



# Insect Research Updates: Cherry Fruit Fly, Leafrollers, and Codling Moth

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# Cherry Fruit Fly Insecticide Trial - 2015



# Cherry Fruit Fly Control – the Challenges

- Primary sources of CFF:
  1. External - gravid females (with mature eggs) fly into orchard – infestation in border trees
    - No delay between first immigration & egg laying
  2. Internal – a hotspot in the previous season may generate emerging flies
- Contact insecticides must prevent egg-laying – rapid kill (2-3 hr for gravid females in lab studies)
- New control technologies:
  - Systemic activity to kill eggs & larvae within fruit
  - Add feeding stimulants to encourage flies to ingest insecticide droplets before eggs are laid



# Diamide Insecticides

- IRAC Class 28: ryanodine receptor modulators – calcium channels
  - Impair nerve and muscle function
  - Stop feeding quickly, regurgitation, reduce movement, paralysis
  - Translaminar (local) and limited systemic activity
  - Safe to mammals, birds, & aquatic organisms
- Altacor (Chlorantraniliprole) - DuPont
- Exirel (Cyantraniliprole) – DuPont
  - Greater mobility within plant & activity against a broader spectrum of pests
- Cyclaniliprole – ISK Biosciences
  - Anticipate registration in 2016

ALTACOR® is a water dispersible granule.

Active Ingredient	By Weight
Chlorantraniliprole 3-Bromo-N-[4-chloro-2-methyl-6-[(methylamino)carbonyl]phenyl]-1-(3-chloro-2-pyridinyl)-1H-pyrazole-5-carboxamide	35.0%
<b>Other Ingredients</b>	65.0%
<b>TOTAL</b>	100.0%

GROUP 28 INSECTICIDE

codling moth, leafrollers, fruitworms, peach twig borer, cherry fruit fly, apple maggot, plum curculio

For foliar applications to brassica, bulb, cucurbit, fruiting, and leafy vegetables; commercially grown greenhouse eggplant, pepper and tomato; bushberries; citrus, pome, and stone fruits; and tree nuts for pest management of sucking and chewing insects, suppression of certain insect vectored diseases and optimization of the crop's potential.

Active Ingredient	By Weight
Cyantraniliprole 3-bromo-1-(3-chloro-2-pyridinyl)-N-[4-cyano-2-methyl-6-[(methylamino)carbonyl]phenyl]-1H-pyrazole-5-carboxamide	10.20%
<b>Other Ingredients</b>	89.80%
<b>TOTAL</b>	100.00%

EXIREL™ is a suspoemulsion (oil in water emulsion). SHAKE WELL BEFORE USING.

GROUP 28 INSECTICIDE

# 2015 CFF Insecticide Trial – New Diamide

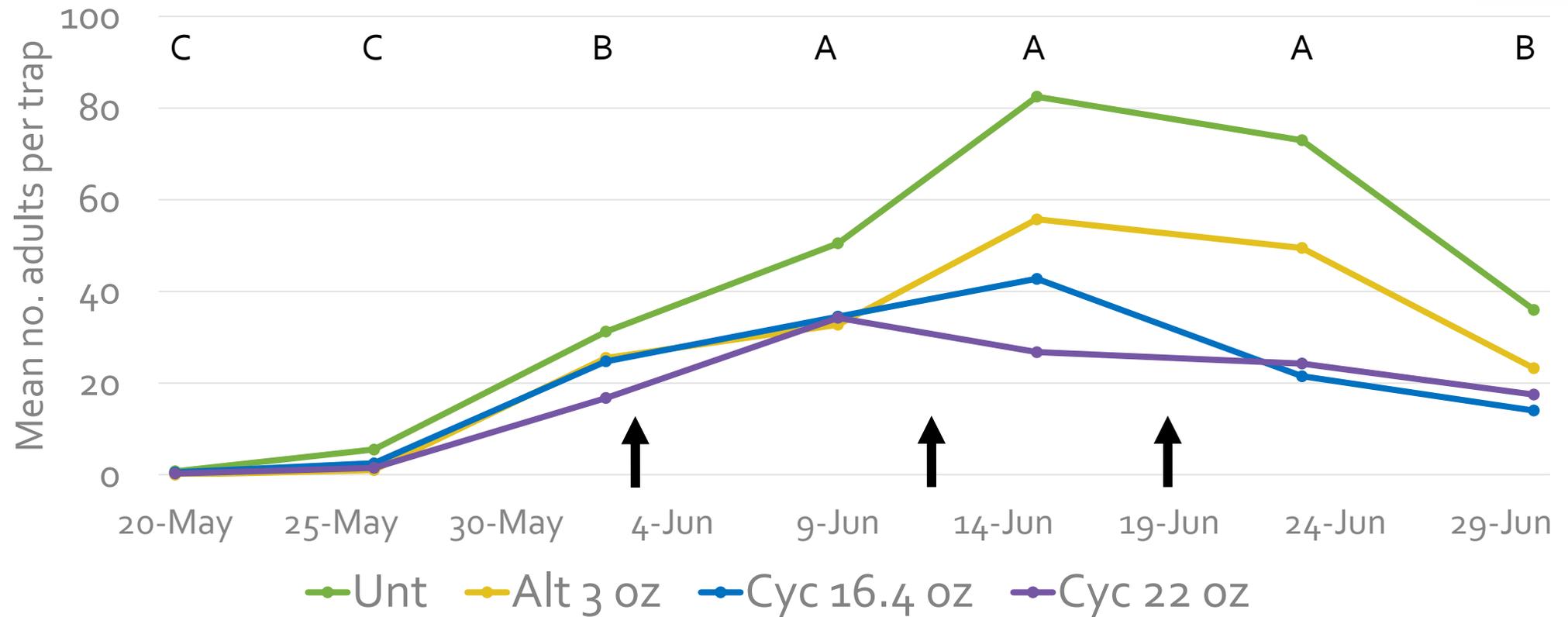
- Tart cherry, USU Kaysville Research Farm
- Plot size: 3 rows × 6 trees (18 trees); row of untreated buffer trees
- 4 replicates, RCBD
- Treatments applied thrice (7- or 9-day interval)
  - June 3, 12, and 19
  - first fly capture May 20 (earliest record), 14 d before first appl.
- Orchard airblast sprayer; 100 gpa & 100 psi
- Treatments
  1. Untreated control
  2. Altacor WG 3.0 oz/ac (label rate is 3-4.5 oz/ac; max. 9 oz/season)
  3. Cyclaniliprole 16.4 oz/ac
  4. Cyclaniliprole 22 oz/ac





