SWD preparation and response

Rufus Isaacs
Department of Entomology
Michigan State University

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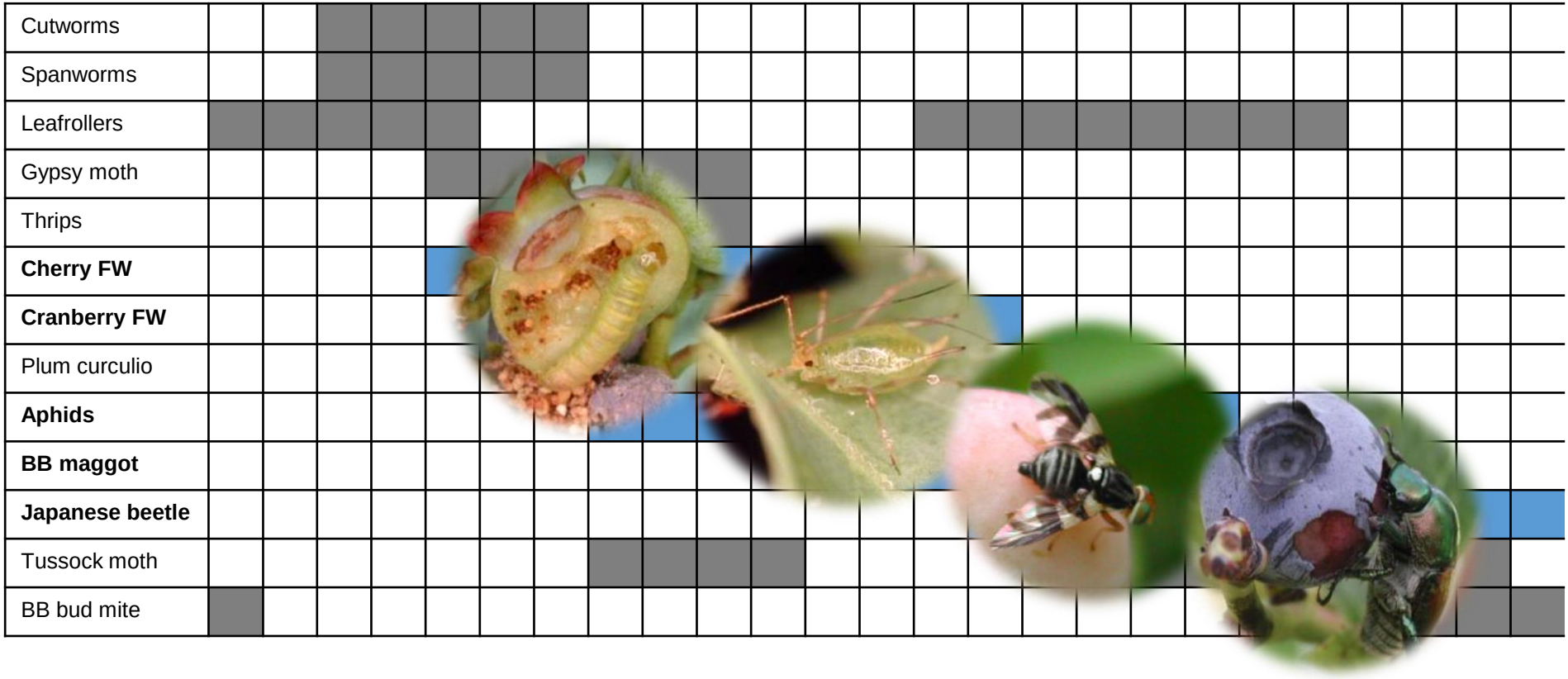
Michigan fruit agriculture

- 7,500 Ha and 0.5 M kg of blueberries
- 4,000 acres of grapes and ~120 wineries
- Strawberry, raspberry, and blackberry
- 125 M kg of cherries (sour and sweet)
- 500 tonnes of apples, from 800 farms
- Second most diverse agricultural state

Seasonal blueberry pest timing

Growth stage	pre-bloom	bloom	mid-season	pre-harvest	harvest	post-harvest

Degree days base 50 F from March 1	100	300	400	700	1100	1300	1900	2500



Bars show period when scouting and management of the pest is most important. Blue = key pest

