

Spotted Wing Drosophila Management



Save the Berries. Managing SWD Workshop
Thursday, March. 15,
Best Western University Inn, Canton NY



Cornell University

Hudson Valley Research Laboratory

A Spotted Wing Drosophila Tsunami: SWD Management in NYS in 2017

- **Spotted Wing Drosophila (SWD) Biology & Ecology**
 - Physiology and Identification
 - Spread and Establishment
 - Generational Cycles & Population Density
 - Temperature Constraints
 - Host Preference
- **Biological control**
 - Insect & Disease
- **Conventional & Organic Controls**
 - Timing, Materials, Efficacy
 - Rainfastness
 - Insecticide Resistance



A Spotted Wing Drosophila Tsunami: SWD Management in NYS in 2017



- Spotted Wing Drosophila (SWD) is an invasive Southeast Asian species of vinegar fly, first reported in 1939 Japanese literature.
- Female SWD damages unripened & healthy fruit while depositing eggs into fruit.
- Wounded fruit have been found to contain microbial organisms, often leading to increased rot.



Female *Drosophila* species

UC Berkeley & UC Cooperative Extension Photos: M. Hauser, CDFA

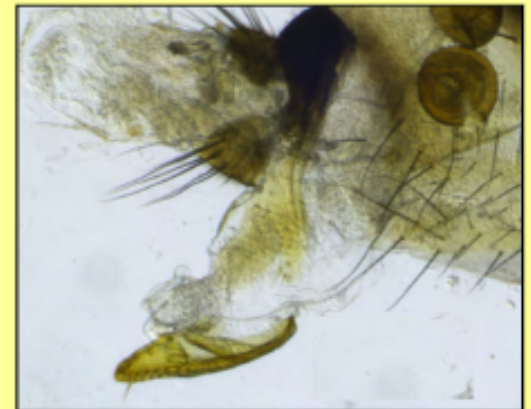
Spotted Wing *Drosophila* (*D. suzukii*)



SWD has a large, saw-like, serrated ovipositor with two even rows of teeth that are much darker than rest of ovipositor

Other *Drosophila* spp.

have smaller, more rounded ovipositors, sometimes with irregular, poorly defined teeth



Male Spotted Wing Drosophila (SWD)

UC Berkeley & UC Cooperative Extension

Photos: M. Hauser, CDFA



Double stripes on
tarsi of front legs



Leading edge of
wing has dark spot



Unbroken abdominal bands

SWD Look-a like wing patterns = Biodiversity



Nicolas Gompel and Benjamin Prud'homme, UW-Madison

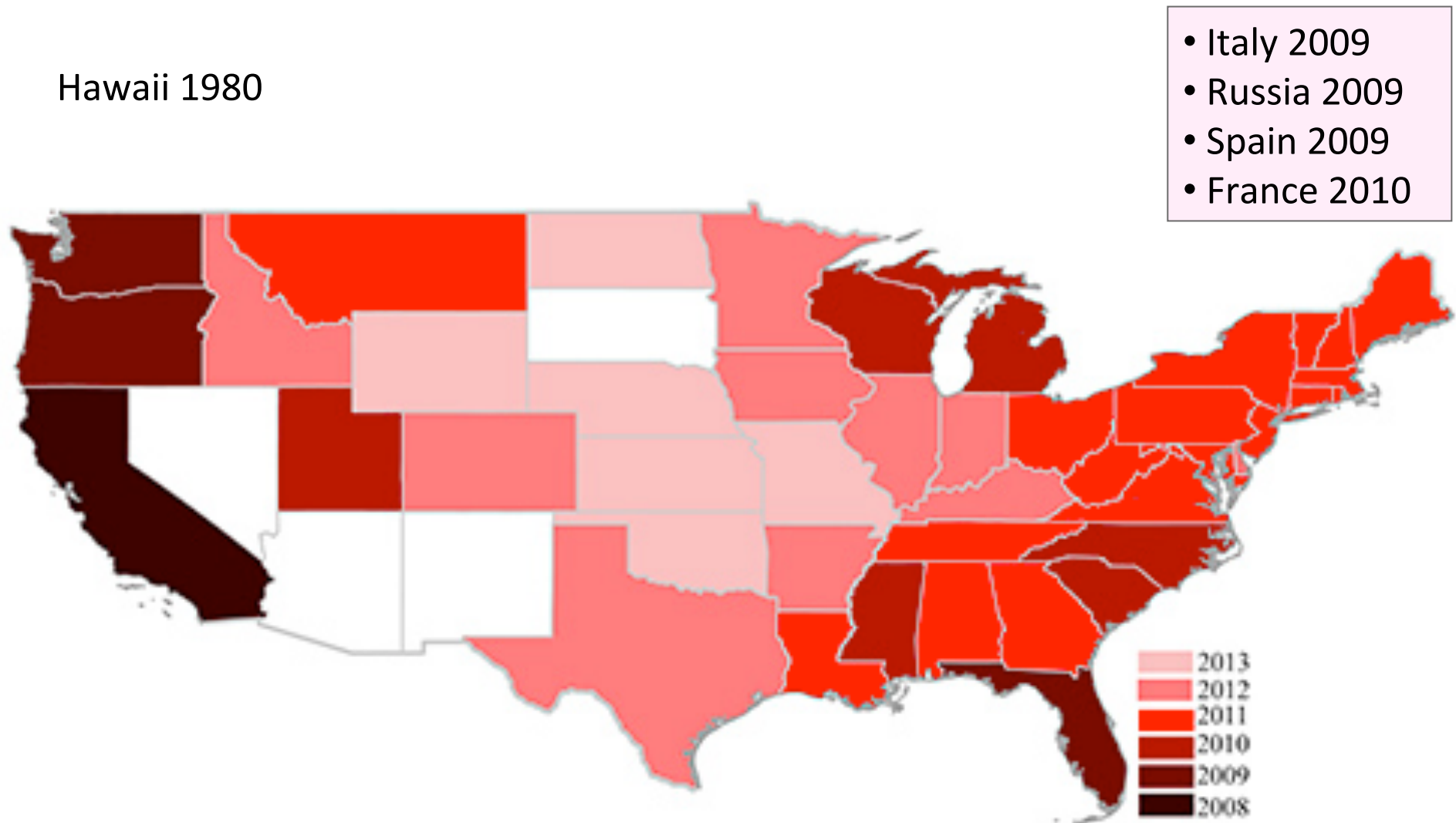


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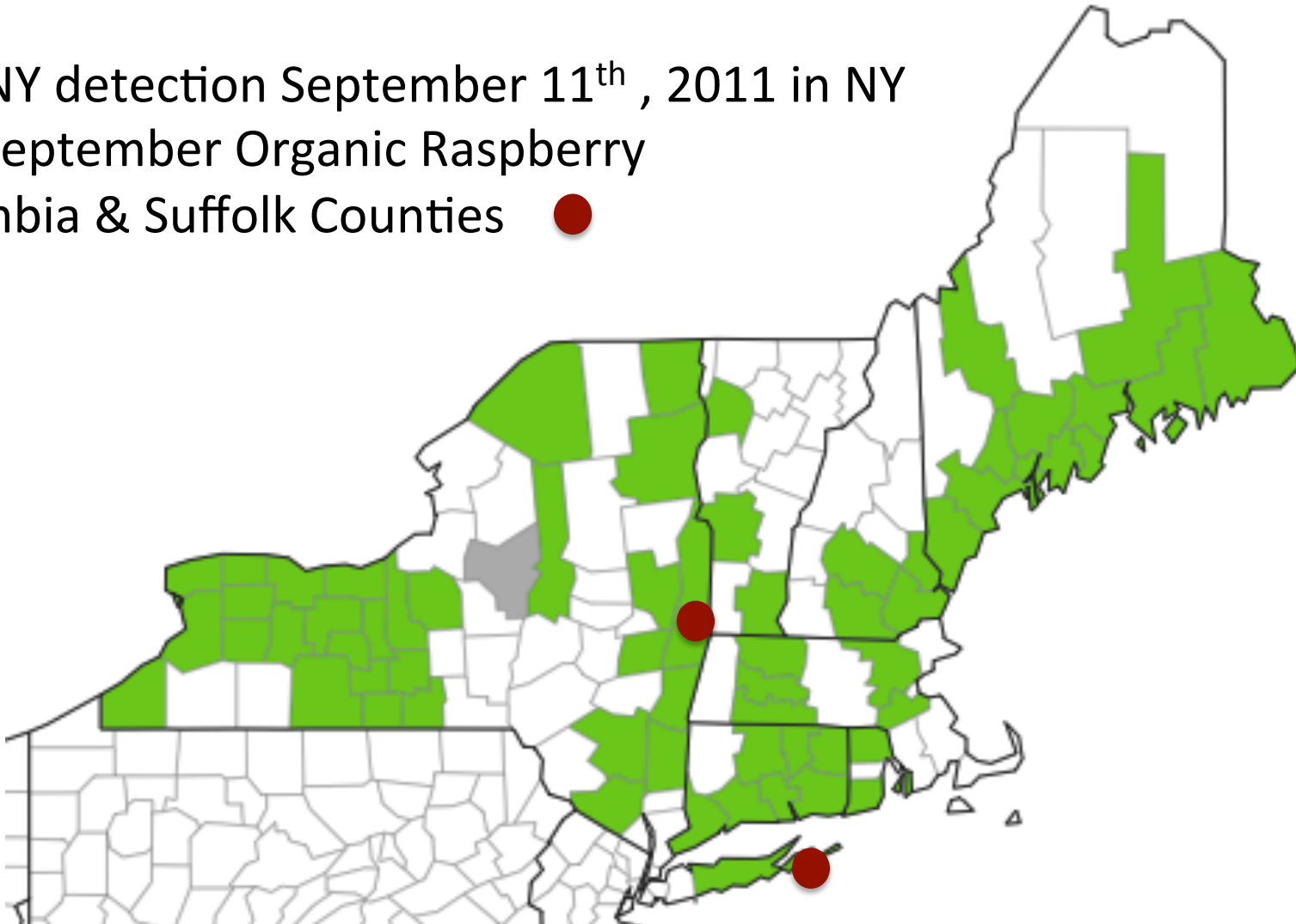
SWD Spread from 2008 – 2013 in the US