# WCFF Adult Trap Capture by Treatment and Date

May 20 - June 30, 2015

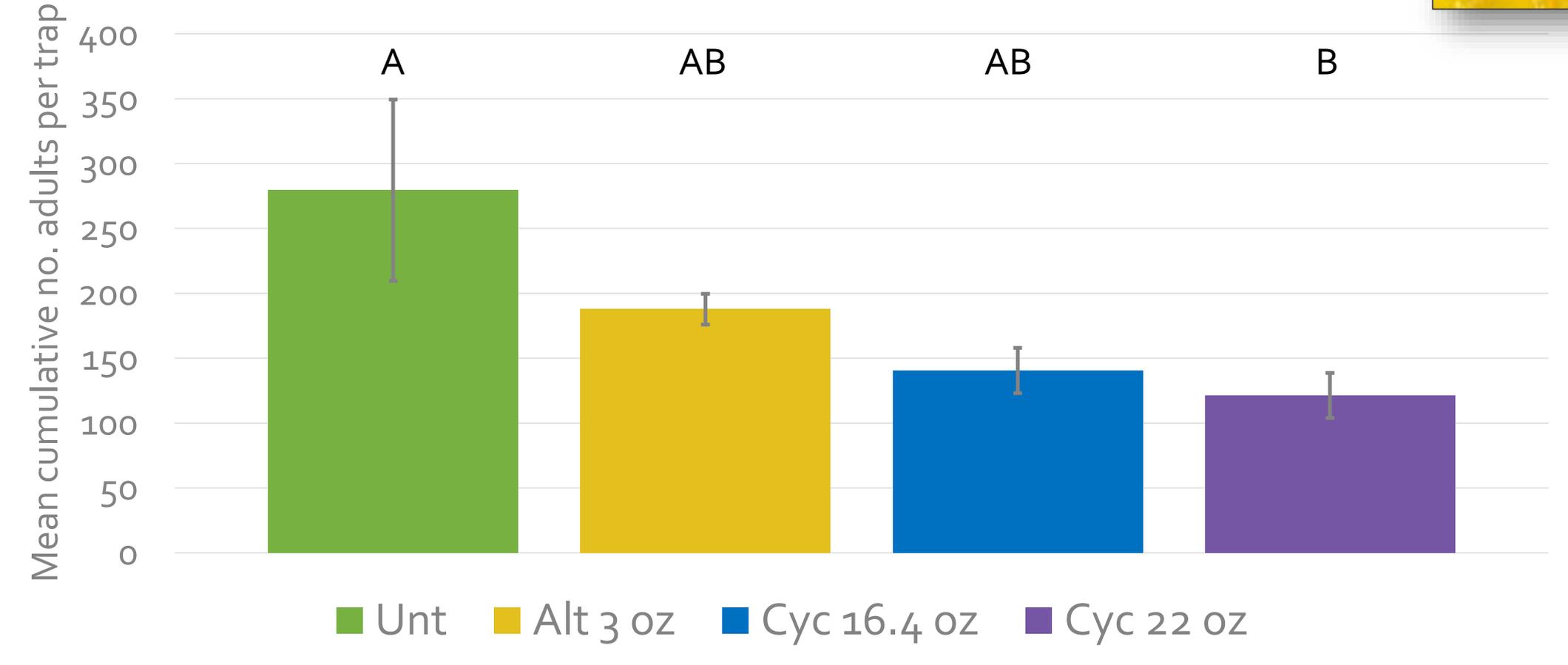


ANOVA:  $p < 0.0001$



# Cumulative WCFF Adult Trap Capture by Treatment

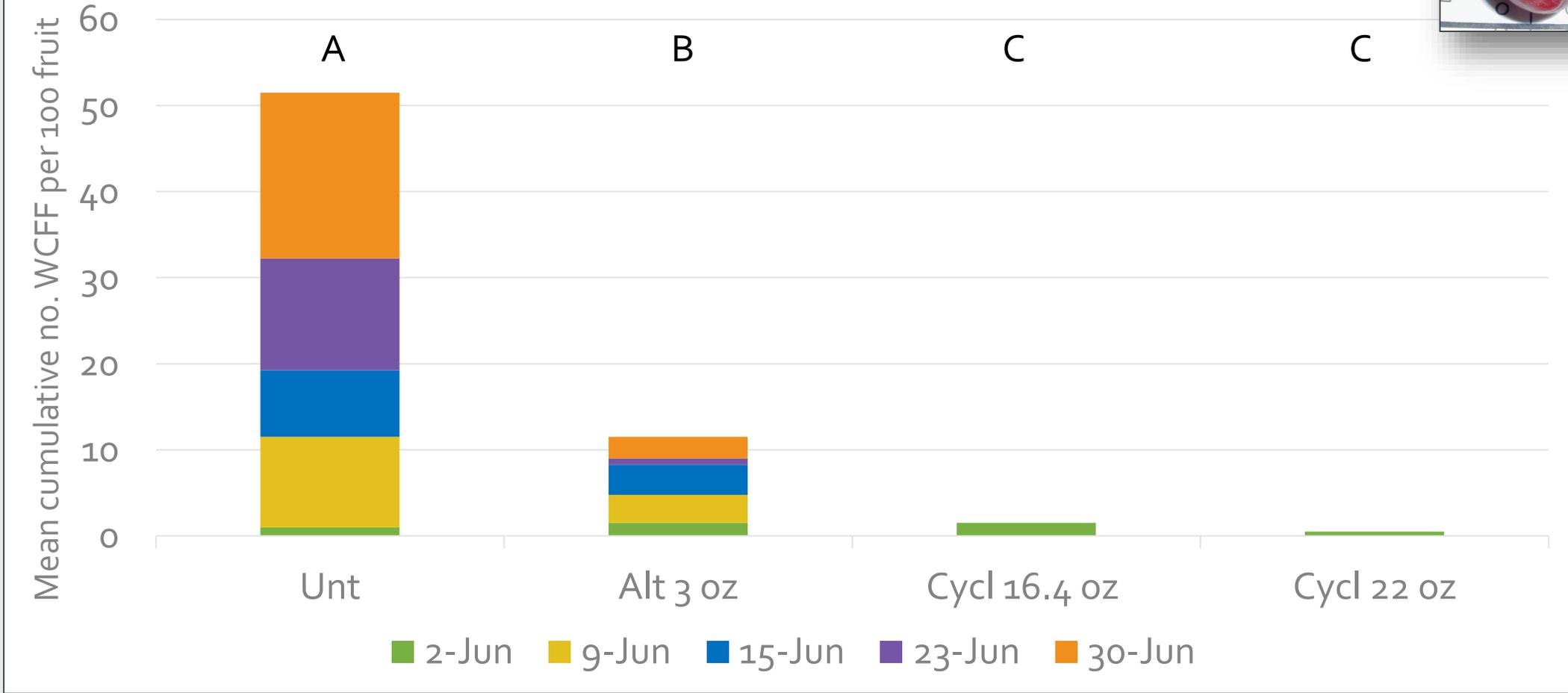
May 20 - June 30, 2015



ANOVA:  $p = 0.04$



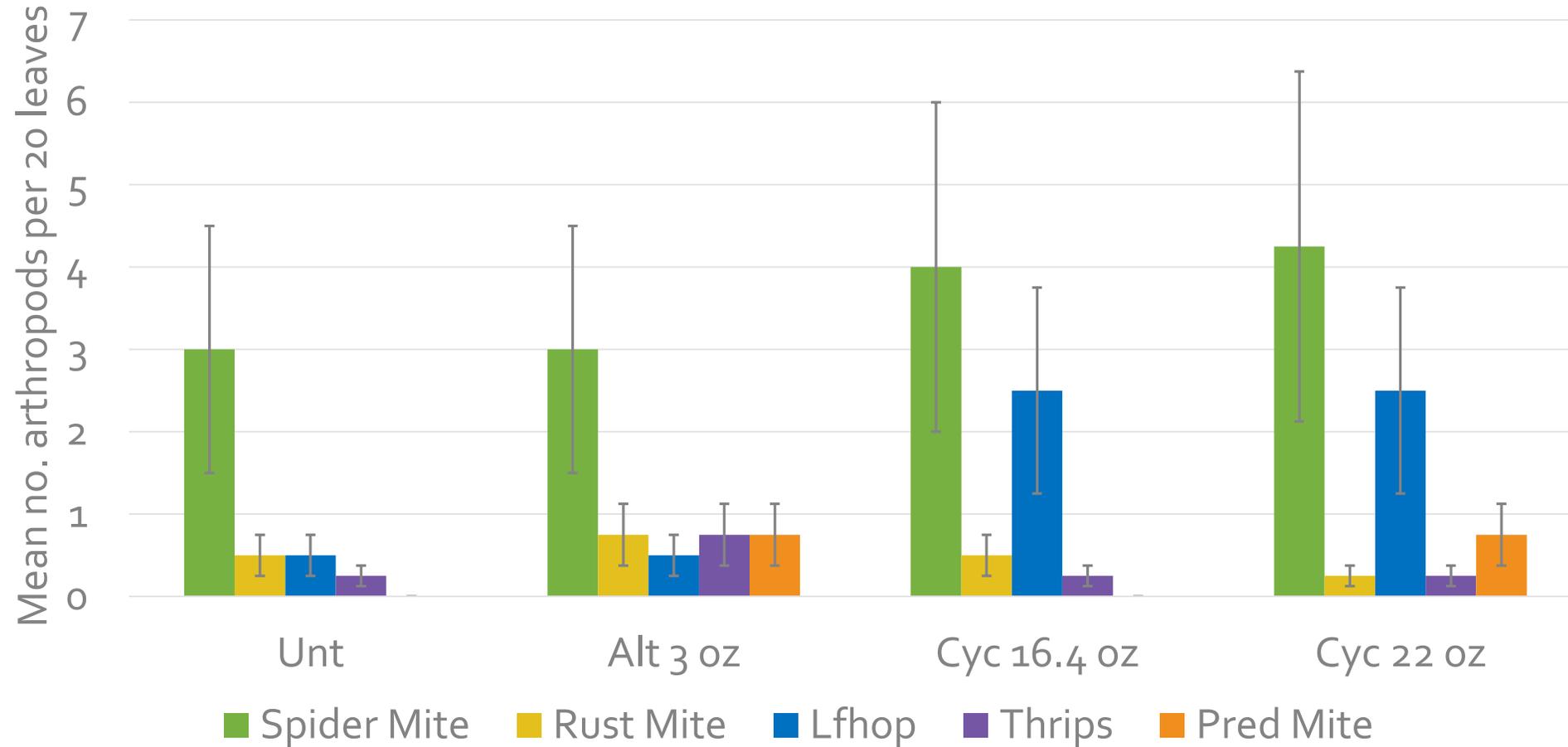
# Cumulative Fruit Infestation by Insecticide Treatment



ANOVA:  $p < 0.0001$

# Mite Flare? No

## Effect of Treatments on Leaf Arthropods: June 30



ANOVA: No differences



# Insecticide Trial Conclusions

- WCFF population pressure was high (280 adults in Unt in 5 ½ -wk trial)
- Cyclaniliprole 22 oz reduced adult trap capture vs. Unt
  - Cycl 16.4 oz and Altacor 3 oz intermediate adult reduction
- Fruit infestation: Cyclaniliprole (both rates) < Altacor < Untreated
  - Cyclaniliprole: low infestation on June 2 before insecticides applied
  - First insecticide application 14 days after first adult capture (late)
- Diamide insecticides did not flare mites, thrips or leafhopper
- Cyclaniliprole (ISK Biosciences) looks to be a good product for WCFF control
  - Registration anticipated in 2016



# Cherry Fruit Fly Trap Comparison Study

Collaboration with Dr. Wee Yee, USDA-ARS, Wapato, WA



# Yellow Sticky Trap Comparison Study – 2014

Evaluated plastic translucent traps and no-mess adhesive



**Alpha Scents**  
Yellow Rectangle  
Bright yellow  
Translucent  
No-mess adhesive



**Yellow Sticky Strip**  
Bright yellow  
Translucent  
No-mess adhesive  
Light-weight



**Olson**  
Yellow Sticky Card  
Bright yellow  
Translucent  
No-mess adhesive



**Scentry Multigard**  
Green-yellow  
Fold-back cardboard  
Not translucent  
Sticky adhesive



**Pherocon**  
Yellow Sticky Trap  
Bright yellow  
Fold-back cardboard  
Not translucent  
Sticky adhesive  
\*Standard trap