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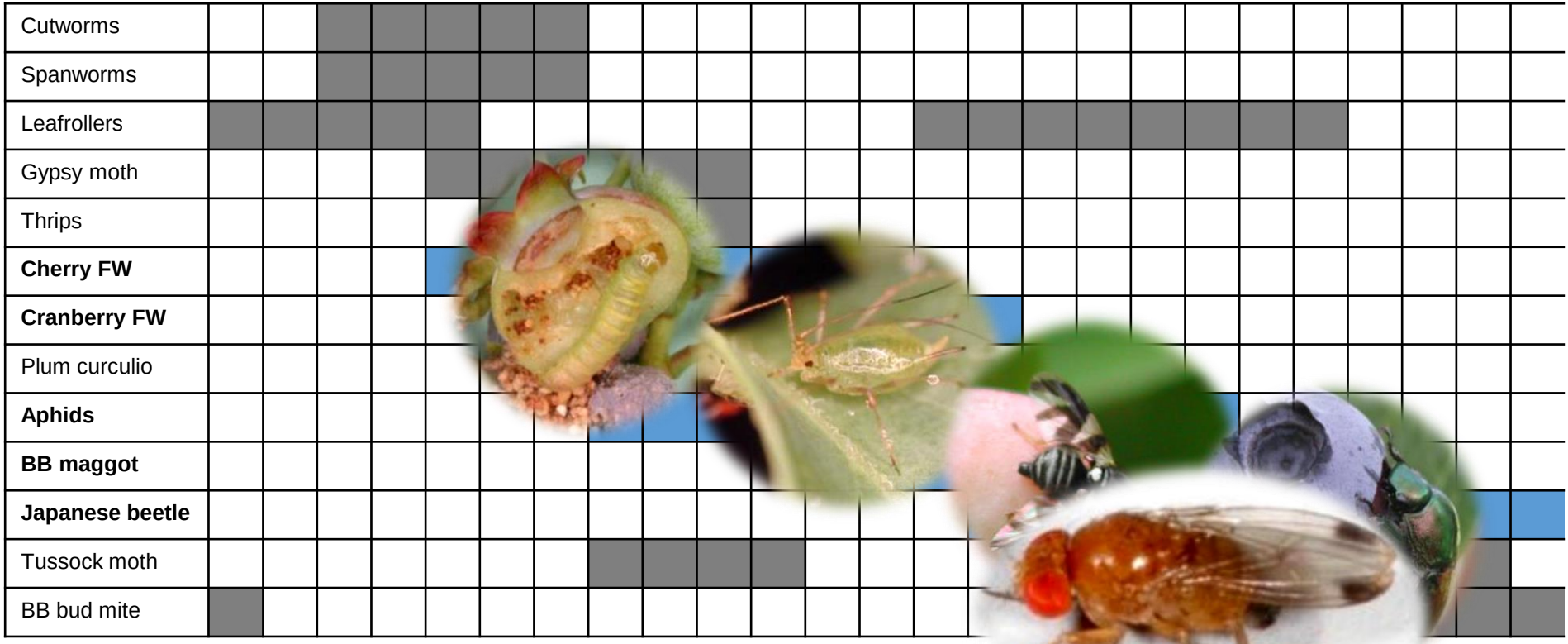

Bars show period when scouting and management of the pest is most important. Blue = key pest

SWD distribution - first 6 years

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The Boston Globe and Hannah Burrack, NCSU

hollandsentinel.com

September 2010

Exotic fly found in Allegan County

CONTRIBUTED

Experts: Spotted wing drosophila not a major threat

By Lisa.Ermak
@hollandsentinel.com
(616) 546-4219

A recent discovery of an invasive pest in Allegan County has small fruit growers on alert, but experts say

ONLY IN PRINT

in a fruit field.

"It was a big heads-up," he said.