Hawaii 1980



SWD in New England - 2011

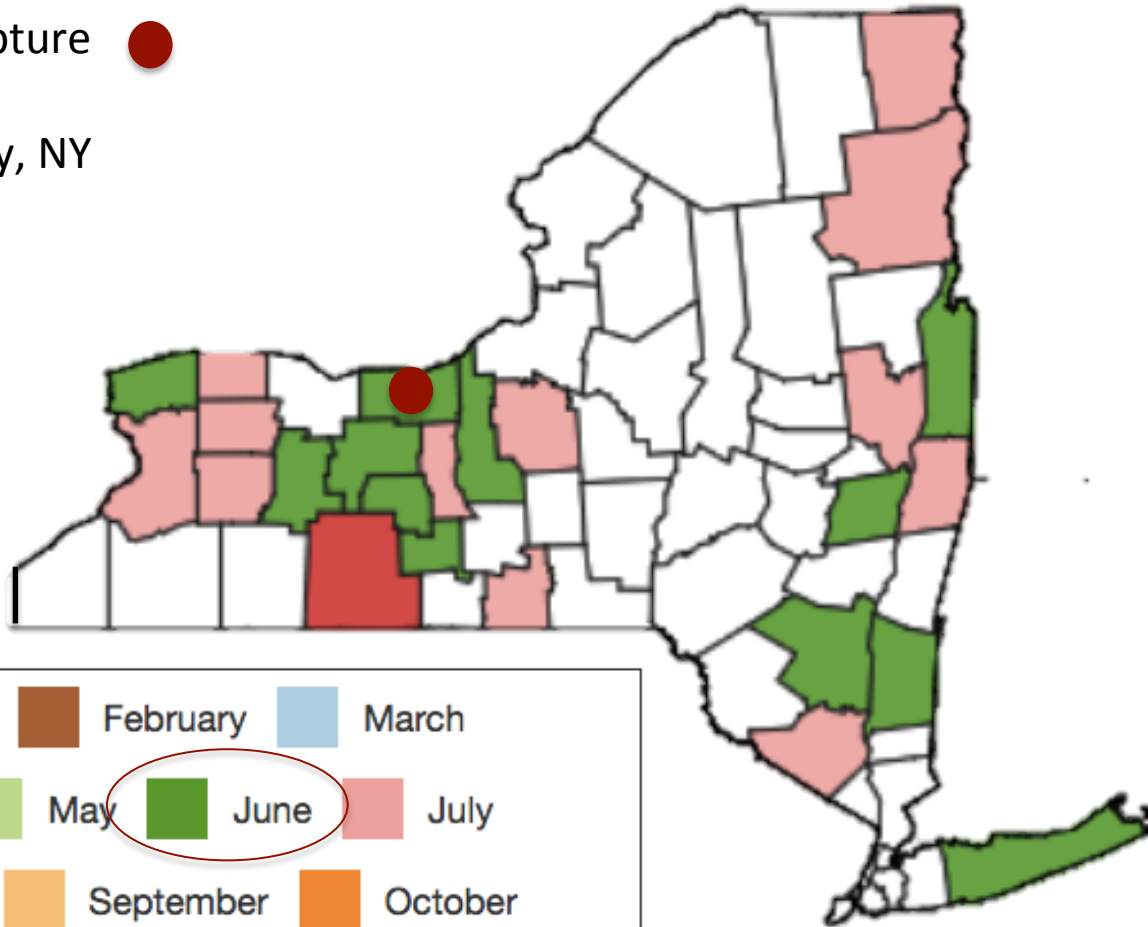
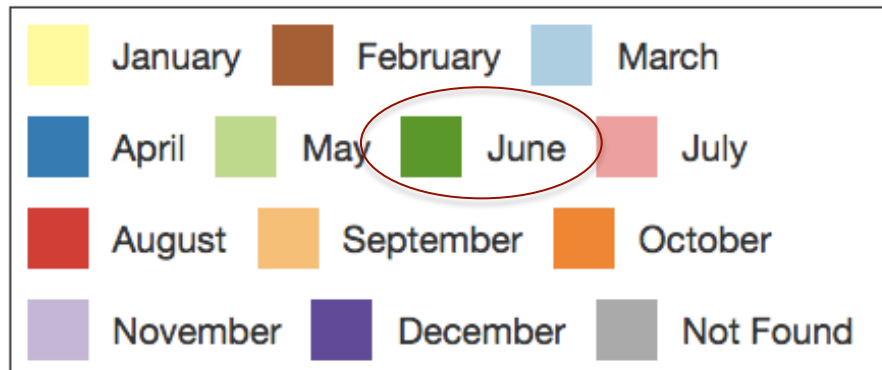
First NY detection September 11th , 2011 in NY
Mid-September Organic Raspberry
Columbia & Suffolk Counties ●



SWD in New York - 2016

First State Capture ●
June 21, 2016
Wayne County, NY

Legend



Monitored in 25 Counties in NYS

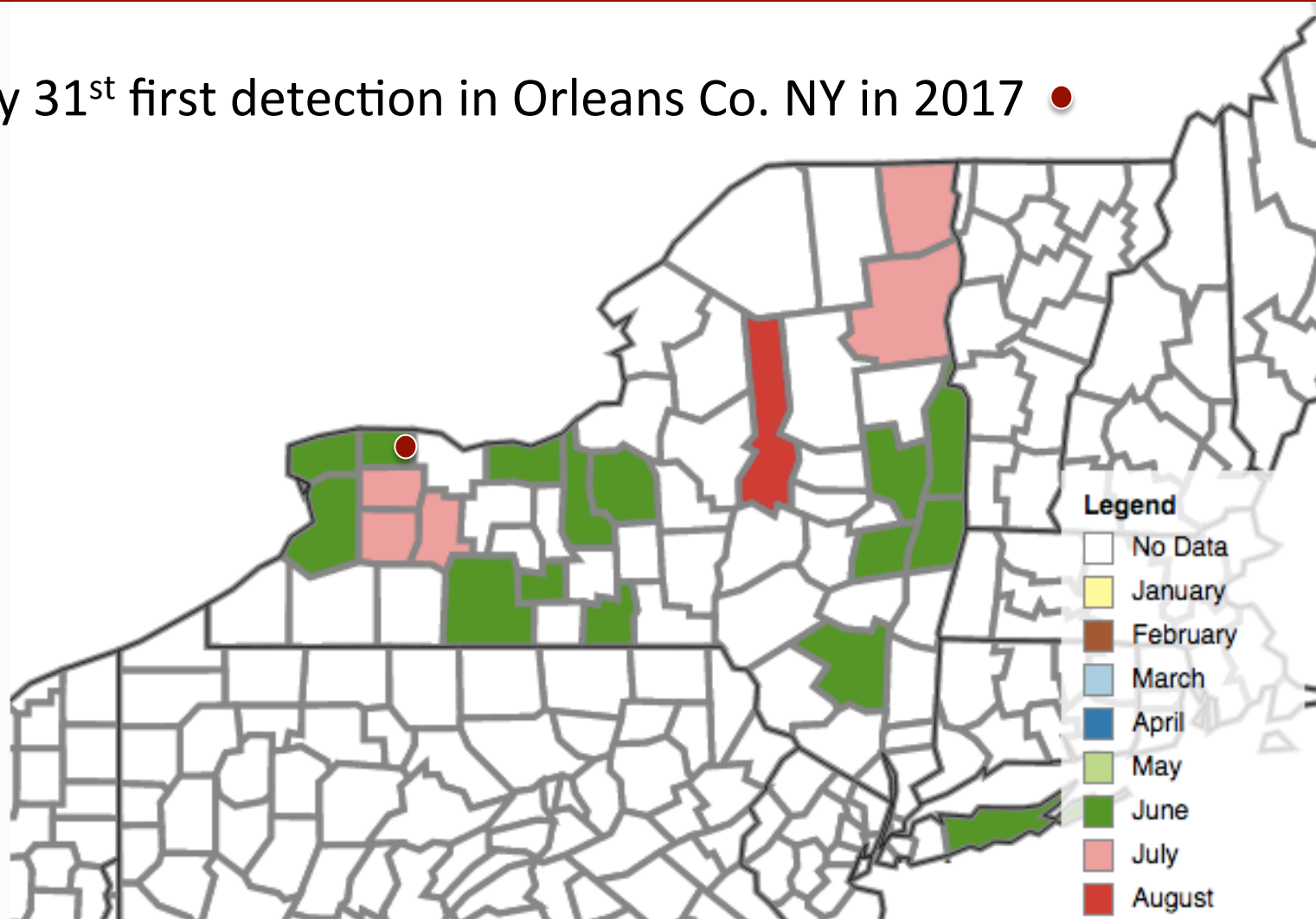


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SWD in New England - 2017

May 31st first detection in Orleans Co. NY in 2017 ●



Life Cycle of the Spotted Wing Drosophila *Drosophila Suzukii* (Matsumurai)

Yearly First Trap Captures

New York

2011 – Sept. 11 (Columbia/Suffolk)

2012 – July 20 (Ulster)

2013 – June 11 (Ontario)

2014 – July 22 (Orleans)

2015 – June 22 (Orange)

2016 – July 7 (Dutchess)

2017 – May 31 (Orleans)
June 27 (Dutchess)