^Ammonium carbonate external bait added to all traps

# Trap Comparison Results

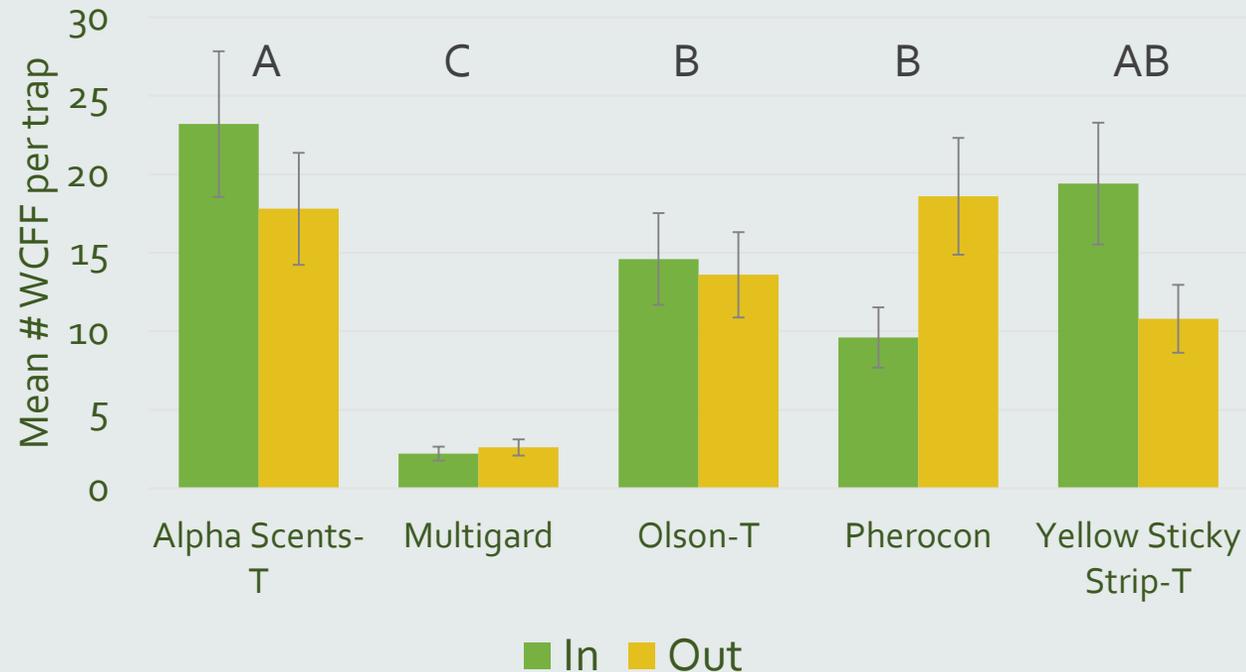
“In” faces tree, “Out” faces out from tree canopy

Cumulative trap catch from May 30 – July 8, 2014 (7 weeks)



Cumulative Trap Capture by Trap Type & Side  
(In vs Out)

Significant interaction ( $p = 0.003$ )



Findings (one year):

Total no. flies caught:

- Alpha Scents trap caught the most CFF
- Translucent traps (AS, OL, YSS) performed as well or better than Pherocon
- Multigard caught the least

Catch on “in” vs “out” sides of trap:

- Translucent traps caught the most on the inside of trap
- Fold-back cardboard (non-translucent) traps caught fewer flies on inside
- YSS & OL were too light-weight