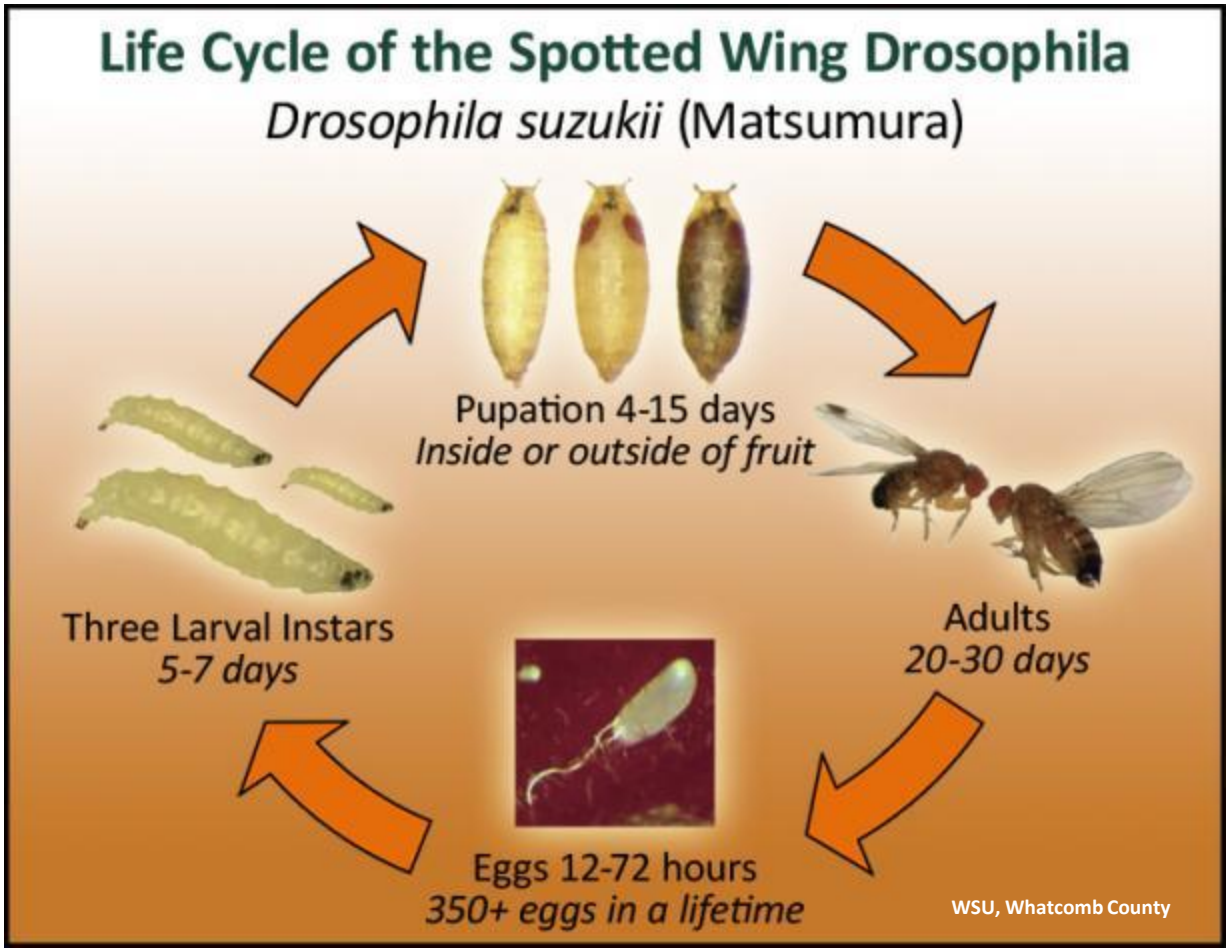
The insect first appeared in the U.S. in 2008 and, Rapid Response Program, which helped researchers find the fly in 13 counties in 2010.

Most of the flies were found in the southern part of the state in backyard gardens and outside of blue-

ment of Agriculture, said it is important to note the pest has not yet been detected in any crop fields, but they are ready to assist fruit growers if they do find the pest.