Michigan

2011 – August 7

2012 – June 3

2013 – May 26

2014 – June 15

2015 – June 28

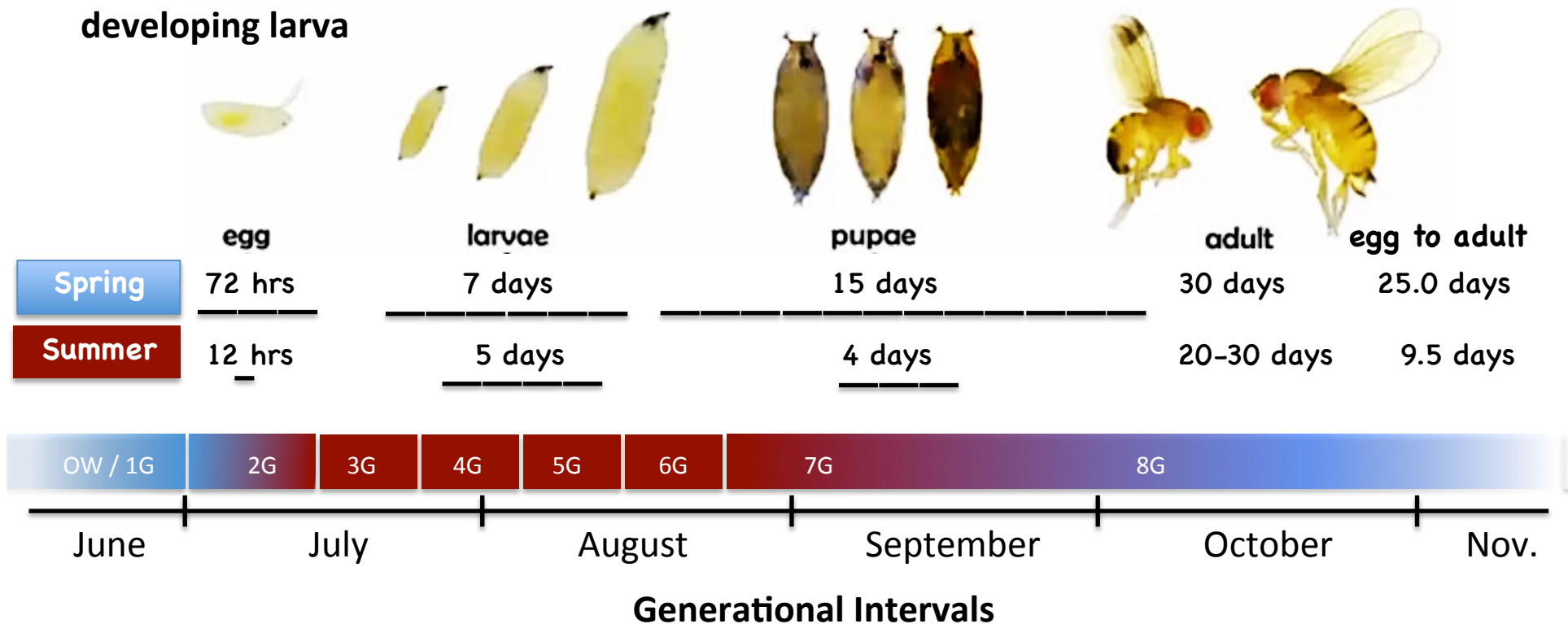
2016 – June 19

2017 – May 19

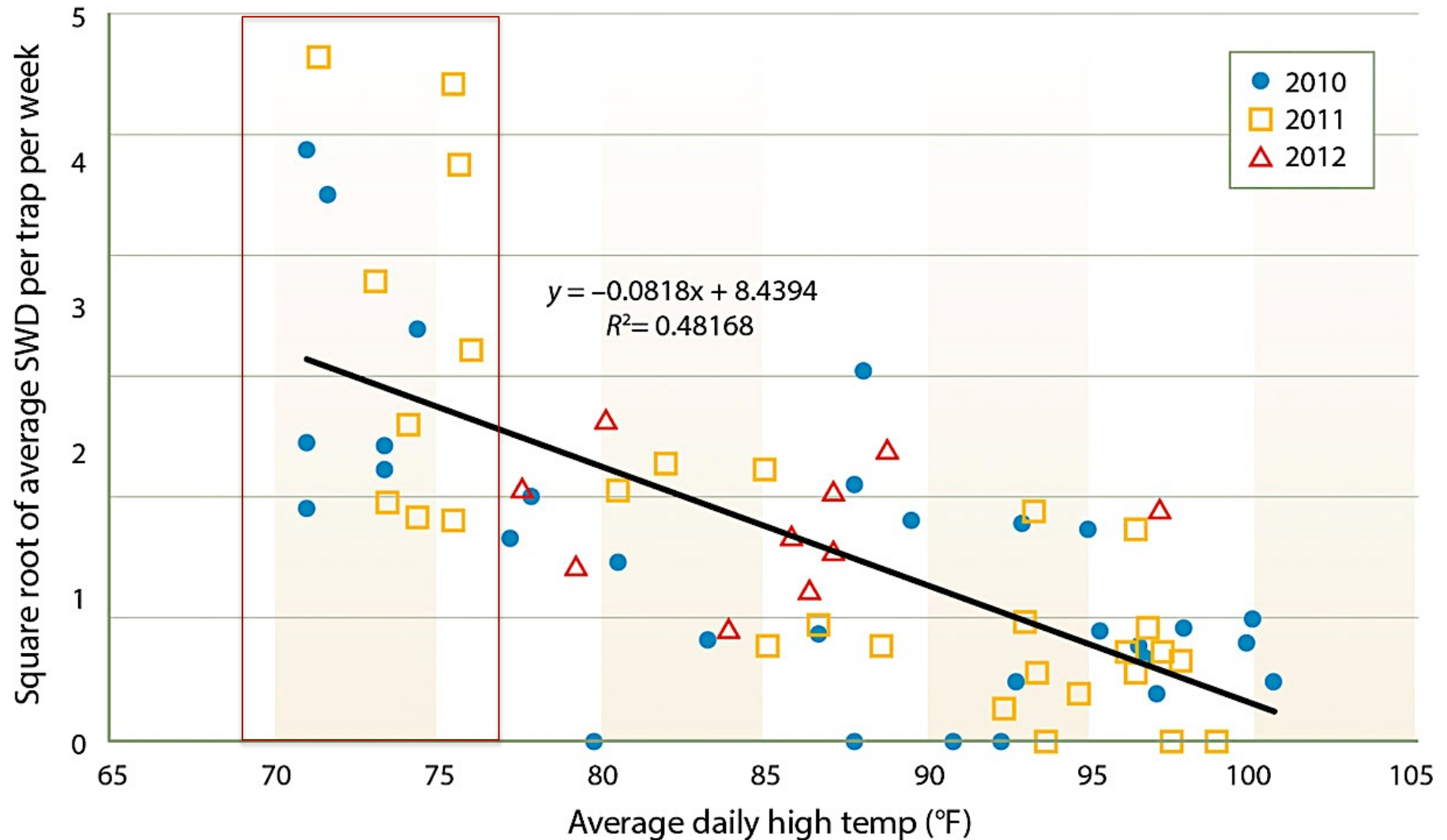
**Earliest Recorded
SWD Captures**

Life Cycle of the Spotted Wing Drosophila *Drosophila suzukii* (Matsumurai)

- Earliest 1st emergence & trap capture on 31st May (Orleans), 27th June (Dutchess), 2017
- ≥ 6 Generations / year
- 350 eggs per female
- Majority of the population at any time exist in the immature life stage
- Insecticides primarily target the adult stage with some activity against the egg and developing larva



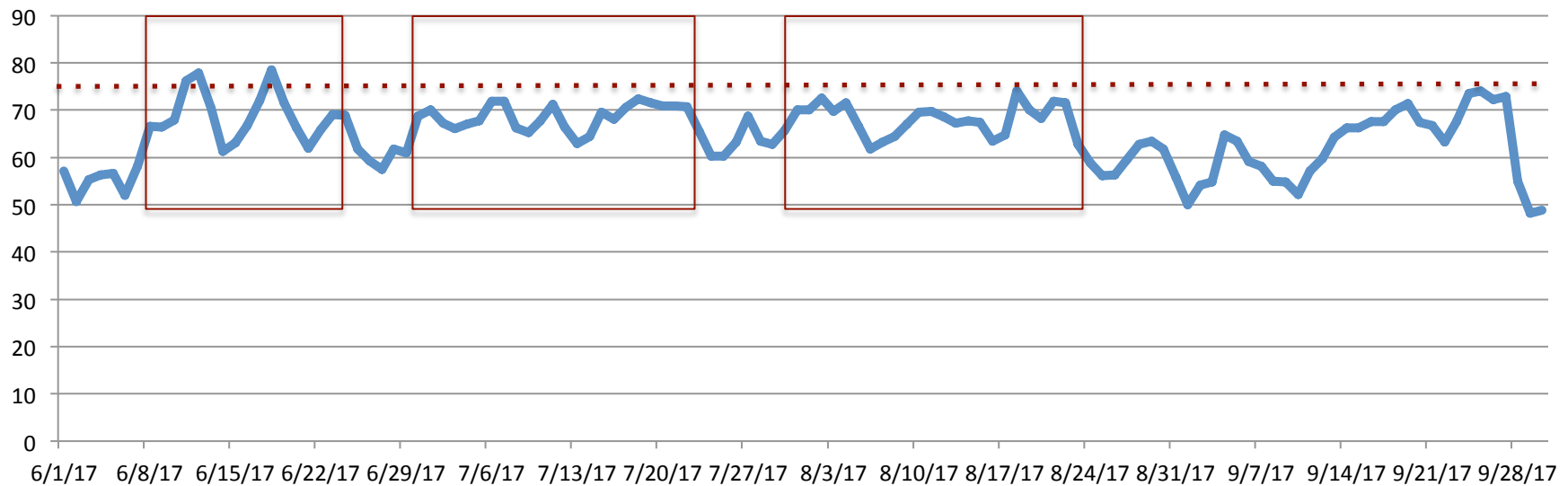
Life Cycle of the Spotted Wing Drosophila *Drosophila suzukii* (Matsumurai)



Haverland, D.R. et. al. Phenology of spotted wing drosophila in the San Joaquin Valley varies by season, crop and nearby vegetation. *California Agriculture* 70(1):24-31. <https://doi.org/10.3733/ca.v070n01p24> January 01, 2016

Life Cycle of the Spotted Wing Drosophila *Drosophila suzukii* (Matsumurai)

2017 NEWA Station: Canton (Greenwood)



Concentrated Periods of Reproduction

Fruit Affected by SWD

Highest risk

Strawberries

Raspberries

Cherries (Tart pref.)

Nectarines

Blueberries

Blackberries

Moderate risk

Peaches

Grapes

Pears

Apples

Tomato

Alternate hosts

Wild plants with berries,
such as...

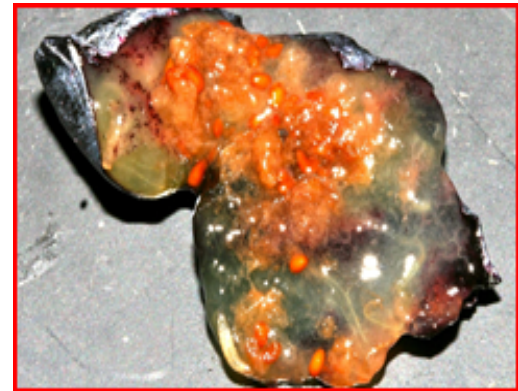
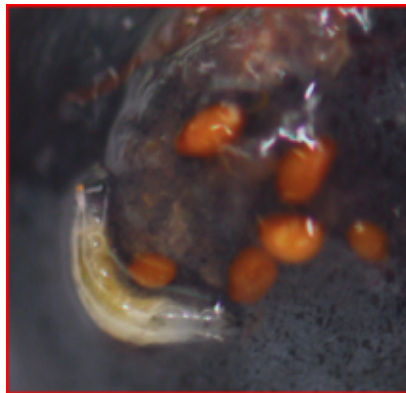
Tartarian Honeysuckle

Snowberry

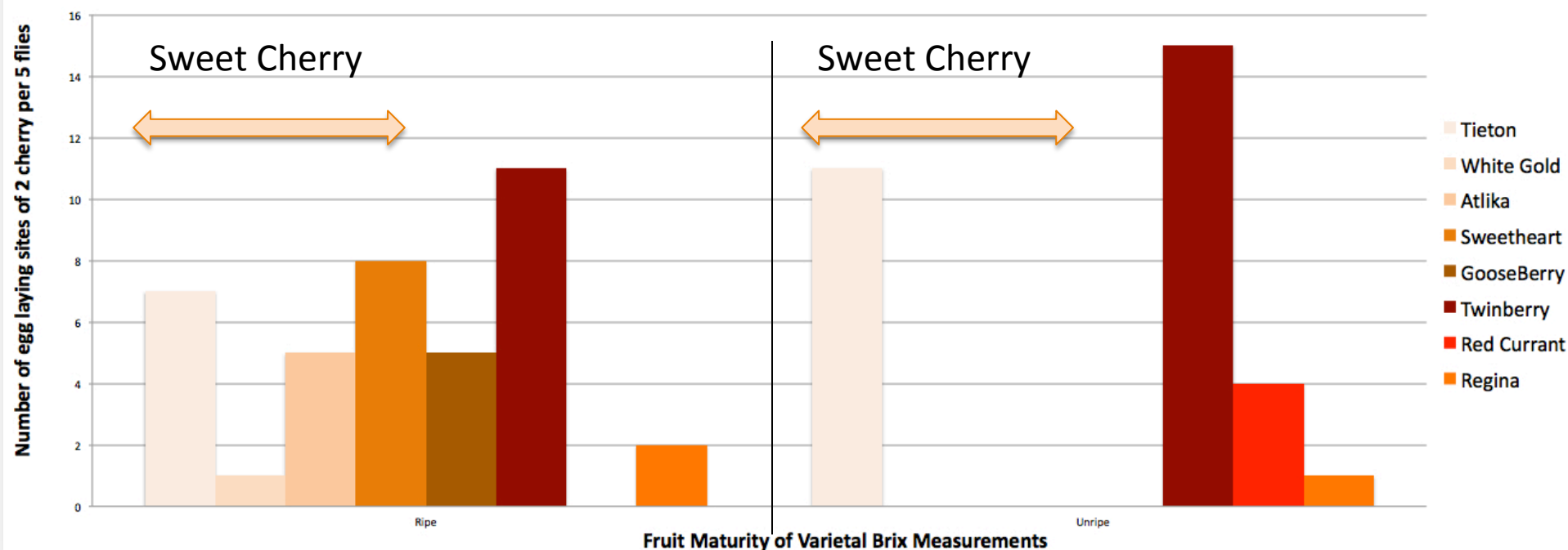
Elderberry

Pokeweed

Dogwood



SWD Oviposition Into Ripe and Unripe Sweet Cherry, Gooseberry and Current **Varietal and Maturity Preference** **Hudson Valley Lab, Highland NY. July 1, 2013**



SWD oviposition during pre-harvest and ripened development.