# Yellow Sticky Trap Comparison Study – 2015

Evaluated plastic translucent and 3-D traps



**Yellow Sticky Strip**  
Bright yellow  
Translucent  
No-mess adhesive  
Light-weight  
**YSS**



**Pherocon**  
Bright yellow  
Fold-back cardboard  
Not Translucent  
Tangletrap  
\*Standard trap  
**PHR**



**Pal Z**  
Yellow-Lime Green  
Folded plastic sheet  
Dev. European CFF  
Not Translucent  
**PAZ**



**Yellow Sphere**  
Bright Yellow  
Plastic sphere  
Not Translucent  
Tangletrap  
**YSH**

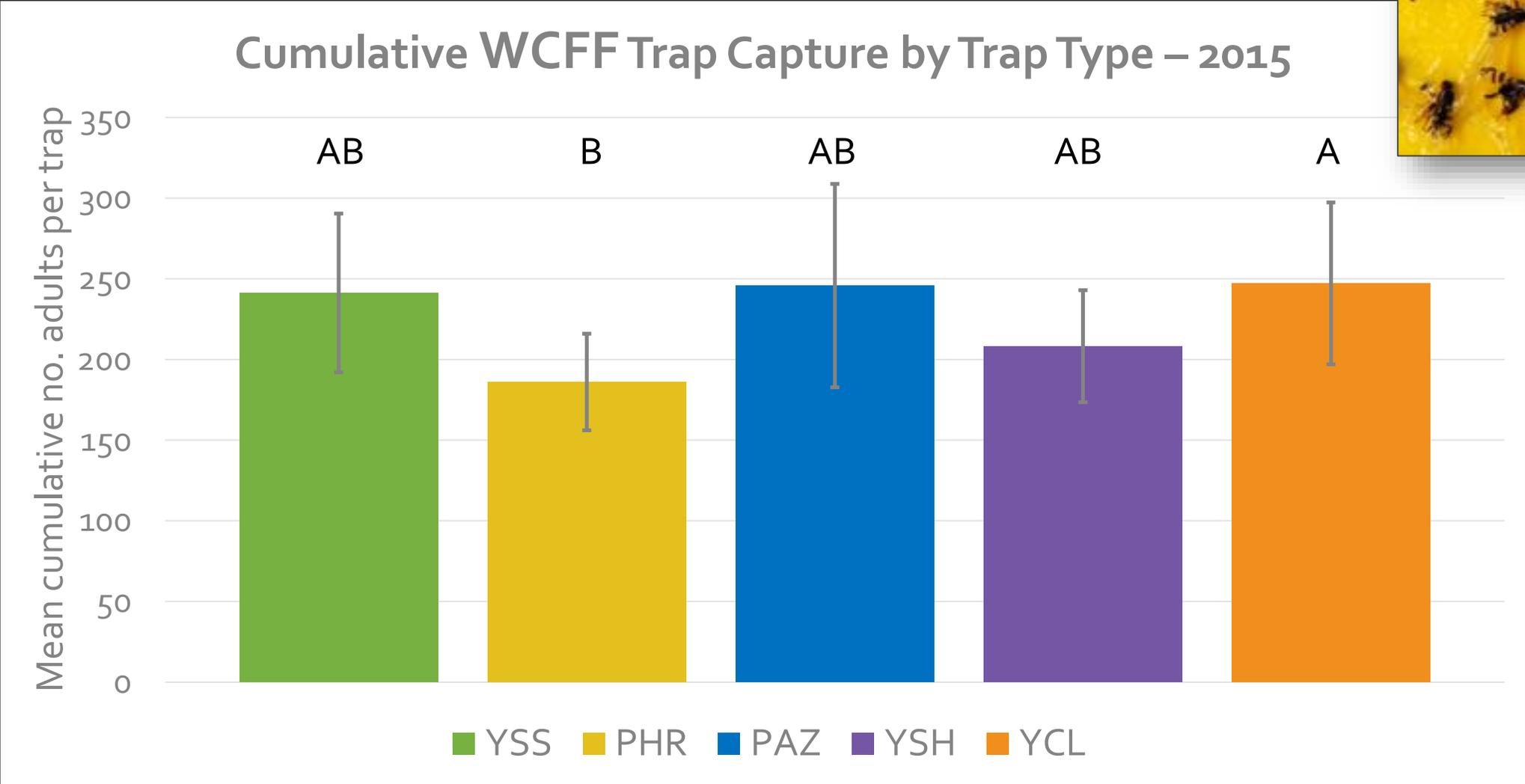


**Yellow Cylinder**  
Bright Yellow  
Folded YSS  
Translucent  
No-mess adhesive  
**YCL**

^Ammonium carbonate external bait added to all traps

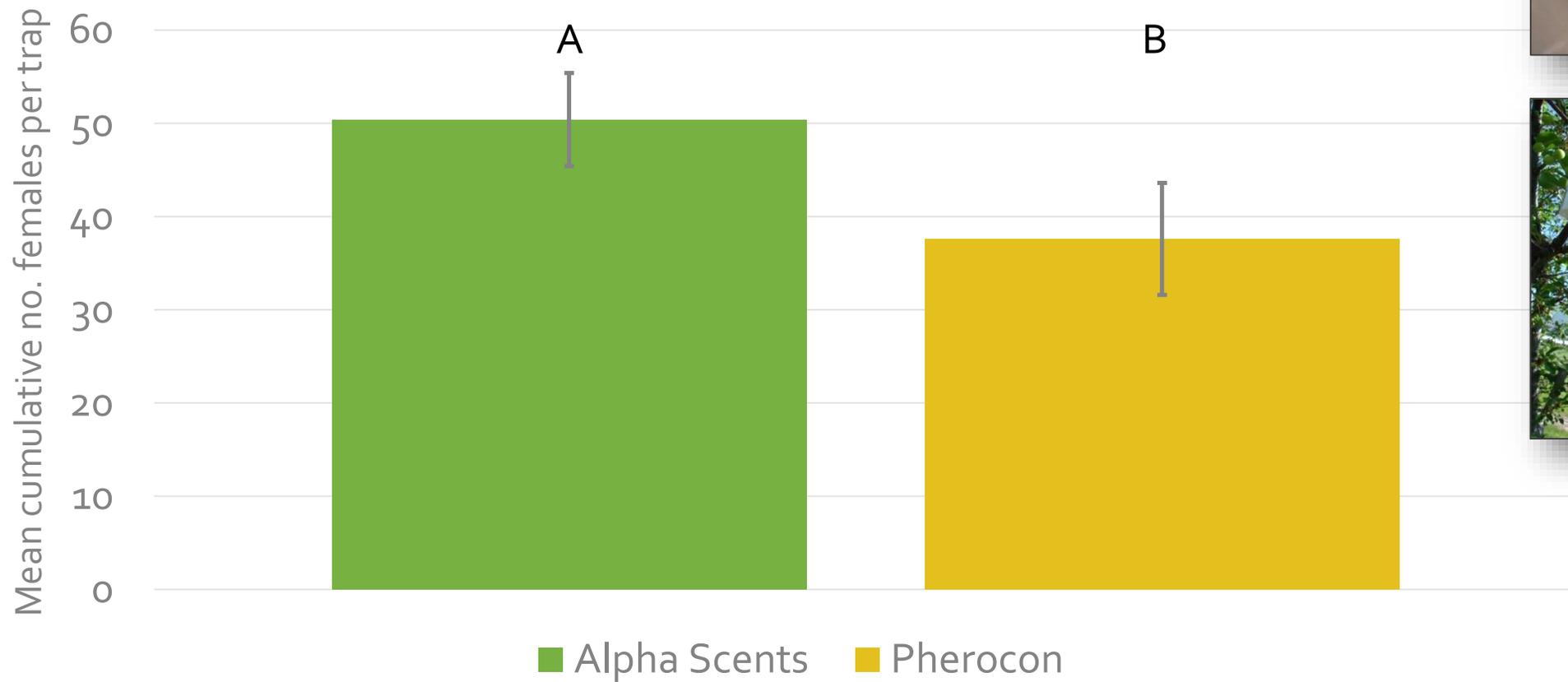


### Cumulative WCFF Trap Capture by Trap Type – 2015



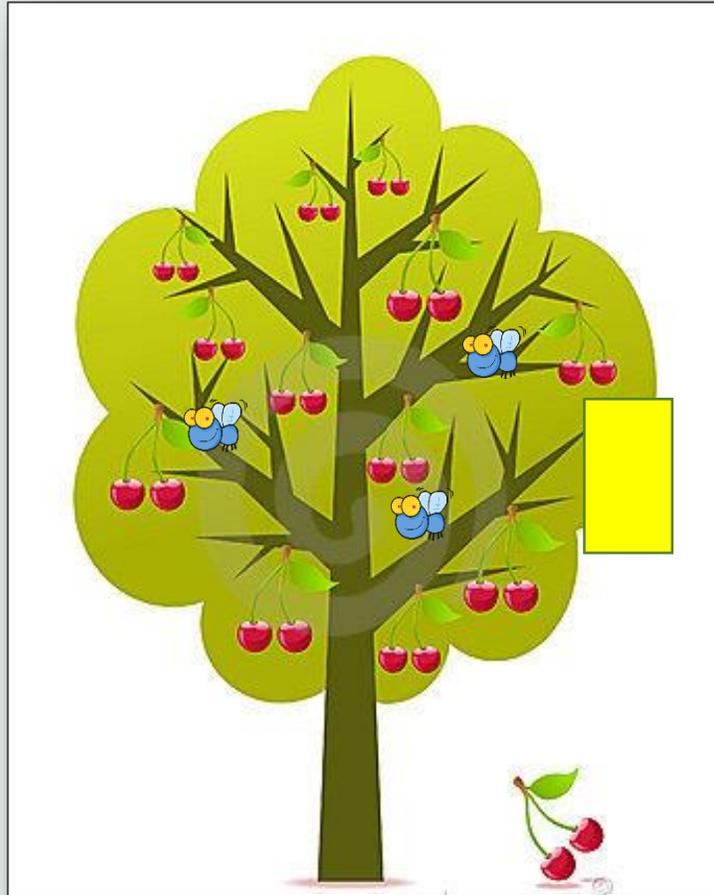
ANOVA:  $p < 0.0001$

## Effect of Trap Type on Cumulative Capture of Female WCFF (2015 Insecticide Trial)



ANOVA:  $p = 0.01$

# Implications of New Yellow Sticky Traps



- CFF spends more time within tree canopy near fruit
- More CFF caught on inside of translucent traps
  - See yellow color shining through trap from sunlight
  - Solid cardboard traps looks dark from inside of tree canopy
- Bright yellow, translucent & 3-D traps increased trap catch
- No-mess adhesive is less messy
  - Tacky, but adhesive doesn't rub off
  - More difficult to remove flies
- External ammonium bait
  - Increases trap catch  $\geq 2\times$
  - Increases attraction of non-target flies & insects

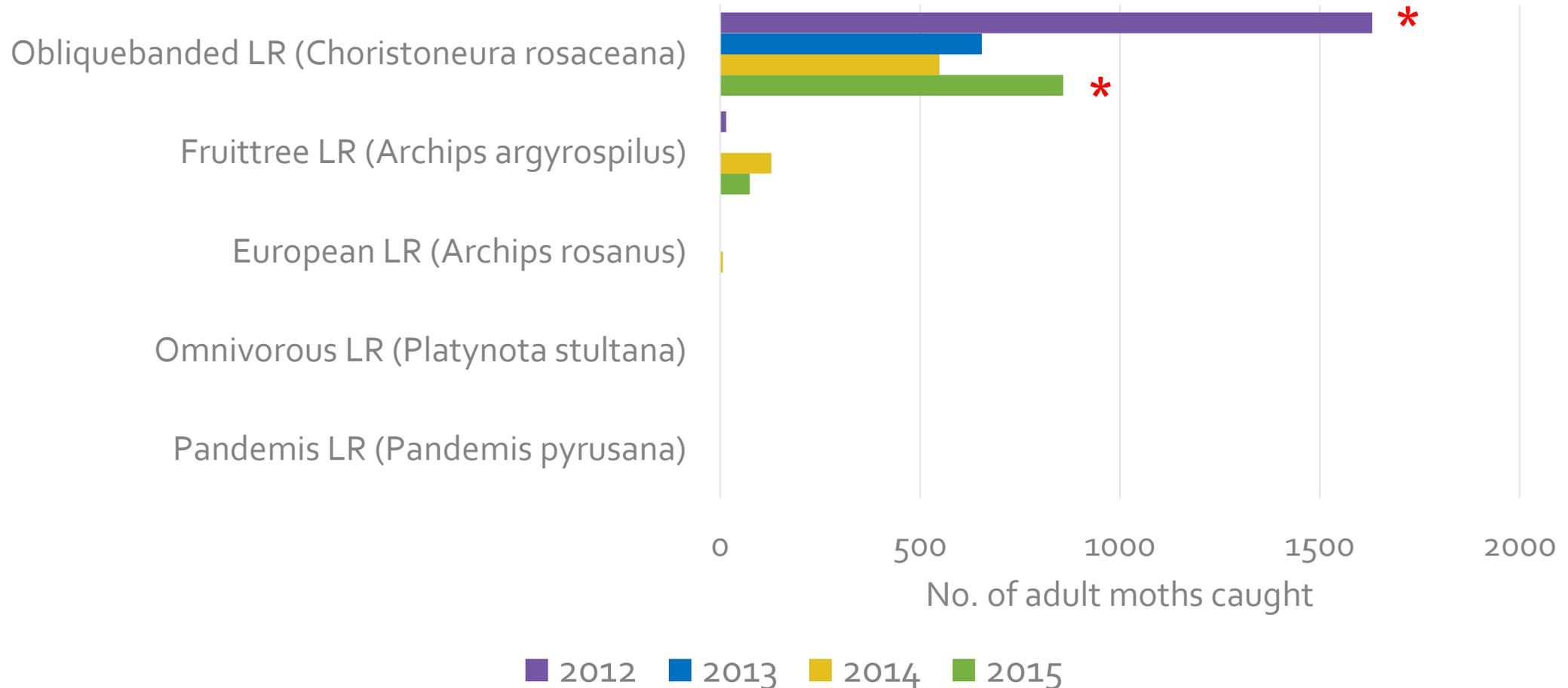


# Orchard Leafroller Survey 2014 & 2015

Collaboration with Marion Murray, USU  
Utah Specialty Crop Block Grant



## Utah Orchard Leafroller Survey, 2012-2015



2012 & 2013: 6-8 orchards

2014: 10 managed and 11 un- or low-managed apple & cherry: Cache, Box Elder, Davis, Weber & Utah counties

2015: 20 managed apple & cherry: Box Elder, Weber & Utah counties.