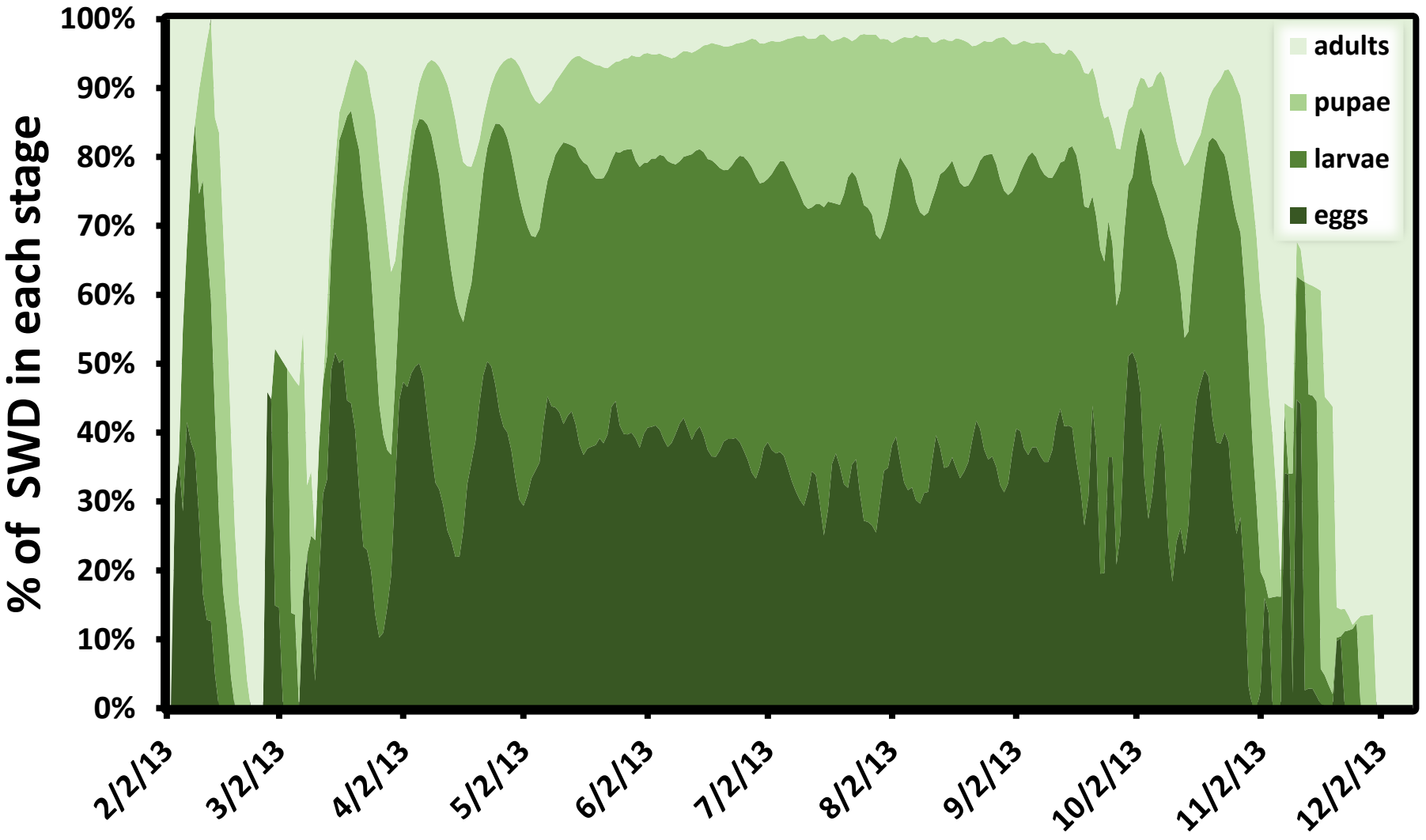
"Right now, our role is to facilitate getting the right

Life cycle of SWD



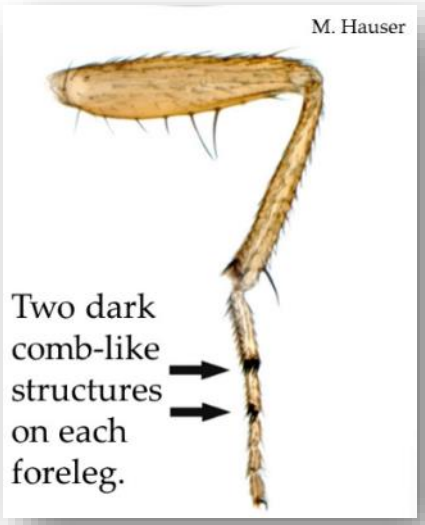
- This is NOT just another fruit fly!
- Optimal development at 65-70°F, **~12 day** generation time.
- Adult flies live for 3-6 weeks, and females can lay over 300 eggs.
- Female fly lays eggs into ripening fruit.
- Limited by summer heat and winter cold.

SWD population structure



Adapted from Wiman et al. (2014). Integrating temperature-dependent life table data into a matrix projection model for *Drosophila suzukii* population estimation . PLoS ONE.