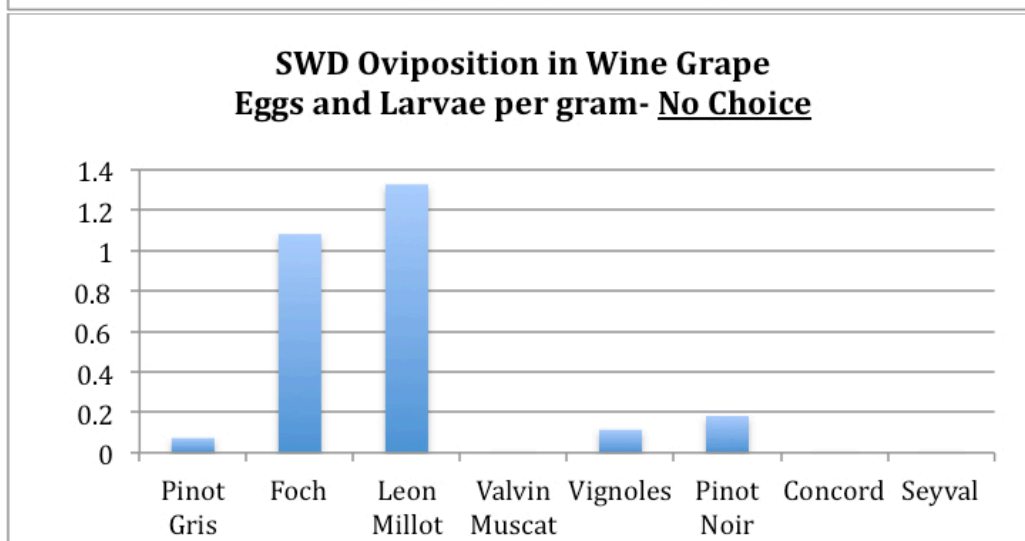
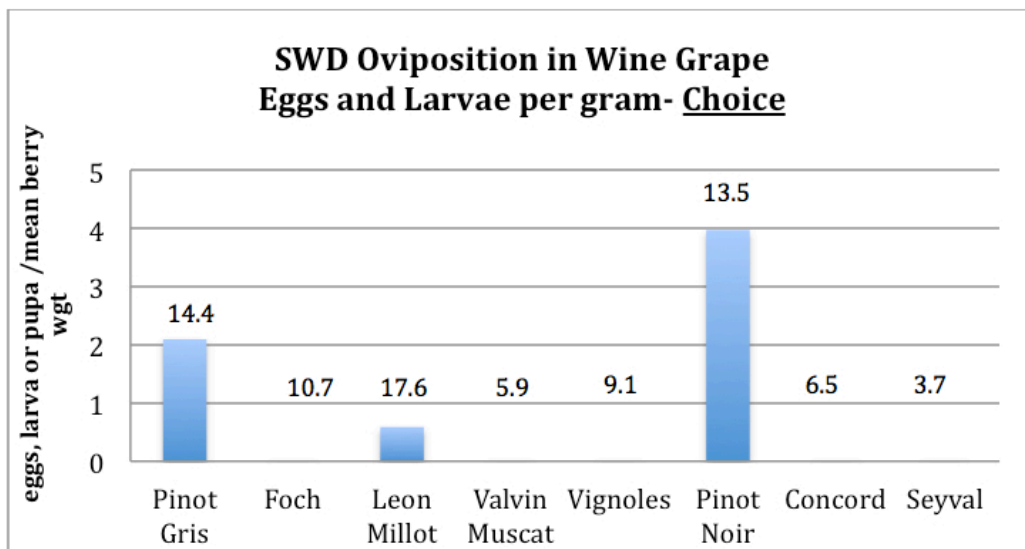
Male and Female flies were introduced to fruit, and allowed 48 hours to oviposit before they were removed and eggs were counted.

Each fruit was isolated with 2 cherry (fruit) of each V. and 5 female SWD adults.



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Choice Test

Variable ripening (Brix#)

- Grape varieties placed in same container.
- 40 female SWD

No-Choice Test

- Grapes varieties placed in individual containers.
- 5 female SWD

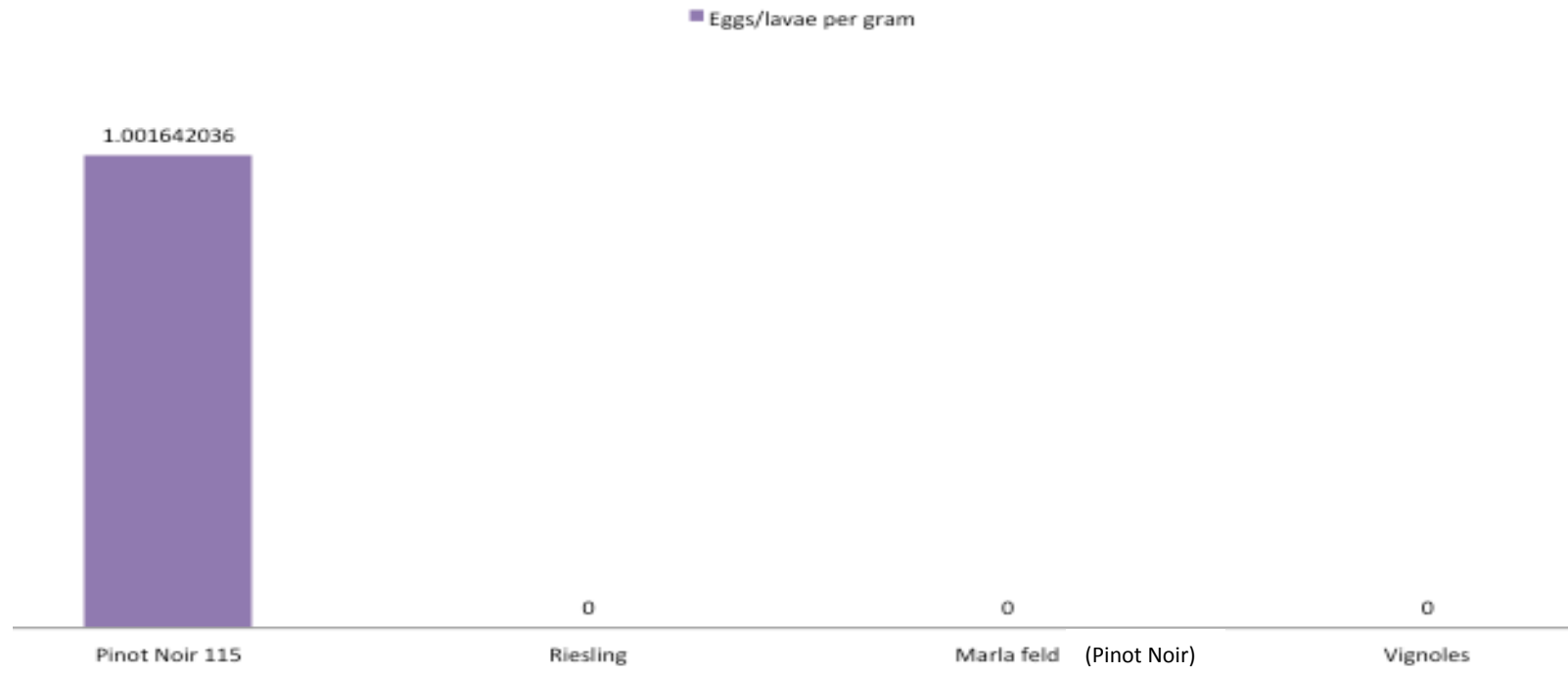
- SWD ovipositional preference in pre-ripened grape varieties.
- Allowed 48 hours to oviposit.



Managing SWD in Grape



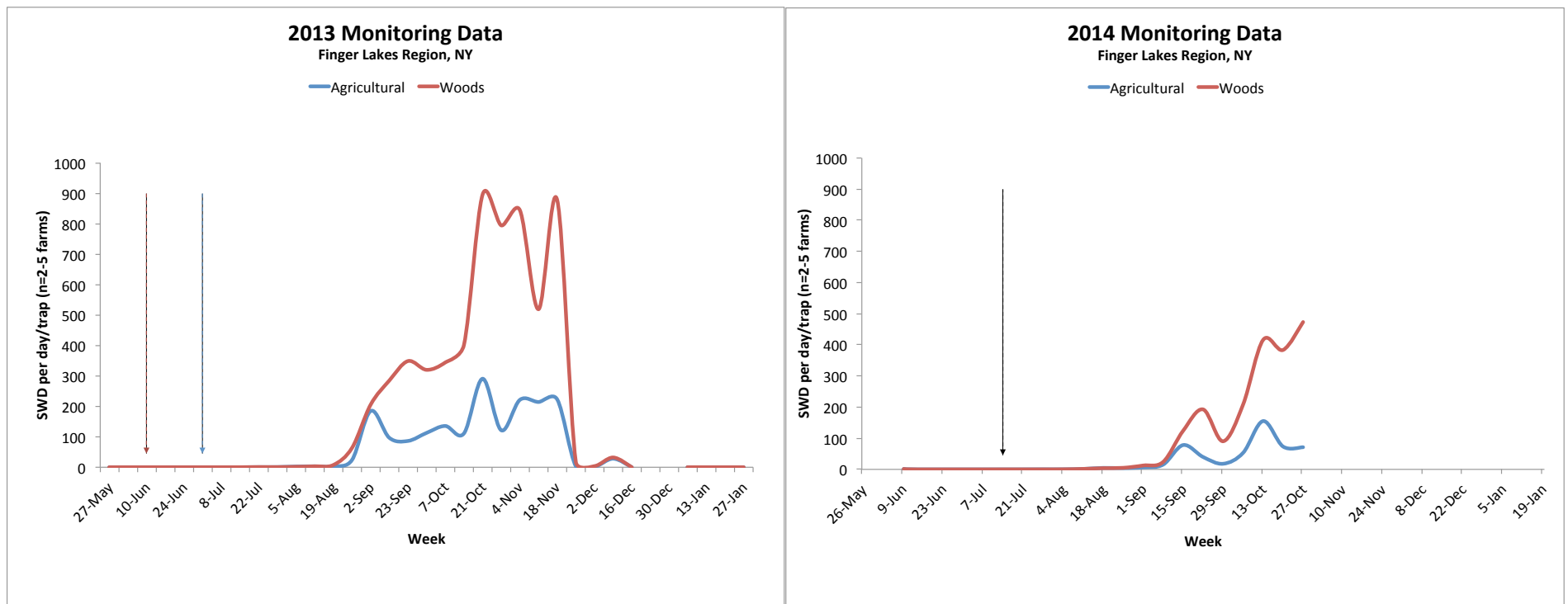
SWD Infestation in Grape- Ulster County- September 16th



- Grapes collected and analyzed from an Ulster County vineyard indicated that Pinot Noir 115 is at high risk of SWD infestation.



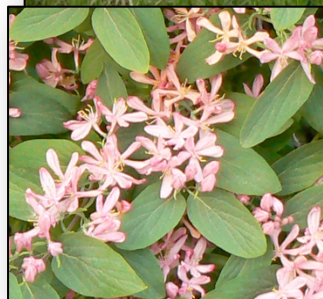
SWD SEASONAL DYNAMICS IN THE NORTHEAST



Credit: Greg Loeb Lab, NYSAES Geneva, NY

SWD Attract and Kill Management 2015

Monitoring *L. tartarica*



Honeysuckle is a primary host for SWD; *L. tartarica* fruit favored over raspberry in June-August.

Begin to build in high numbers then move from alternate host to crops.