# Leafroller Species Present in Utah Orchards



## **Obliquebanded leafroller**

Primary species in N. UT  
Commercial orchards  
2 gens./yr  
June & August/early Sep



## **Fruittree Leafroller**

Secondary species  
Un- & low-managed orchards  
1 gen./yr  
Late June/early July



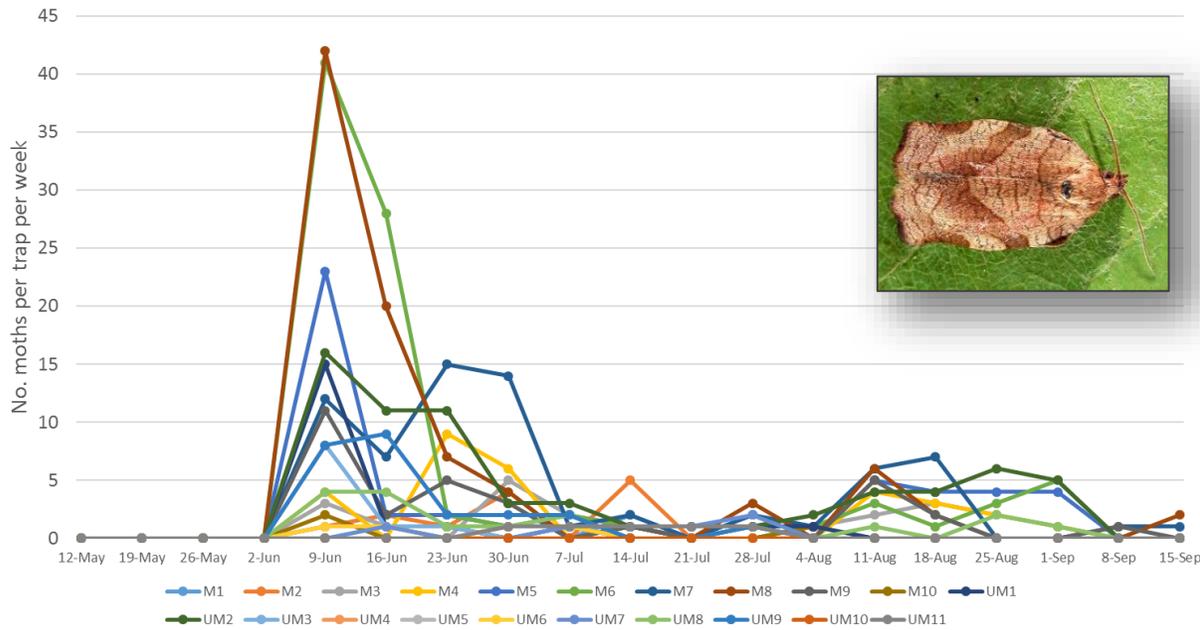
## **European Leafroller**

Invasive species  
Very few

# No Leafroller Larvae or Injury Detected 2014 and 2015



Obliquebanded Leafroller Moth Flight - 2014

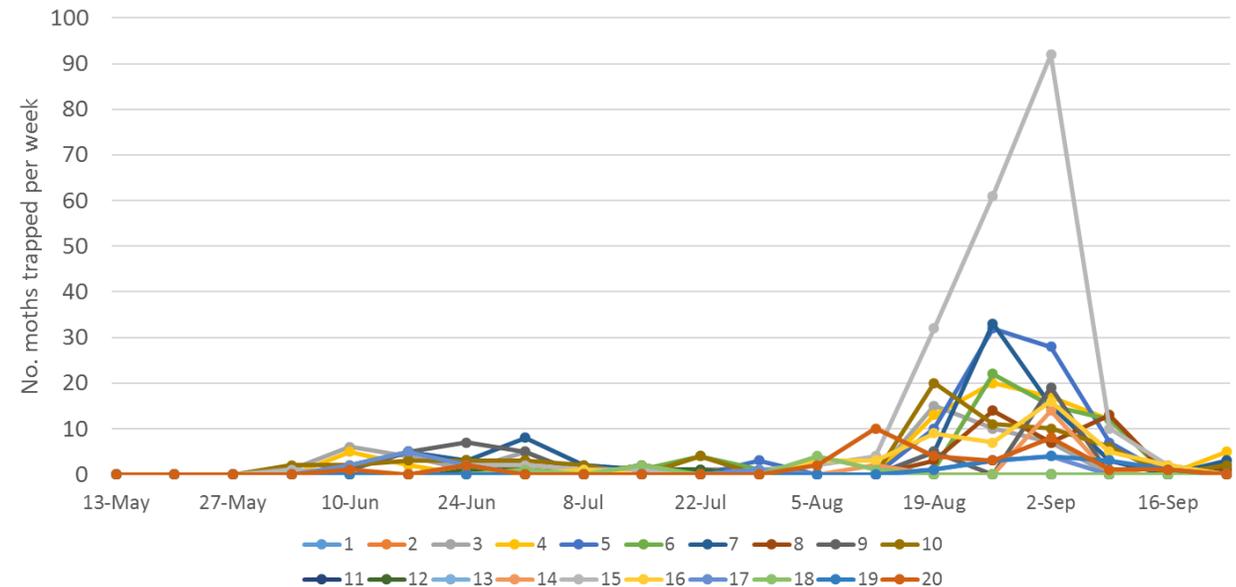


## OBLR Moth Fight Patterns – 2014 and 2015

- 2 gens/yr: peaks early and late summer
- Overwinter as young larvae in silken cases on tree limb
- Moth flight pattern varied between 2014 & 2015

- 2014: Large 1<sup>st</sup> gen peak
- 2015: Large 2<sup>nd</sup> gen peak
- 2× population size in 2015
- Indicative of a building population?
- No larvae & no leaf/fruit injury observed

Obliquebanded Leafroller Moth Flight - 2015



# Orchard Management Intensity

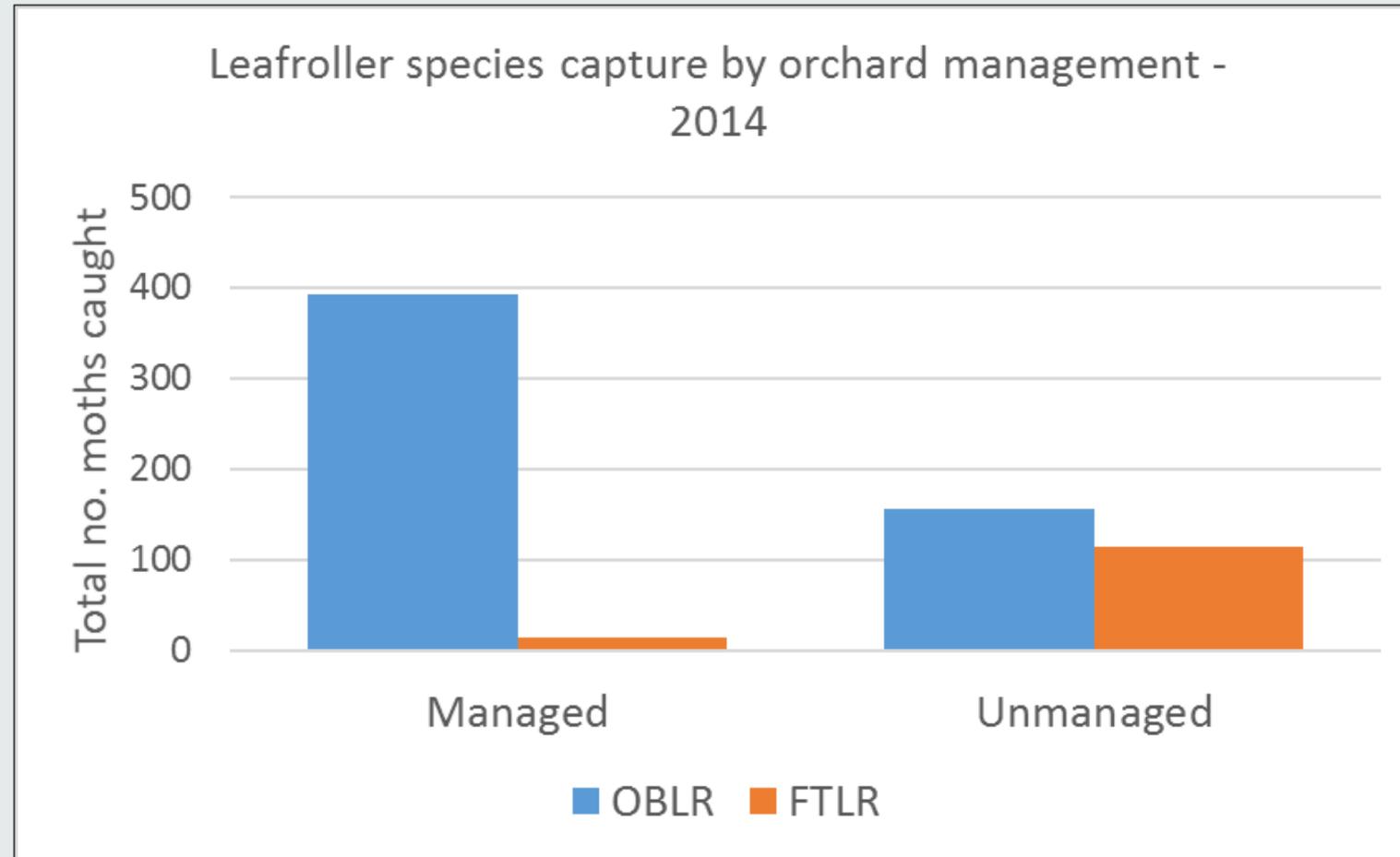
## Obliquebanded and Fruittree Leafrollers