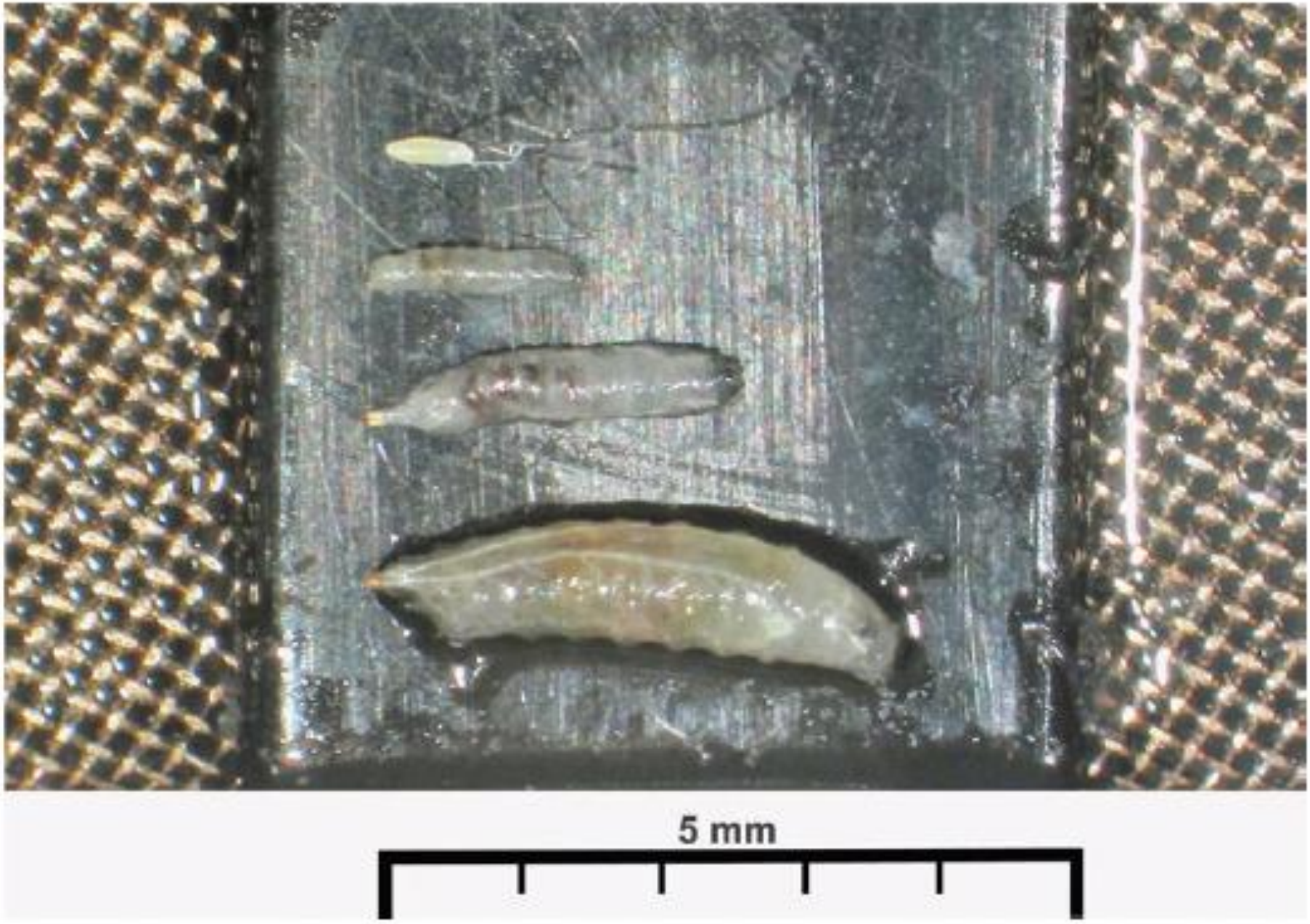
Identification



Wing pattern and leg combs (M)

Well-developed ovipositor (F)