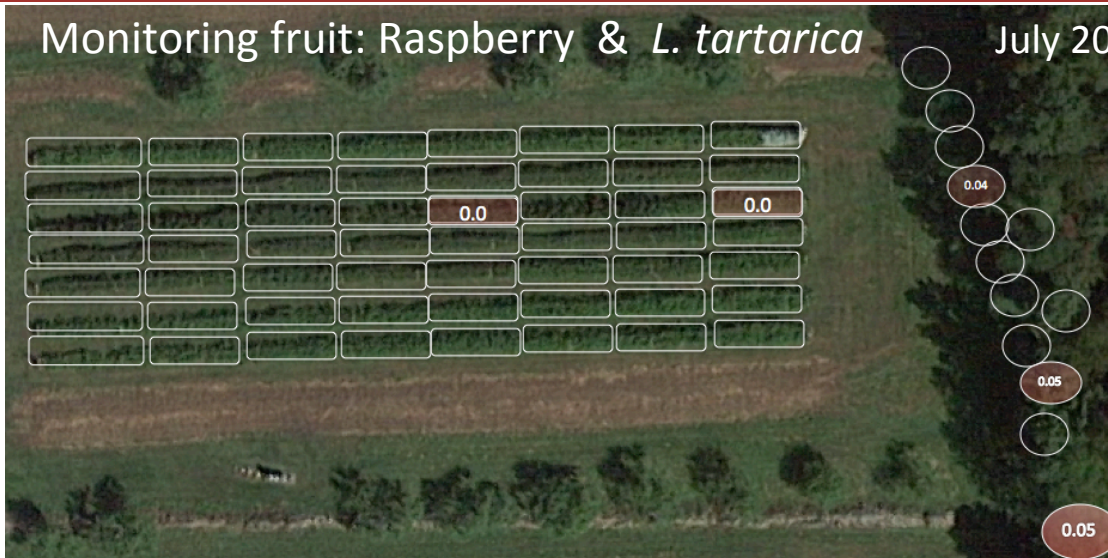
Potential for use as management sites using biological control and attract and kill for SWD in alternate hosts.



SWD Attract and Kill Management 2015

Monitoring fruit: Raspberry & *L. tartarica*

July 20



July 27



WestWind Farm, Accord NY

- First SWD eggs found in *L. tartarica* on 20 July
- SWD populations build over several weeks prior to migration to commercial fruit.

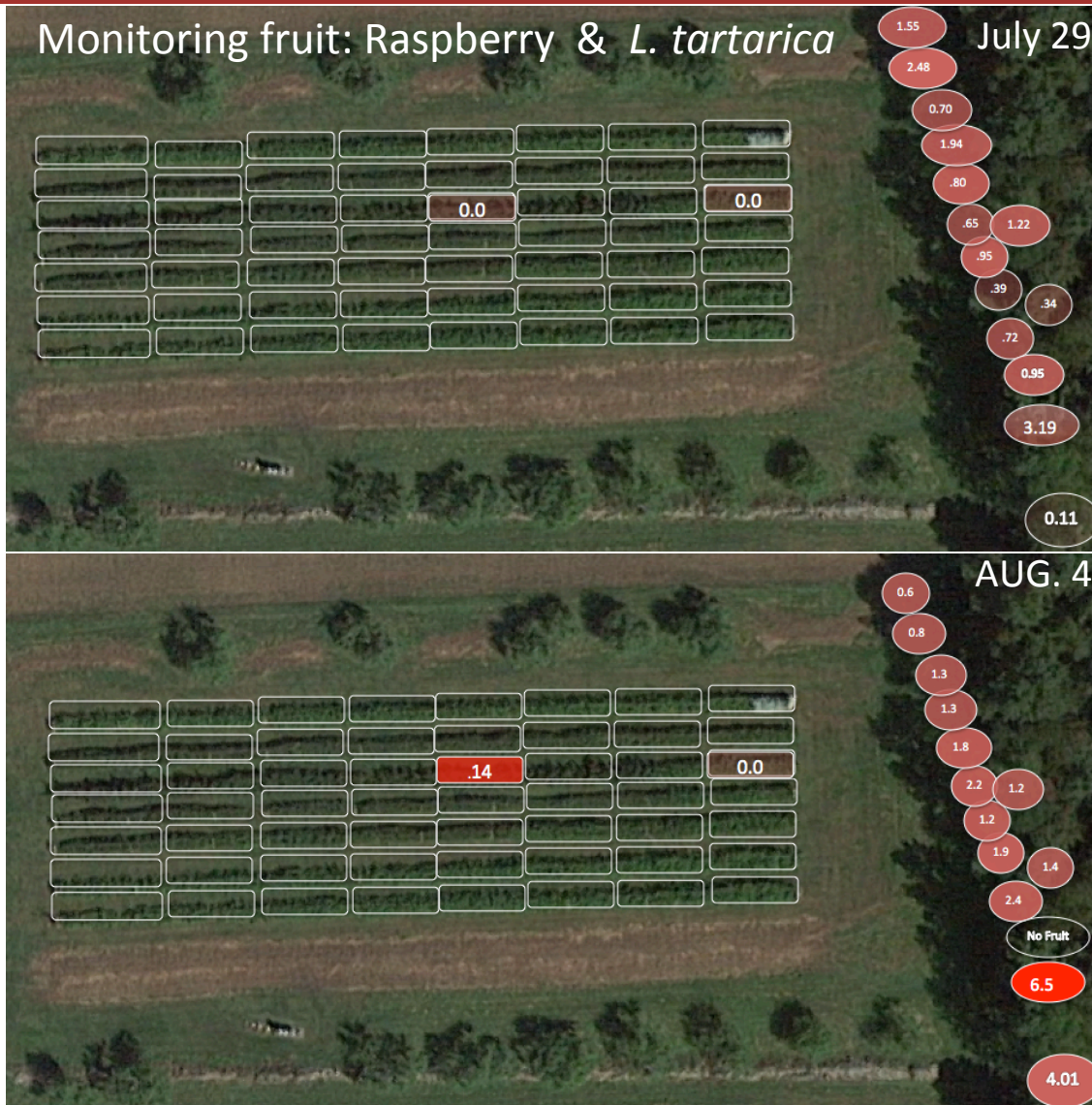


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SWD Attract and Kill Management 2015

Monitoring fruit: Raspberry & *L. tartarica*

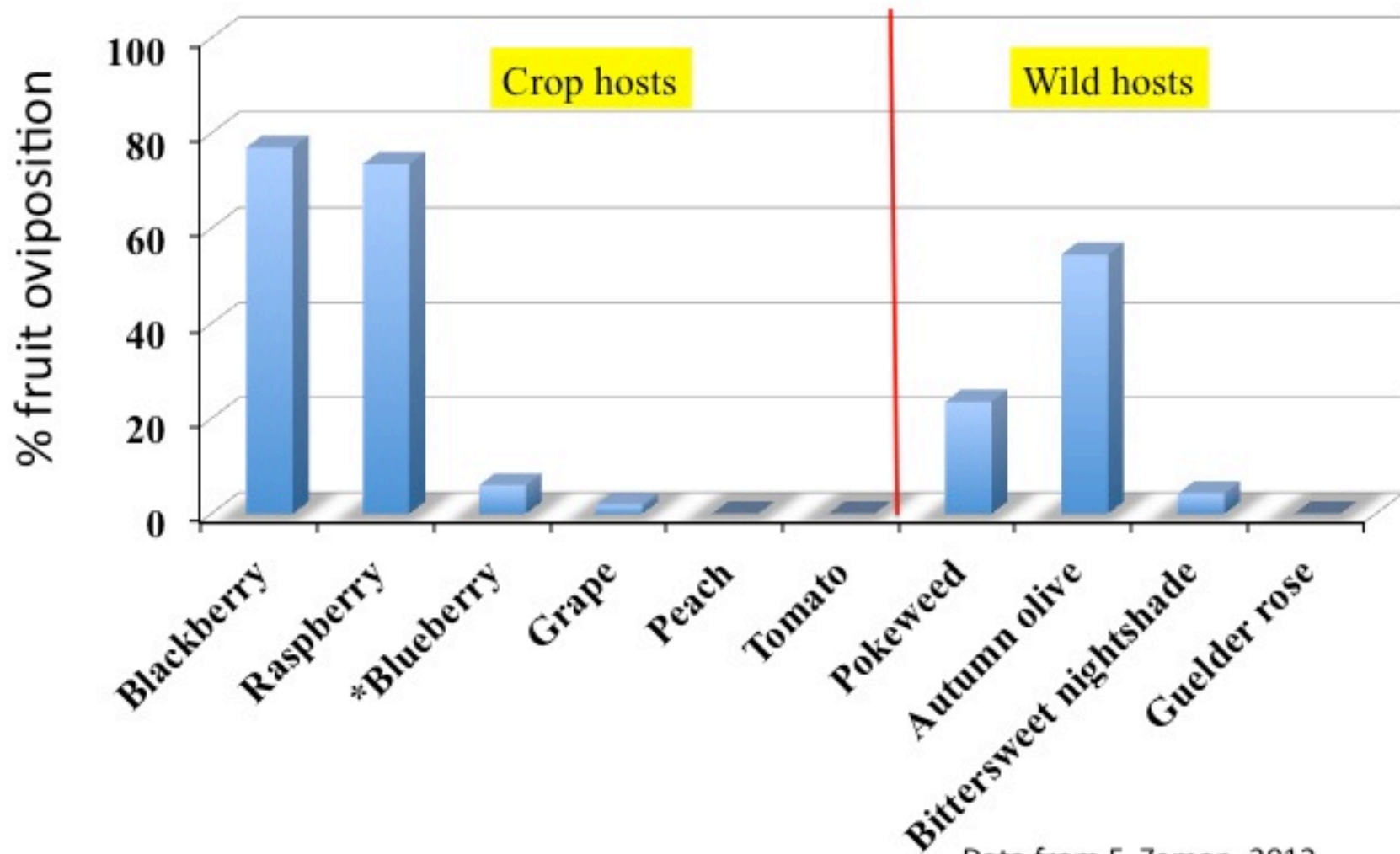


WestWind Farm

- First SWD eggs found in raspberry on 4 August.
- Raspberry collections taken through to the end of season.



Fruit and wild berries oviposited or egg laid by SWD -2012



Data from F. Zaman, 2012

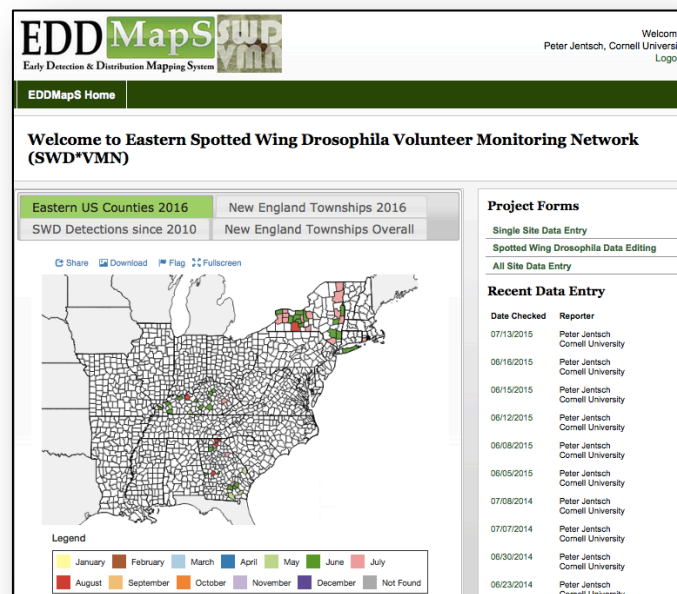
Sampling and Monitoring Protocols

Monitoring: Set traps in late May along wooded / hedgerow edge of crop
Check traps weekly for adult fly. (Scentry or Trace SWD trap and lure; \$15.00 ea.)