- OBLR: Commercial orchards**
- Tolerates insecticides & other mgmt. practices
  - Natural enemies important



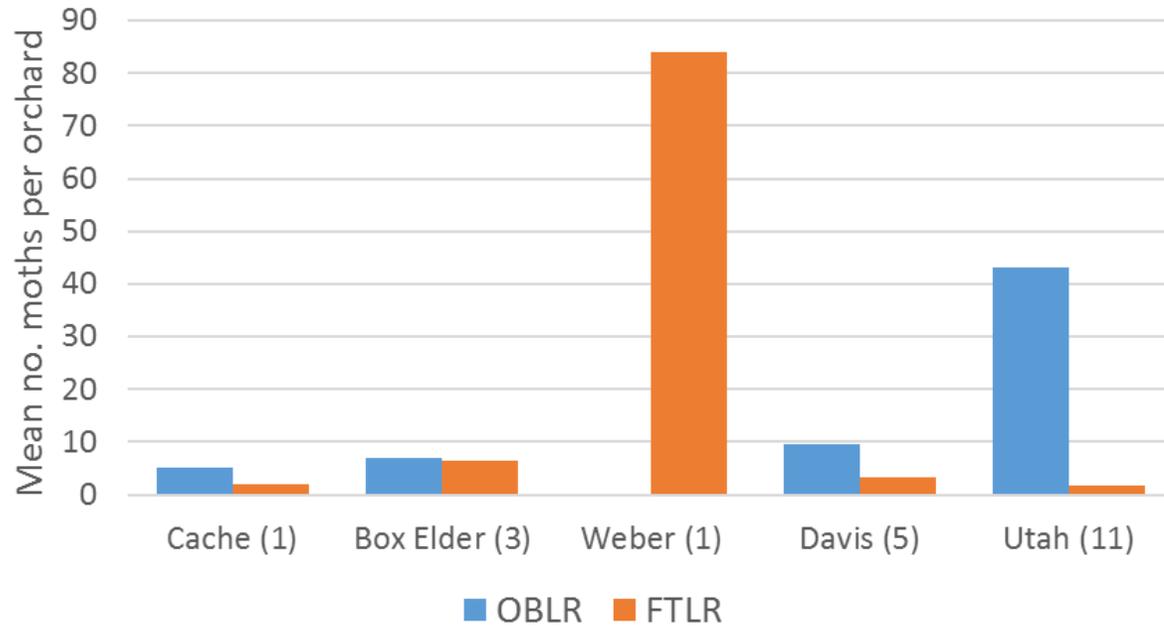
- FTLR: Low- & Un-managed orchards**
- Sensitive to insecticides or other practices



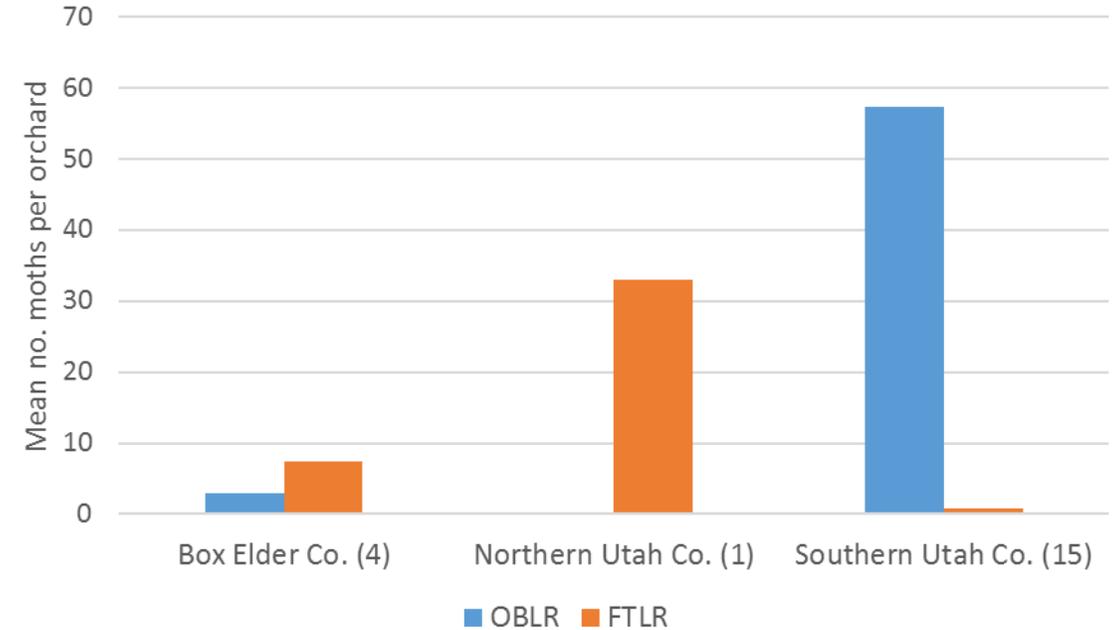
# Orchard Location



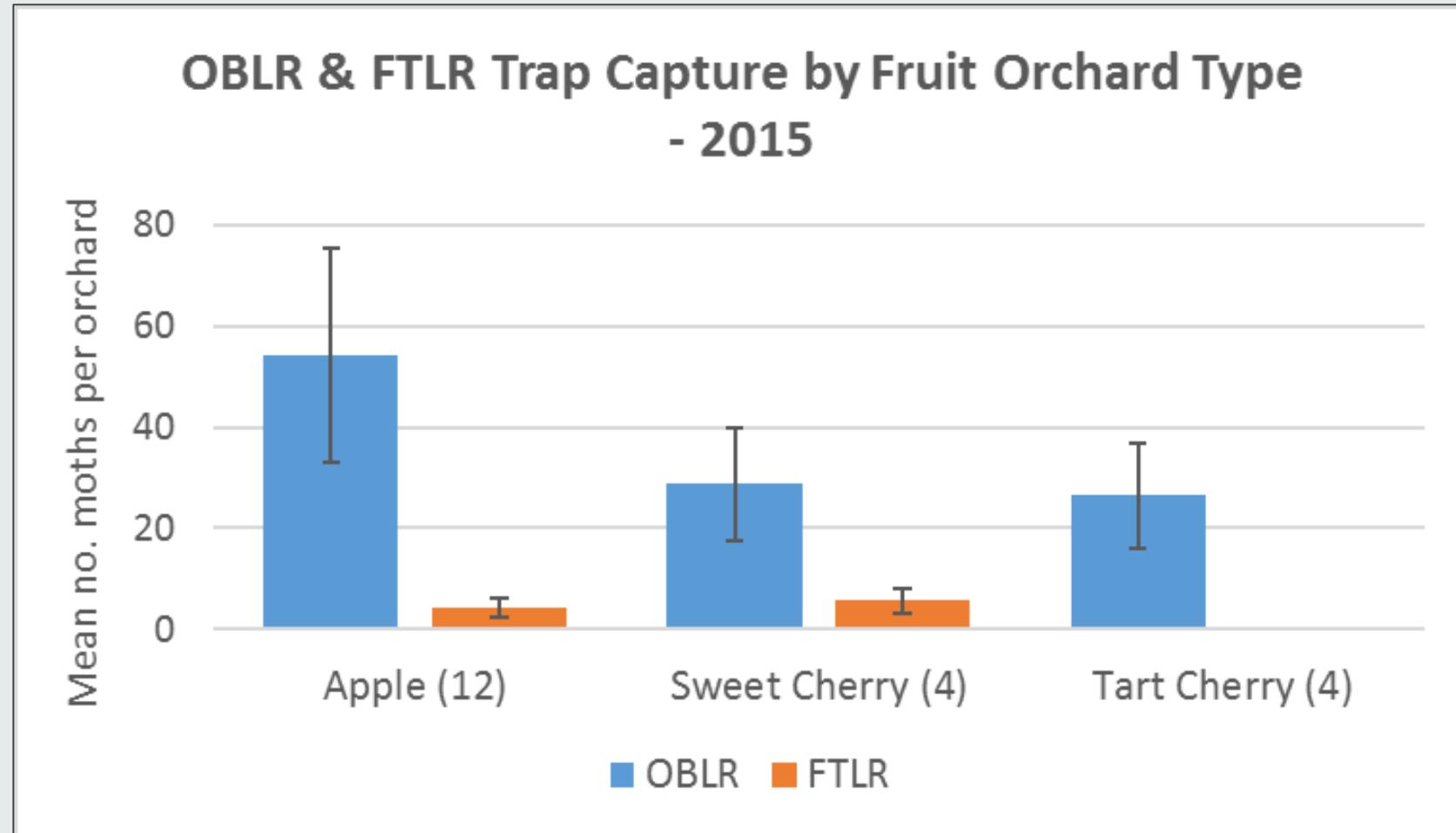
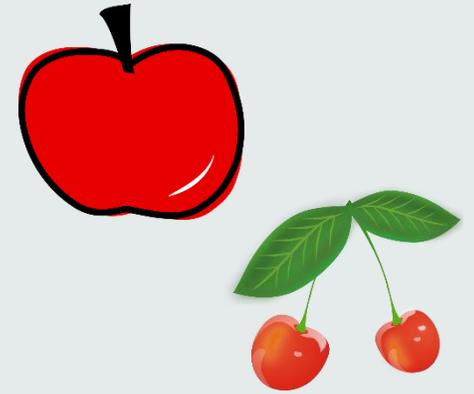
Leafroller species capture by county - 2014