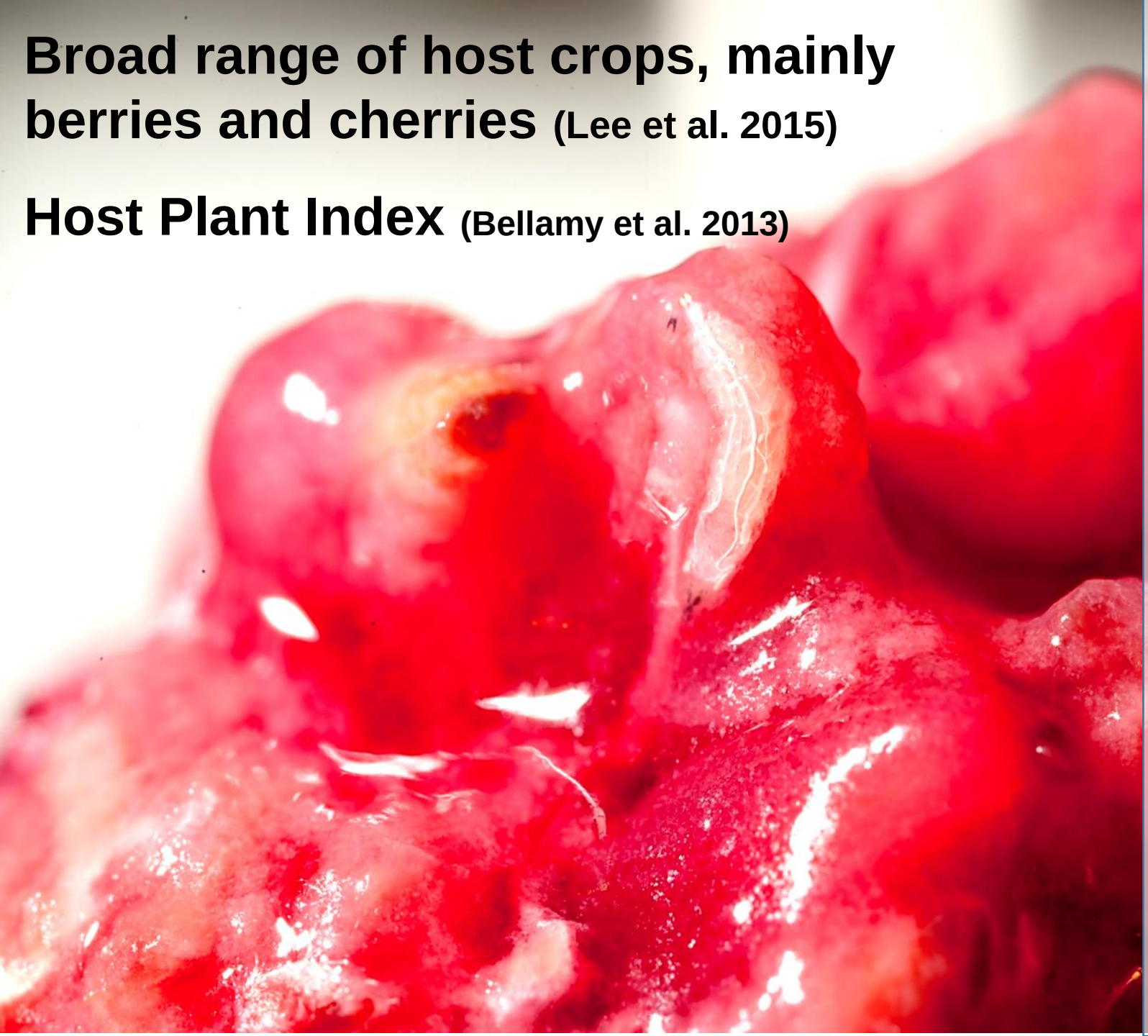
http://www.canr.msu.edu/ipm/uploads/files/MSU-SWD-ID.pdf



Van Timmeren et al. 2017

Broad range of host crops, mainly berries and cherries (Lee et al. 2015)

Host Plant Index (Bellamy et al. 2013)