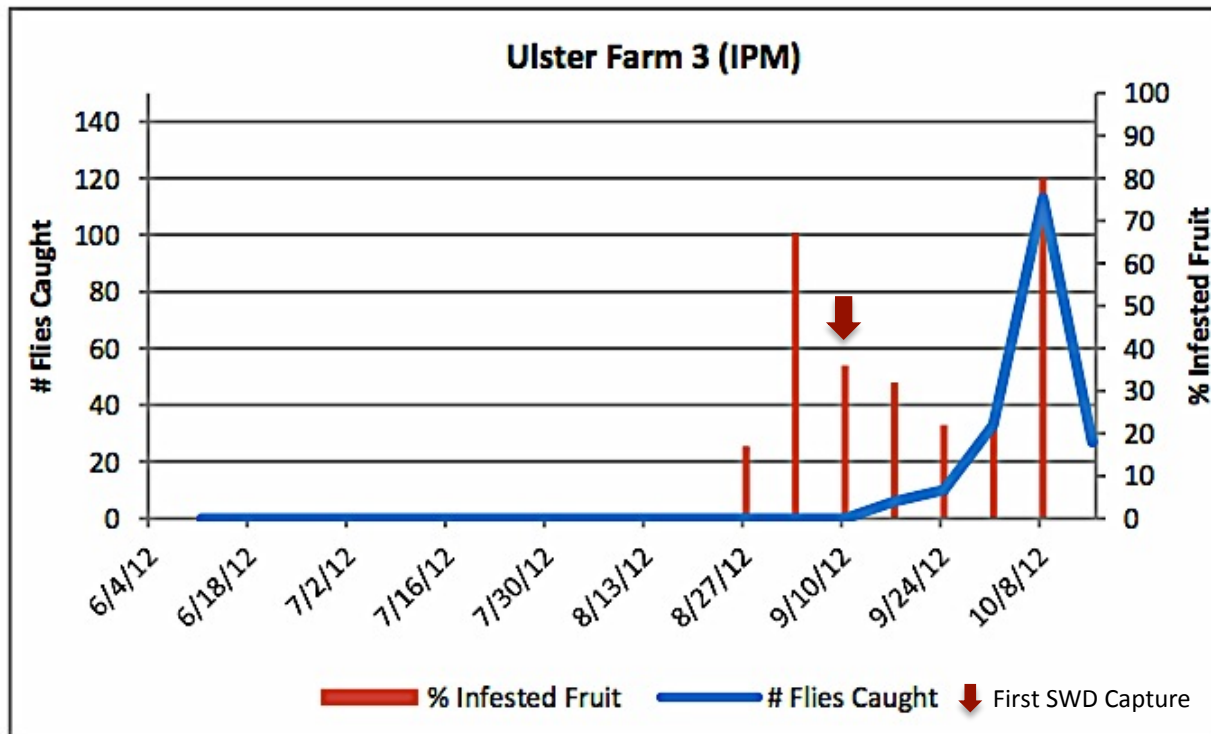
Extension Outreach: EDDMaps for first trap capture

Sampling: Sample 25 fruit from each of 4 edge plants to observe 1st eggs in fruit

Application: Begin at 1st observation of egg laying.



Monitoring SWD Using ACV on 6 Farms in the Hudson Valley Eastern, NY - 2012

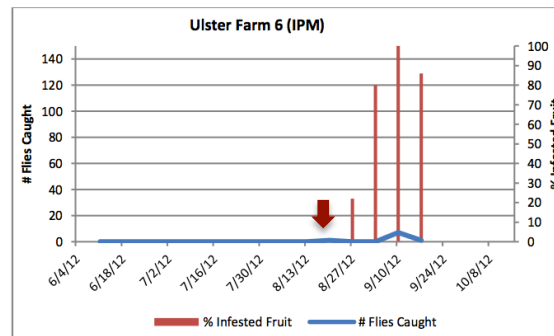
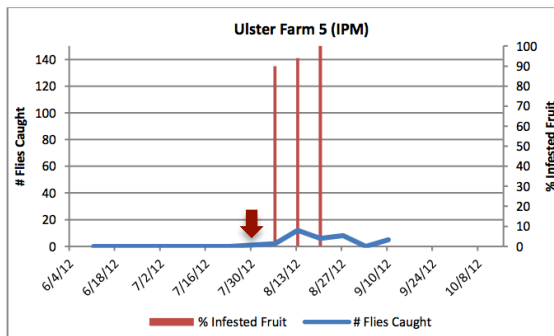
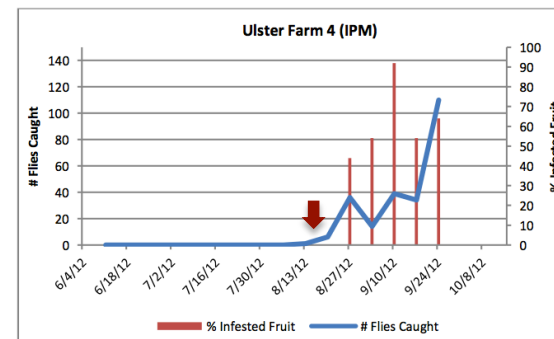
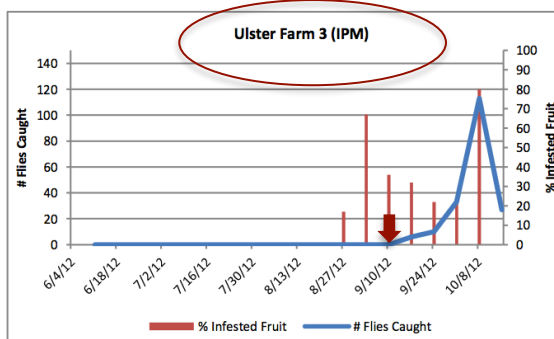
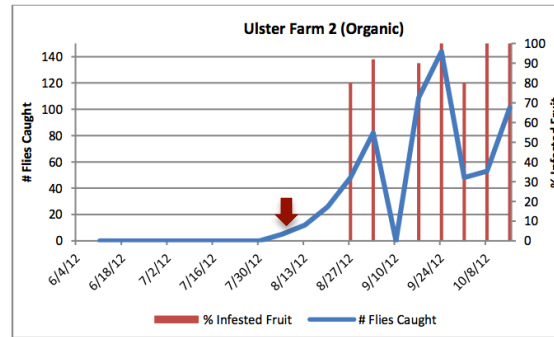
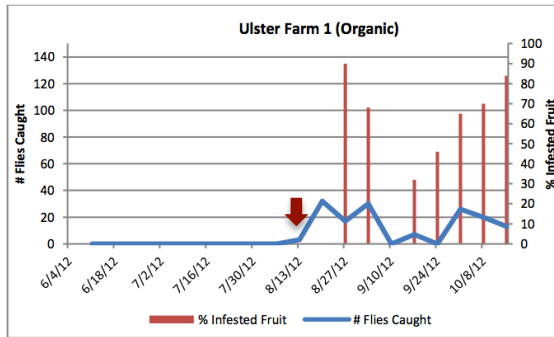


Monitoring & Fruit Injury

- SWD oviposition may precede adult trap captures in highly susceptible fruit production systems.



Monitoring SWD Using ACV on 6 Farms in the Hudson Valley Eastern, NY - 2012



Monitoring & Fruit Injury

- SWD oviposition may precede adult trap captures in fruit production systems.
- Older traps were less attractive, allowing SWD damage prior to 1st adult trap capture.
- Newer traps have increased sensitivity to adult presence
- Both conventional and organic production systems contain raspberry fruit with SWD eggs & larva.



Managing Insecticide Resistance: Raspberry

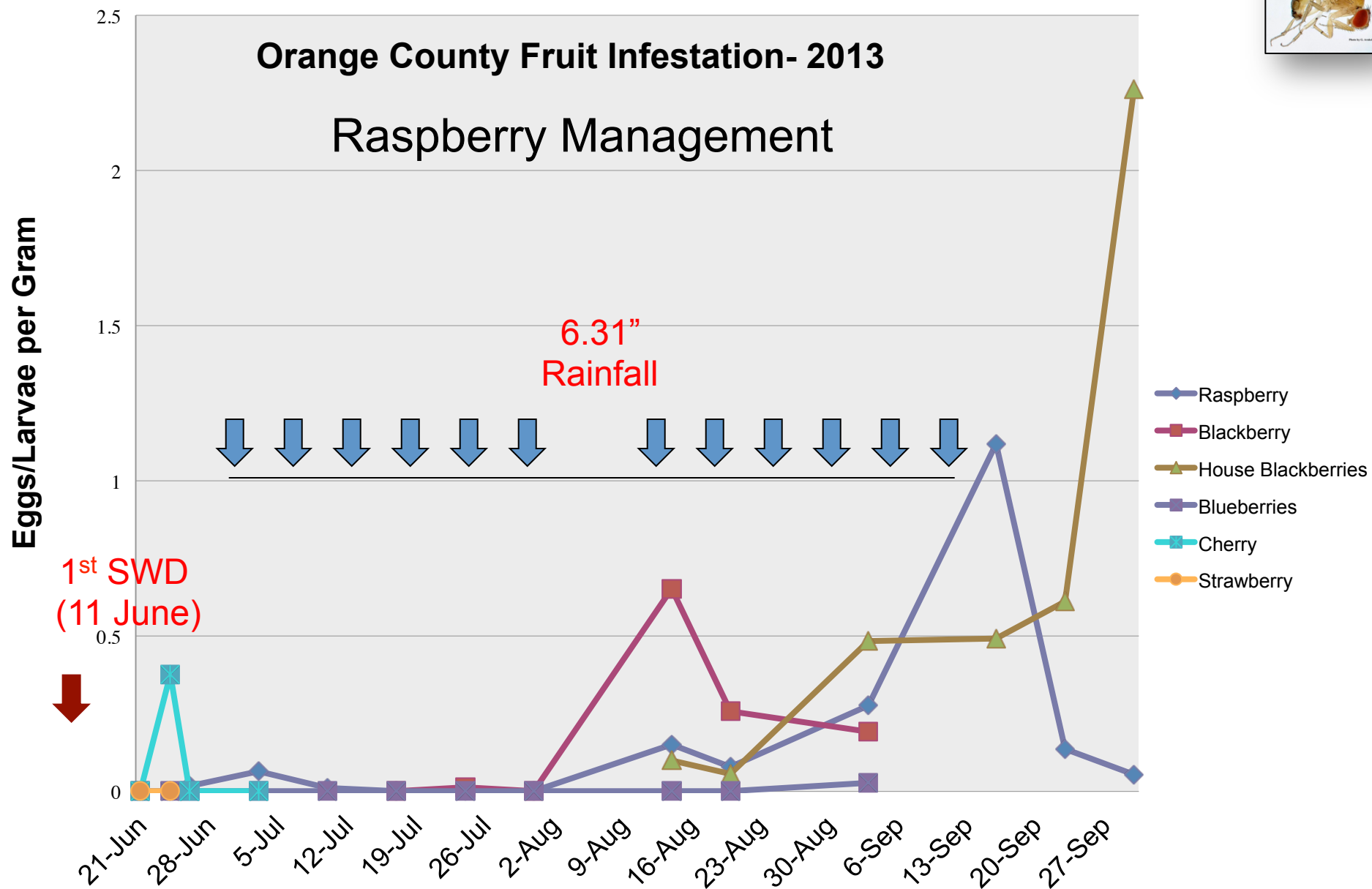


SWD Control in Mixed Small Fruit; Orange Co. 2012 Pick-Your Own Program

Date	Material	Rate	Commodity
27 June	Malathion 57	2 pts./A	Raspberry
1 July	Assail 30SG	5 oz./A	Raspberry
5 July	Malathion 57	2 pts./A	Raspberry
12 July	Delegate 25WDG	3 oz./A	Raspberry
14 July	Brigade	8 oz./A	Raspberry
19 July	Assail 30SG	5 oz./A	Raspberry
22 July	Danitol	16 oz./A	Raspberry
27 July	Mustang Max	4 oz./A	Raspberry
30 July	Assail 30SG	5 oz./A	Raspberry
6.31" Rainfall; 6 day application interval			
5 August	Delegate 25WDG	3 oz./A	Raspberry
19 August	Brigade	8 oz./A	Raspberry