Leafroller species capture by county - 2015

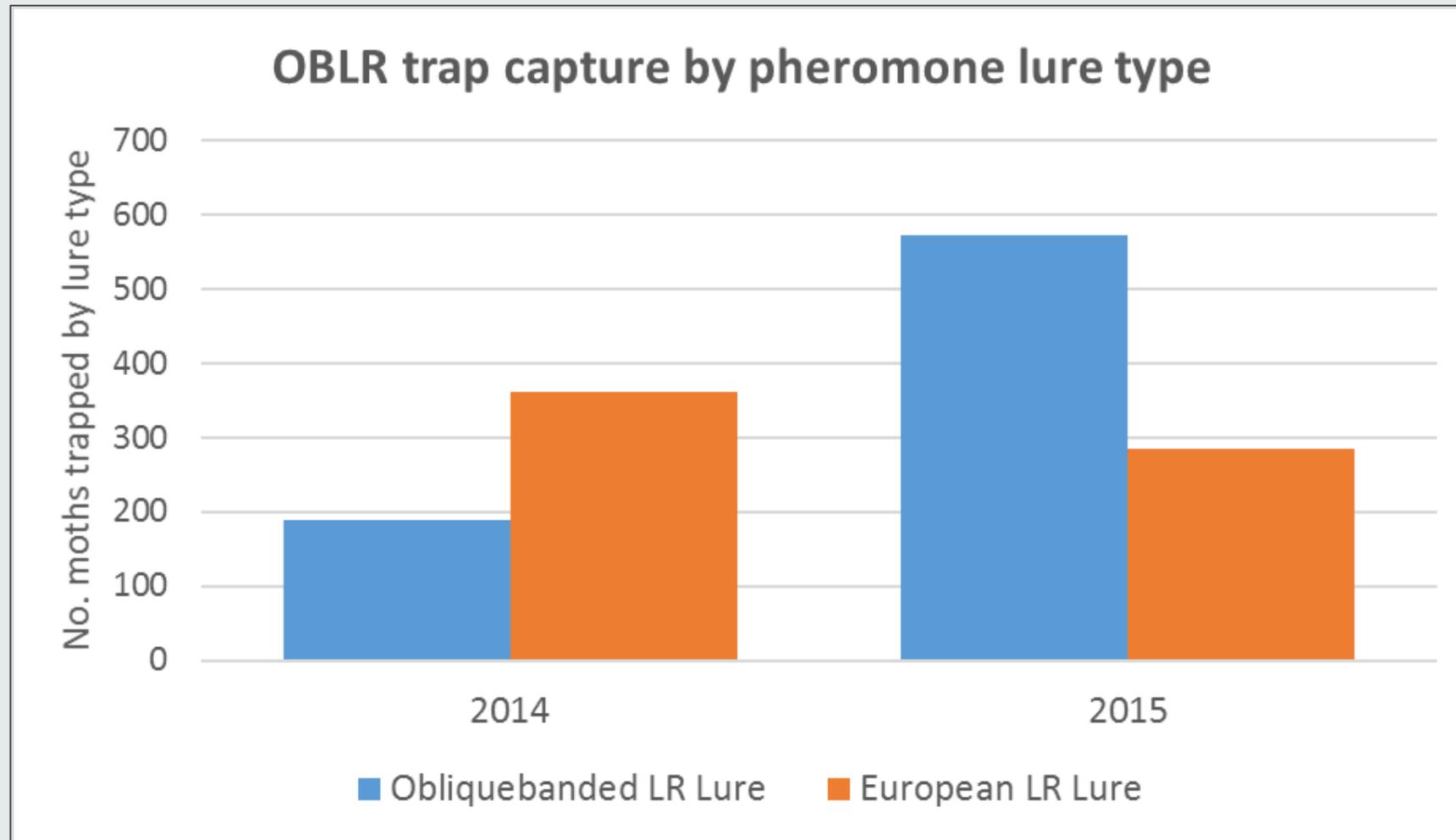


# Orchard Crop Type



No significant difference

# Leafroller Lure Type

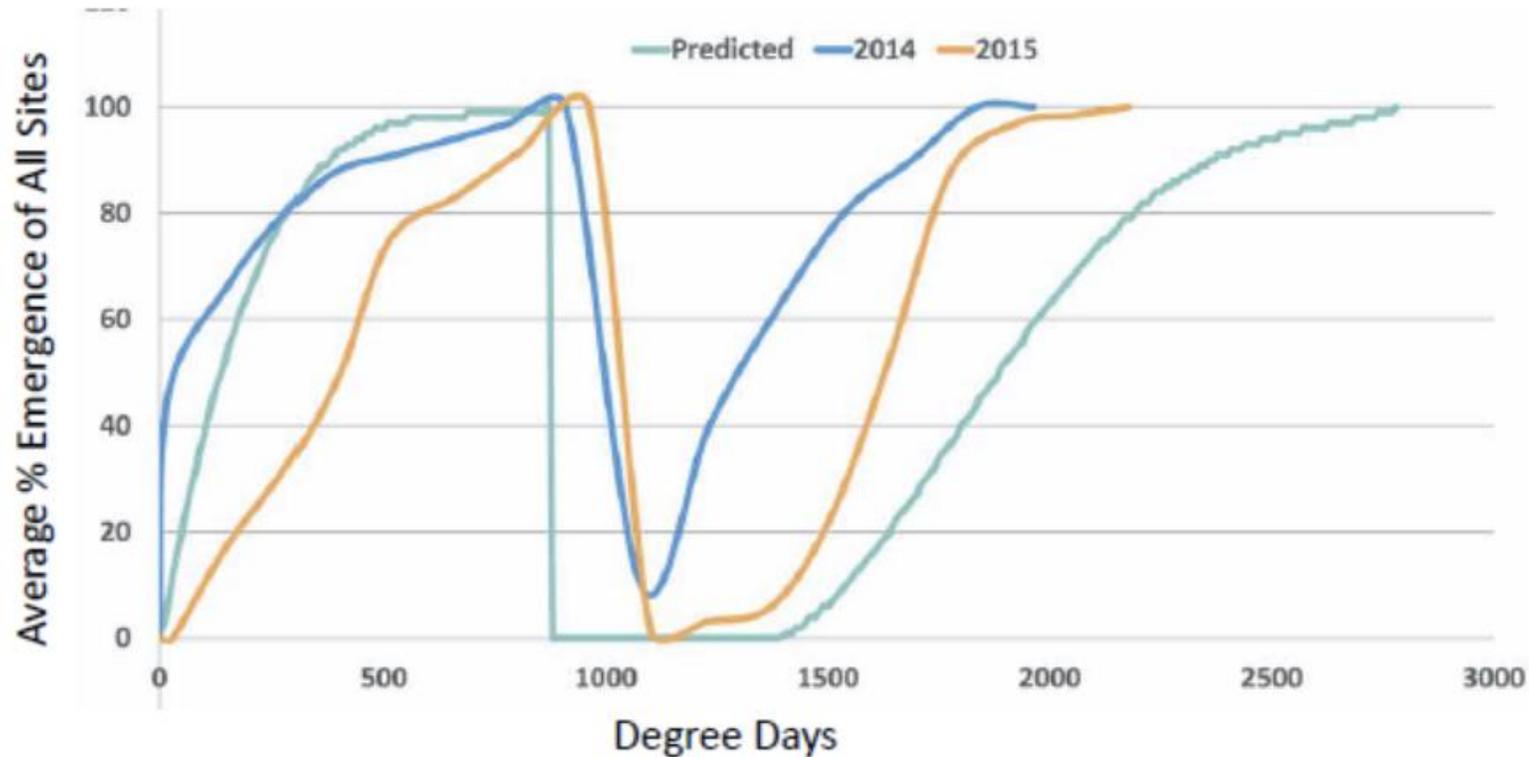


European LR lure will capture both OBLR & ELR

# Prediction of OBLR Moth Flight

WA Degree-day Model (Brunner & Lampson 1997)

## Moth Emergence in 2014 and 2015 Compared to Predicted



OBLR  
2<sup>nd</sup> gen emerged  
~300 DD earlier  
than predicted

# Leafroller Survey Summary

- Leafroller populations relatively low in northern UT orchards in 2014 & 2015
- No larvae or fruit/leaf injury detected
- Obliquebanded was primary leafroller detected
  - Prevalent in commercially managed apple & cherry orchards
  - Tolerant of insecticides used; natural enemies suppress them in unmanaged orchards
- Fruittree LR prevalent in some low- and un-managed orchards
  - Sensitive to insecticides or other mgmt. practices
- Increase in OBLR in some orchards in 2015
  - Populations may be increasing; careful monitoring in 2016
- 2<sup>nd</sup> gen UT OBLR emerged ~300 DD earlier than WA predictive model
  - Adjust DD model in UT TRAPs
- European LR lure attractive to OBLR



# Improving Codling Moth Biofix

New project: funding from UDAF SCBG

- Challenges with setting accurate CM biofix
  - Too few traps
  - Trap checking interval sporadic (daily needed to set biofix)
  - Mating disruption has decreased CM pops.
  - Variable environmental conditions
- WA study (Jones et al. 2013) found biofix predictable using
  - Latitude & elevation formula (WA began using in 2008)
  - No traps
- Validate WA formula
  - Determine first CM larval entry
  - Trap catch, WA formula, temperature, wind speed
- Goal: Improve CM biofix-setting