Non-crop plants as hosts for SWD



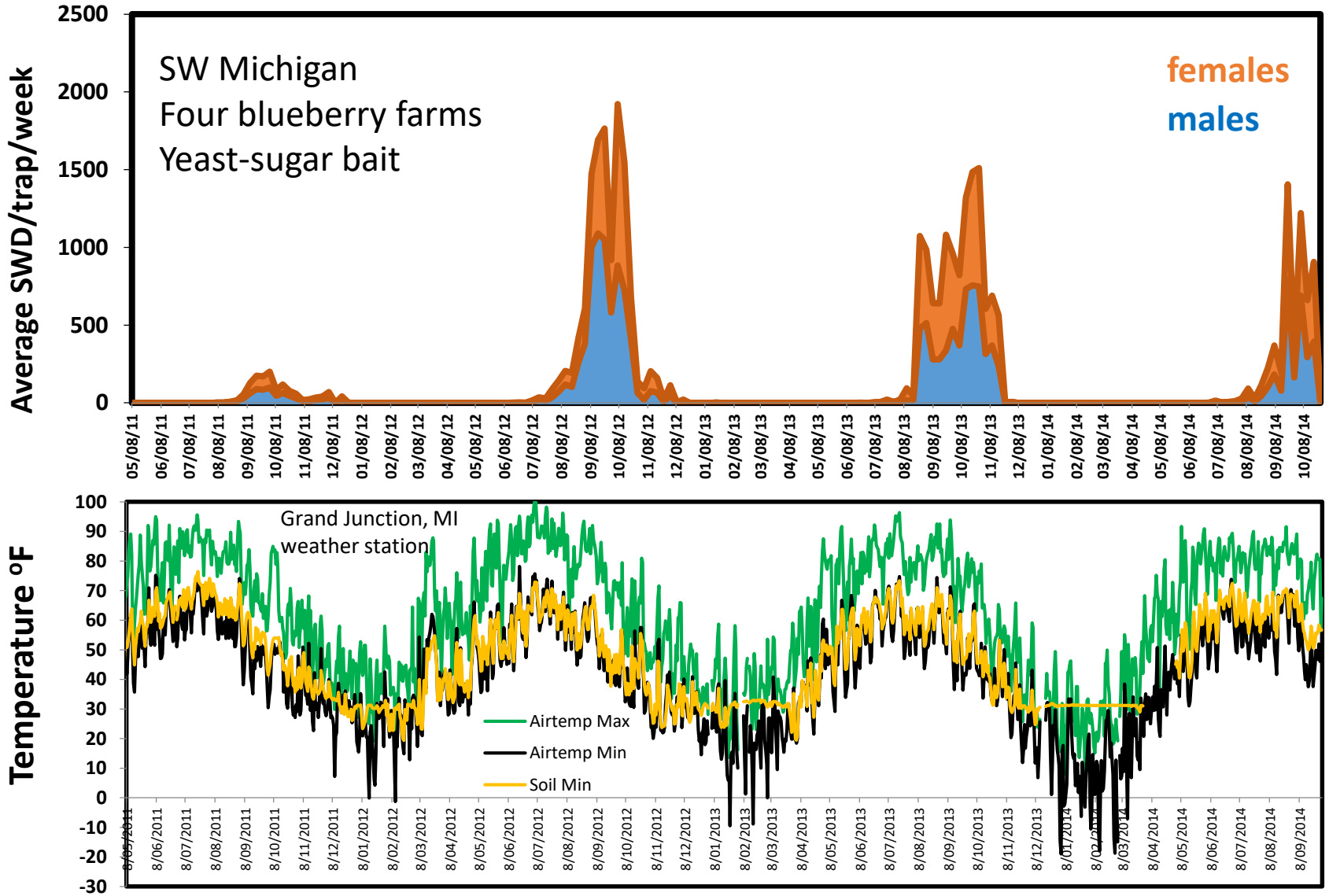




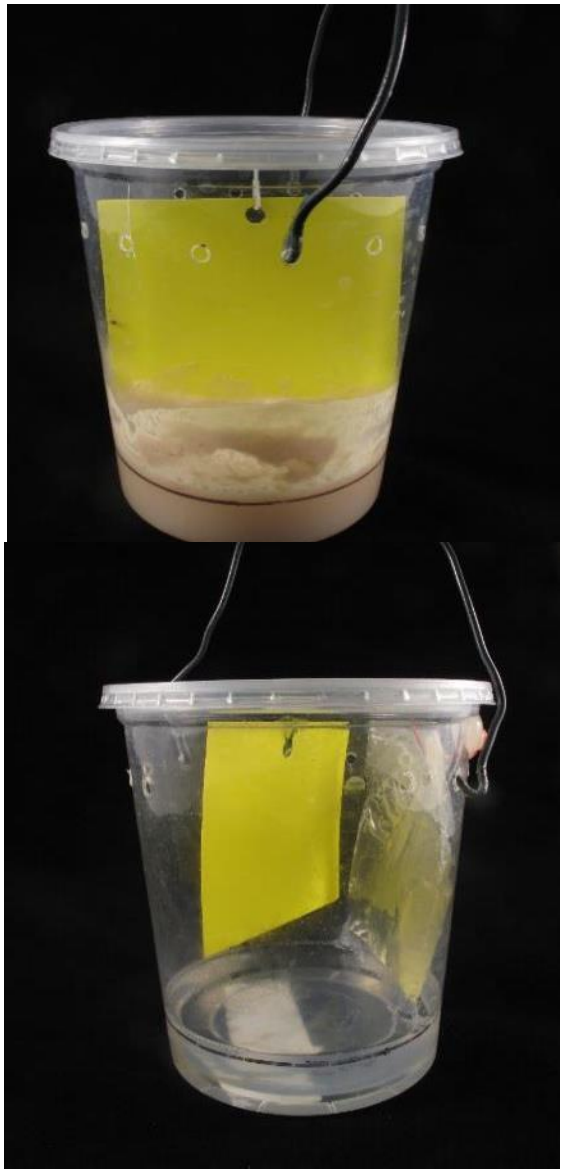

Common name	Scientific name	Ripe fruit period
Honeysuckle	*Lonicera* spp.	7/1 – 10/7
Common blackberry	*Rubus* sp.	7/8 – 9/16
Bittersweet nightshade	*Solanum dulcamara*	7/21 – 10/3
Stiff dogwood	*Cornus foemina*	8/19 – 10/6
Elderberry	*Sambucus canad.*	8/15 - 9/20
American pokeweed	*Phytolacca americ.*	8/26 – 10/7
Silky dogwood	*Cornus amomum*	8/29 – 10/7
Spicebush	*Lindera benzoin*	9/8 – 10/7
Autumn olive	*Elaeagnus umbellata*	9/8 – 10/6

Longer list in Lee et al. (2015) Annals Ent. Soc. America
See also: https://eorganic.info/sites/eorganic.info/files/u461/SWD-hostlist-by_reference.pdf