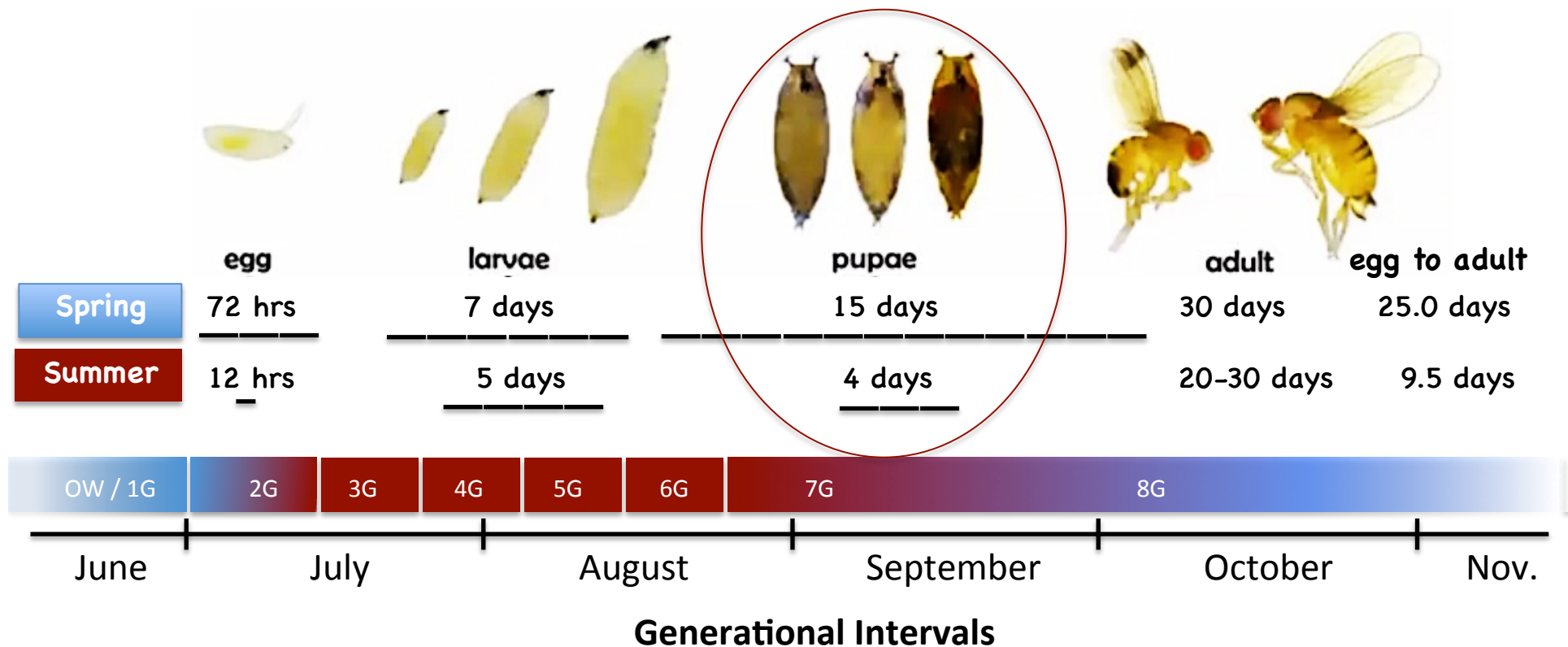


Managing Insecticide Resistance: Raspberry



Life Cycle of the Spotted Wing Drosophila *Drosophila suzukii* (Matsumurai)

- Earliest 1st emergence & trap capture on 22nd June, 2017
- ≥ 6 Generations / year
- 350 eggs per female
- Majority of the population at any time exist in the immature life stage
- 80% of pupa fall to the ground from fruit (blueberry); partially buried



Biological Control of Spotted Wing Drosophila

Most SWD pupae drop from the fruit and reside in the top 0.5 cm layer of soil.

Predators of SWD include:

- Ground beetle species (Carabidae)
- Field crickets (*Gryllus pennsylvanicus* Burmeister)
- Ants
- Harvestmen

Pupal predation rates in wild field blueberry were high, with higher rates of predation on exposed pupae compared to buried pupae.

Laboratory studies confirmed that ground beetles and field crickets are likely predators of *D. Suzukii* pupae.

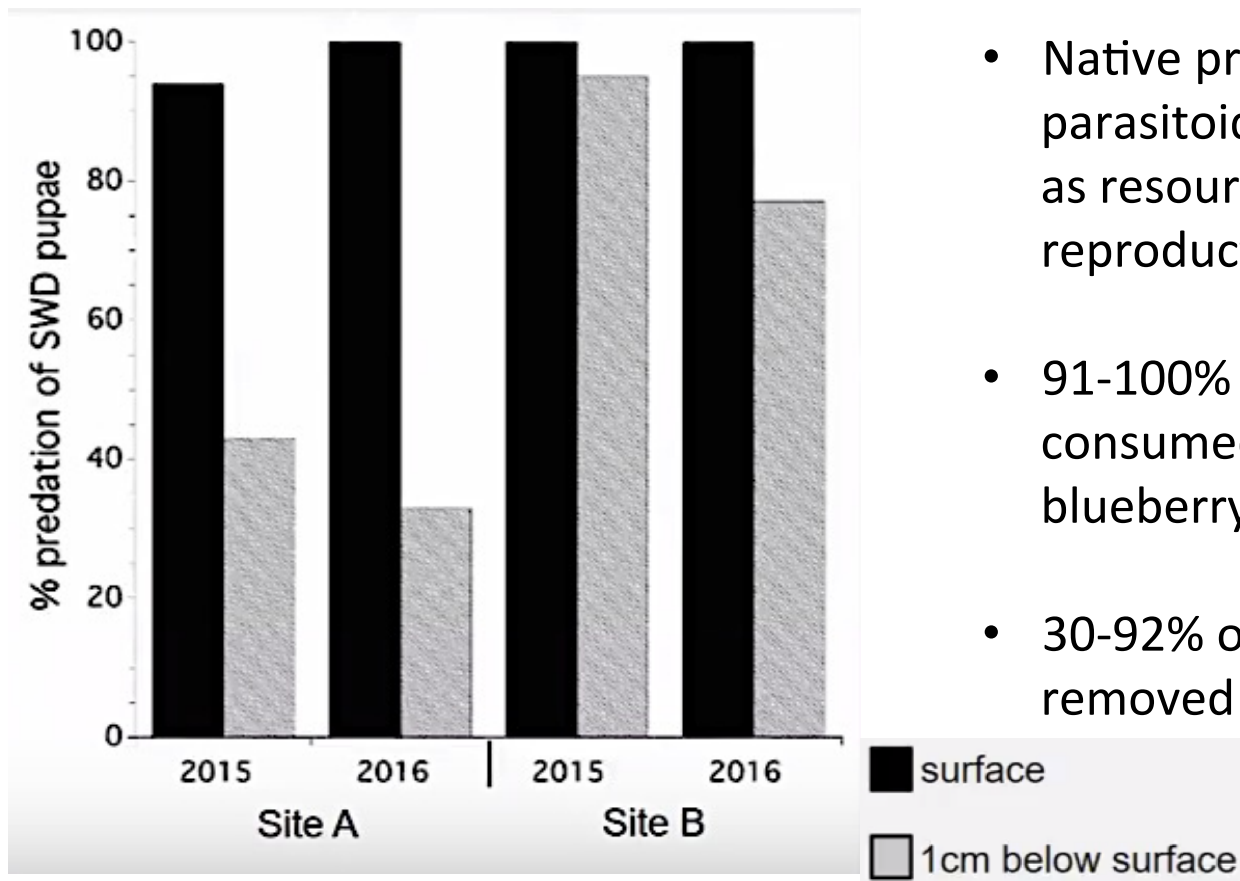
[J Econ Entomol.](#) 2017 Dec 5;110(6):2308-2317. doi: 10.1093/jee/tox233.

Pupation Behavior and Predation on *Drosophila Suzukii* (Diptera: Drosophilidae) Pupae in Maine Wild Blueberry Fields.

[Ballman ES](#)¹, [Collins JA](#)¹, [Drummond FA](#).



Biological Control of Spotted Wing Drosophila: Predator Feeding on SWD Pupa



- Native predators, native & Asian parasitoids utilize SWD larva and pupa as resources for feeding and reproduction.
- 91-100% of surface SWD pupa were consumed by predators in a wild blueberry study in Maine.
- 30-92% of buried SWD pupa were removed and consumed by predators.

J Econ Entomol. 2017 Dec 5;110(6):2308-2317. doi: 10.1093/jee/tox233.

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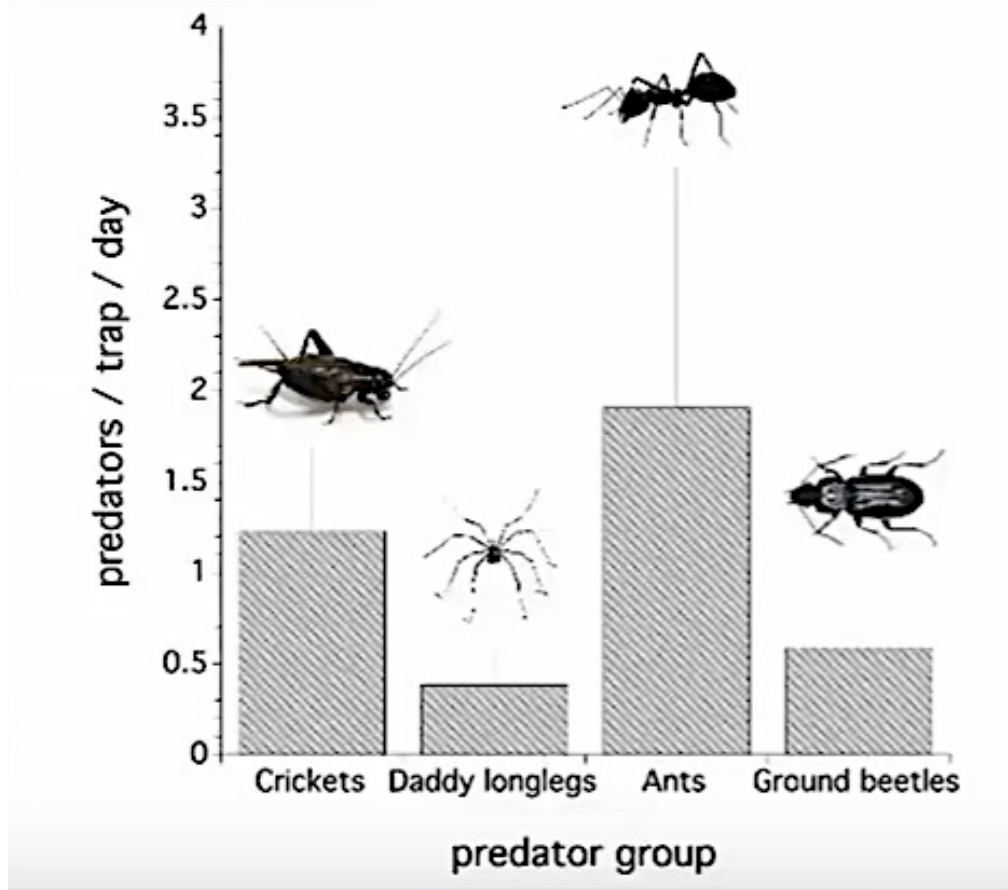
Ballman ES¹, Collins JA¹, Drummond FA.



