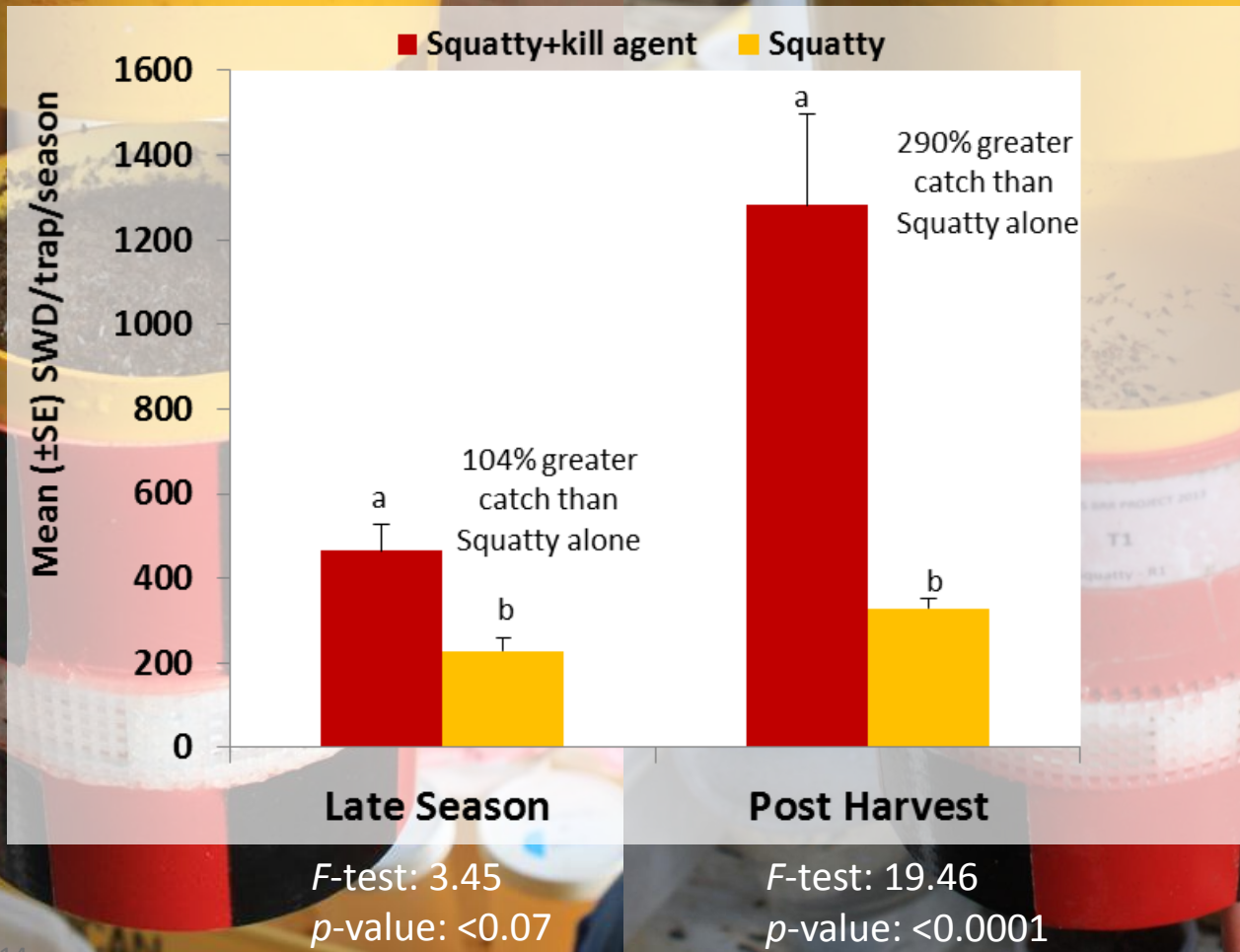


663.8 +/- 140.4

318.3 +/- 48.1

F test: 20.31; df = 1; p value: < 0,0003

The addition of a killing agent in “Squatty Botty©” fly trap significantly increased trap catch





Take Home Message

- Chinkingiang vinegar, Suzukii Trap®, *H. uvarum* show potential
- Cha-Landolt lure with high specificity
- Importance of trap placement
- Headspace and volume are key

Future Research

- Attract and Kill
- Mass trapping
- Testing commercial lures



Thank You's

Dr. Amy J Dreves

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Dr. Kate Field

Wanda Crannell

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Grower collaborators

Dr. James Osborne

Jana Lee, Adam Cave & USDA-ARS Horticultural Crops Research Corvallis

Colleen Burrows, Washington State University Whatcom County Extension

Crop and Soil Science Department

E.R. Jackman Internship

NIFA-USDA-SCRI 2010-51181-21167

Questions?