# Invasive Fruit Pest Guide

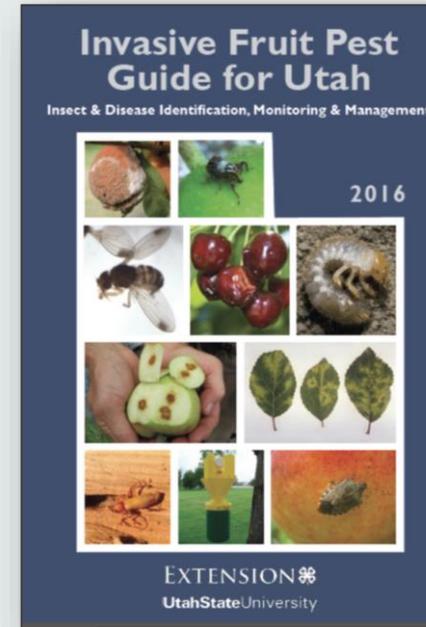
Supported by UDAF Specialty Crop Block Grant with C. Nischwitz, L. Spears & C. Burfitt

## ■ Pests:

1. Brown rot
2. Plum pox virus
3. Brown marmorated stink bug
4. Spotted wing drosophila
5. Plum curculio
6. Japanese beetle
7. Velvet longhorned beetle

## ■ Go-to guide

- Identification, life history, monitoring, management
- Photos, references, resources



## Chapter 1 Japanese Beetle

### Quick Facts

- Japanese beetle (JB) is a quarantine insect pest due to its invasive nature, its extensive plant host range and plant damage inflicted by adult and immature life stages.
- JB has been established in the eastern U.S. for nearly 100 years; it was first detected in Utah (Orem) in 2006.
- An intense eradication program directed by the Utah Department of Agriculture and Food was successful in eliminating JB from Utah.
- Monitoring programs continue today to prevent re-establishment of JB in Utah.
- Turf grass is at greatest risk for infestation by JB larvae (white grubs); adult JB attacks numerous ornamental, fruit, and vegetable plants.

### Pest Identification and Life History

JB adults are about 1/2" in wide and 1/2" in long (6.5 x 13 mm). Adults are highly characteristic in color: metallic green head and mid-section (thorax) with copper-brown wing covers (Fig. 1.1-1.2). The adults have five pairs of white hair tufts along the sides of the abdomen and another pair on the last abdominal segment. The legs have prominent spines, and the body underneath is metallic green and copper-brown.

Adults emerge from pupae (Fig. 1.3) in the soil during June and July, and feed on a wide range of crop, garden, and ornamental plants over a 6-8 week period. Adults release both sex and aggregation pheromones to congregate males and females for mating and feeding. Plant odors emitted from beetle damaged leaves also cause beetles to aggregate. Mated females will fly to turf grass and burrow 2-3 inches (5-8 cm) underneath the soil to lay their eggs. Each female can lay up to 60 individual eggs.

Eggs are cylindrical when laid and about 1/16 inch (1.5 mm) in diameter (Fig. 1.4). The young larva grows inside the egg, and when it is ready to hatch, the egg is nearly 1/8" and 1/8" inch (3 mm) in diameter. The body of the newly hatched larva is creamy white with a grayish-brown hind end. The head is yellow-brown with darker mandibles (chewing mouth). The larva grows from just under 1/8 inch (3 mm) in length upon hatching to 1 inch (25 mm) at maturity. The larva (Fig. 1.5), also known as a white grub, has three pairs of underdeveloped legs (one on each of their thoracic segments).

### Background

The Japanese beetle (JB), *Popillia japonica* Newman (Coleoptera: Scarabaeidae) is a quarantine pest in the U.S. Originally from Japan, JB was first found in the U.S. in 1916 in a New Jersey nursery. It was likely introduced from Japan in shipments of ornamental plants. By the late 1970s, JB had spread throughout the eastern U.S., reaching as far west as Wisconsin. More recently, JB has spread to many western states. In its native environment, JB is not a serious pest due to the natural predators that keep its population in check. Without its natural enemies in the U.S., JB has become established in favorable environments with an abundant food supply and limited

### Chapter 1: Japanese Beetle

**Life History of Japanese Beetle in Utah** There is one generation per year; the majority of its lifespan is spent as a larva (white grub) in the soil feeding on roots of turf grass and other plants. (Adapted from drawing by J. Kubota (University of Nebraska) & Joel Flood (UPNE))

Adults emerge as described. The pupae color varies from creamy white through tan, to the metallic green of adulthood in late population. Pupae are about 1/2" wide and 1/2" long (6.5 x 11 mm). Pupae often place in an embryonic cell made by the final instar of the larva. Most of the JB life cycle is spent underground, only emerging as adults to feed, mate, and lay eggs during the summer (Fig. 1.6).

**Plant Hosts and Injury Symptoms**  
A main reason for the quarantine pest status of JB is the number and diversity of plants it attacks (over 300 species of ornamental and crop plants). Preferred adult hosts include rose, apple, plum, peach, blackberry, raspberry, strawberry, bean, and corn. Adults chew on the leaves, flowers, fruit, and in some cases, stems of plants (Figs. 1.7-1.14). They are voracious feeders. Adults skeletonize leaves,

chewing every other tissue, and leaving the veins. They also chew holes in flower buds and petals, soft fruit, and corn silks (Figs. 1.15-1.16). The adult beetles congregate (often together) and can destroy crops in just a few days before moving on. They also tunnel burrow on ornamental plants, consuming leaves and flowers.

The larvae (grubs) attack plants below ground and feed on the fine roots of grasses and some trees, shrubs, and vegetables. Large plantings of turf grasses (e.g., lawns and athletic fields) are especially attractive to egg-laying ones. While damage to grasses is initially difficult to detect, it becomes apparent during late summer and early fall when grubs are large. The compromised grass roots are insufficient in quantity of number and nutrition, and eventually turn leaves and stems yellow and brown. Severely injured turf will die. Feeding damage appears as patches of dead and dying plants mixed with healthy, unaffected grass.

Species Table

#### 1.1. Insecticides recommended for control of JAPANESE BEETLE ADULTS IN COMMERCIAL FRUIT PRODUCTION in Utah.

INSECTICIDE CLASS	Common Name	Examples of Brands	Timing of Application	ppm	Protection Interval*	Comments	
Pyrethroid (P)	allethrin	Waller's, Benger's, Capturor, Fyronite		1-14	7-10	Extremely toxic to fish, aquatic invertebrates, reptiles and snails; spray tanks to bees exposed to direct treatment or residues on blooming crops or weeds; do not may be a problem in public places.	
	cyfluthrin	Mustang XL		14	7-10		
	cypermethrin	Mustang Max		1	3		
	deltamethrin	DeltaDor	Contact activity and short residual.		3-5		
	ethofenprox	Akara XL	Begin applications when JB adults are first detected, and before populations enter a phase of rapid increase.	10-21	14-18	If flowering plants are present, only apply when pollinating insects are not active, such as in early morning or late evening.	
	lambda-cyhalothrin	Carib		3-21	14-18	3-21	Begin applications to increase before JB numbers increase.
	gamma-cyhalothrin	Decathlon		21	5		
	lambda-cyhalothrin	Conquest, Spectracor, Thiodan, Warrior, Warrior		1-21	7	Daytime; not for use on soil borne or golf courses	
	Neonicotinoid (N)	acetamiprid	Assail	Begin application when treatment thresholds have been reached.	7	7	
		clothianidin	Blay	one application before damaging population becomes established; adult beetles will stop feeding after application and mortality will occur within a few days.	7-21	10	
imidacloprid		Corpoon		1-21	7	Thorough coverage is important to sustain optimum control; toxic to aquatic invertebrates, bees and other insect pollinators.	
imidacloprid		Admiral, Merit		14	7		
thiamethoxam		Actara		10-20	7-14		
Other	kaolin clay	Surround WP, Surround CF	Suppression only; start one week before expected infestation and those with 2-4 applications.	0	5-7 (7-14 in apples)	White coating on the soil may require removal after harvest to make fruit marketable. Surround CF: do not use after fruit set.	

# Chlorpyrifos Registration Cancellation

- EPA proposed to revoke all crop tolerances for the insecticide chlorpyrifos (Lorsban)
  - Comment period ended January 5, 2016
- Why?
  - Drinking water concerns in small watersheds with intense agriculture
- Orchard uses
  - Dormant/delayed-dormant applications
    - Aphids
    - Scale
    - Campyloomma bug
  - Trunk treatment for greater peachtree (crown) borer

**Specimen Label**

**RESTRICTED USE PESTICIDE**  
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

 **Dow AgroSciences**

**Lorsban<sup>®</sup>-4E**

**INSECTICIDE**

®Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

**For control of listed insects infesting certain field, fruit, nut, and vegetable crops.**

Group	1B	INSECTICIDE
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Active Ingredient:  
chlorpyrifos: O,O-diethyl-O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate ..... 44.9%  
Other Ingredients..... 55.1%  
Total ..... 100.0%

# Acknowledge

- USU Extension Tree Fruit Team & IPM Program
- Dr. Wee Yee, USDA-ARS, Wapato, WA
- Student Research Assistants
- Funding:
  - UDAF Specialty Crop Block Grant Program
  - Utah Agricultural Experiment Station
  - USU Extension