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Biological Control of Spotted Wing Drosophila: Predator Feeding on SWD Pupa



In wild blueberry

- 61-91% of SWD Pupa removed by predation
- Ants remove and carry off pupa from soil

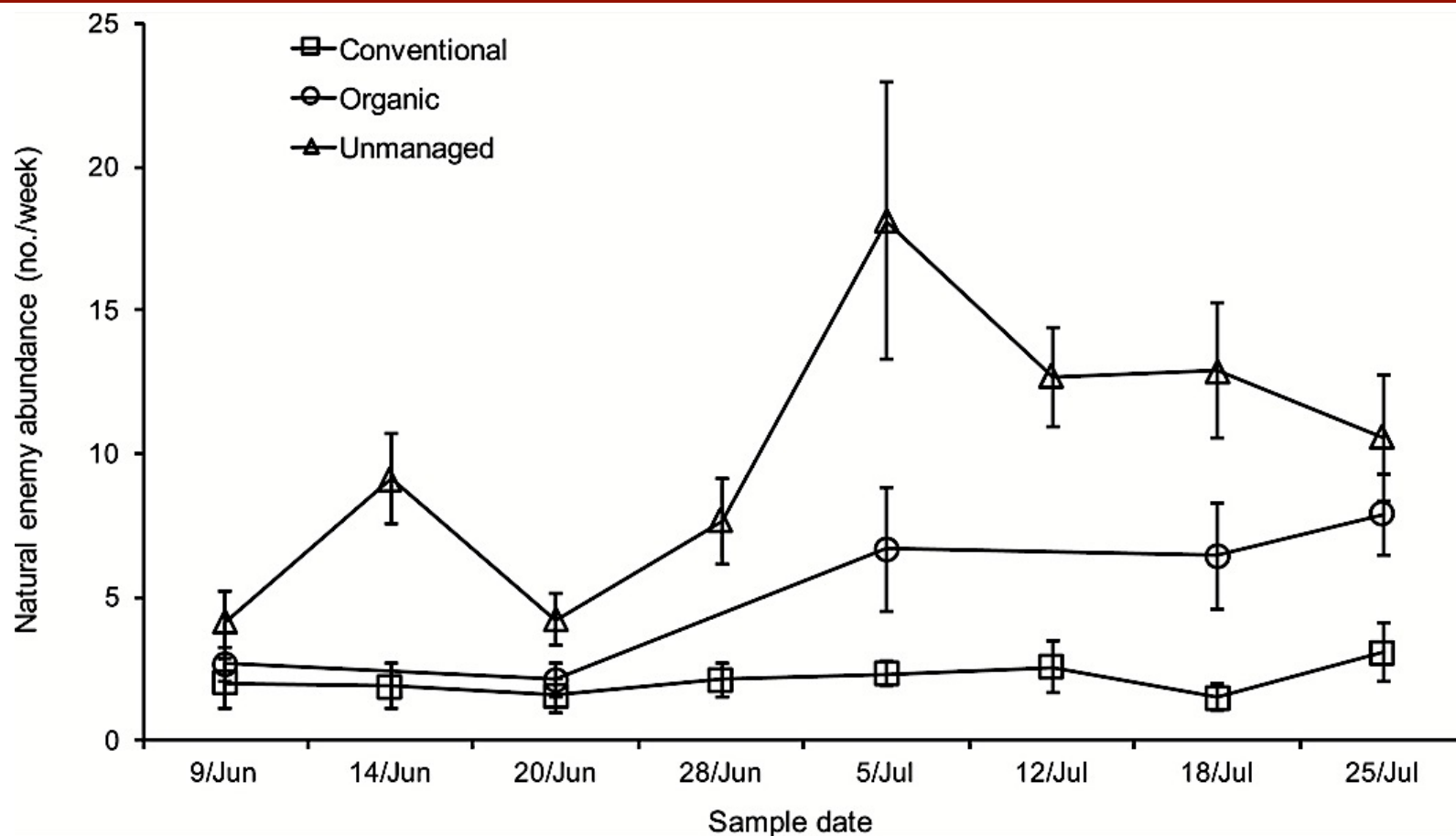
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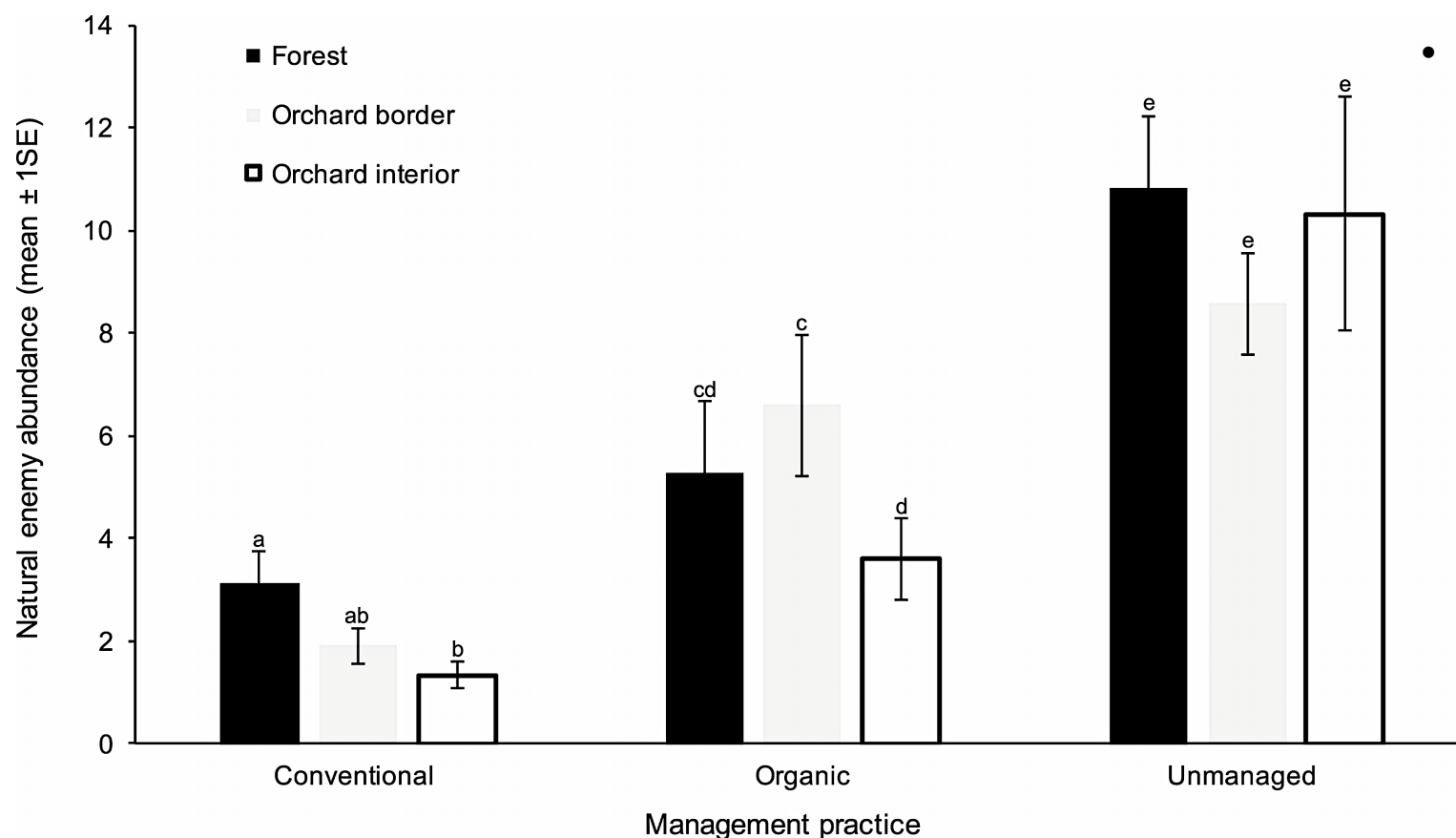
Biological Control of Spotted Wing Drosophila



Seasonal mean (± 1 SE) **natural enemy abundance** from suction samples pooled across transect and site to over time. Symbols represent corresponding management practice collected during the blueberry growing and harvest season.

Natural Enemy Abundance in Southeastern Blueberry Agroecosystems: Distance to Edge and Impact of Management Practices. T Seth Whitehouse Ashfaq A Sial Jason M Schmidt. *Environmental Entomology*, Volume 47, Issue 1, 8 February 2018, Pages 32–38, <https://doi.org/10.1093/ee/nvx188> 23 December 2017

Biological Control of Spotted Wing Drosophila



- 60% of pupa consumed in unmanaged plots

Georgia: Seasonal mean (± 1 SE) **natural enemy abundance** from suction samples pooled across transect and site to over time. Symbols represent corresponding management practice collected during the blueberry growing and harvest season.

Natural Enemy Abundance in Southeastern Blueberry Agroecosystems: Distance to Edge and Impact of Management Practices. T Seth Whitehouse Ashfaq A Sial Jason M Schmidt. *Environmental Entomology*, Volume 47, Issue 1, 8 February 2018, Pages 32–38, <https://doi.org/10.1093/ee/nvx188> 23 December 2017

Drosophila parasitoid, a pteromalid wasp attacks the pupal stage of the spotted wing drosophila.



Dr. Peter Shearer, OSU's Mid-Columbia Agricultural Research and Extension Center at Hood River

Biological Control of Spotted Wing Drosophila: Native Parasitoid Wasp Species

Larval parasitoids

Leptopilina boulardi



Leptopilina heterotoma



Leptopilina clavipes



Pupal parasitoids

Pachycrepoideus vindemmiae



Trichopria drosophilae



- Most SWD parasitism occurs in the non-crop environment
 - SWD is highly resistant to parasitism.
 - Larva & pupa can wall off the parasite egg by encapsulation (melanin)
- *****
- Collections of Asian parasitoids held in quarantine have demonstrated greatest specificity and highest potential for SWD bio- control



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Biological Control of Spotted Wing Drosophila

Family	Parasitoid species	Host	Country
Braconidae	<i>Asobara japonica</i>	SWD, other drosophilids	SK, CHN
	<i>Asobara leveri</i>	SWD, other drosophilids	SK, CHN
	<i>Asobara brevicauda</i>	SWD	SK
	<i>Asobara triangulata</i>	SWD	SK
	<i>Asobara mesocauda</i>	SWD	SK, CHN
	<i>Asobara unicolorata</i>	SWD	CHN
	<i>Asobara</i> spp.	SWD	CHN
Figitidae	<i>Ganaspis brasiliensis</i>	SWD	SK, CHN
	<i>Leptopilina japonica</i>	SWD	SK, CHN
	<i>Leptopilina formosana</i>	SWD, other drosophilids	SK
	<i>Leptopilina boulardi</i>	Other drosophilids	SK
	<i>Leptopilina</i> spp.	SWD	CHN
Pteromalidae	<i>Pachycrepoideus vindemiae</i>	Other drosophilids	SK
Diapriidae	<i>Trichopria drosophilae</i>	SWD, other drosophilids	SK, CHN



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Research Assistant	Lucas Canino
Research Assistant	Ben Lee
Research Assistant	Addie Kurchin
Summer Research Intern	Cameron Fuhr
Farm Manager	Albert Woelfersheim
Administrative Assistant	Erica Kane
Administrative Assistant	Christine Kane
HRVL & NEWA Weather Data.....	Christopher Leffelman, Albert Woelfersheim

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Questions??

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