2011-2014 season SWD catches



Traps provide early warning of activity, relative pest pressure, and trends through summer

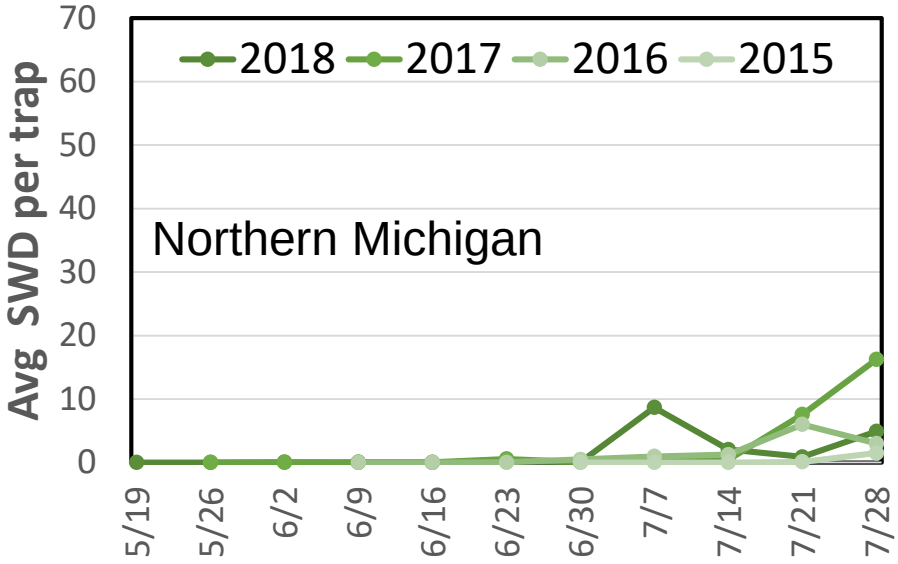


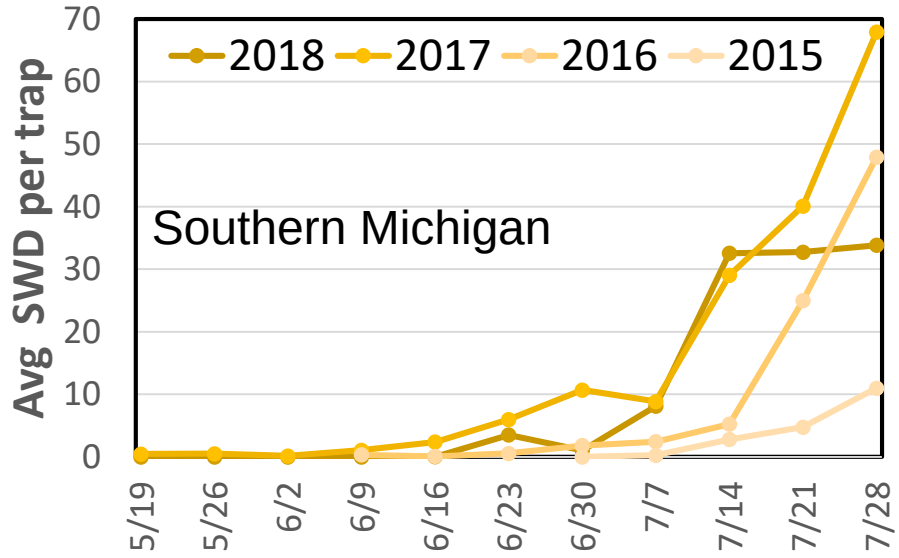
Plastic container with small holes

Yeast & sugar bait (top)
Cheap, more selective, but messy

Commercial lures (bottom)
More $$, less selective, but cleaner

MSU Extension SWD trap network





- Deploy traps in mid-May
- Traps in wild areas and crop
- Check weekly
- Females more common in spring
- Weak catch-infestation correlation
- Risk of false negatives, early season

Michigan spotted wing Drosophila update – July 17, 2018

Levels of SWD in traps continue to rise in southern Michigan, are leveling off mid-state, and dipping a bit in the north.

July 17, 2018 - Author: Julianna Wilson , Rufus Isaacs , Larry Gut

This week the number of spotted wing drosophila (SWD) caught in traps doubled overall, continuing to rise at southern sites, leveling off at central sites, and dipping a bit at northern sites being monitored in Michigan's fruit production areas. Ninety-five sites across 20 counties were monitored for SWD with an average of 36 flies per trap at southern sites, 13 flies per trap at central sites, and two flies per trap at northern sites.

Adult SWD. Photo by MSU AgBioResearch.

Sampling fruit with salt-and-filter method

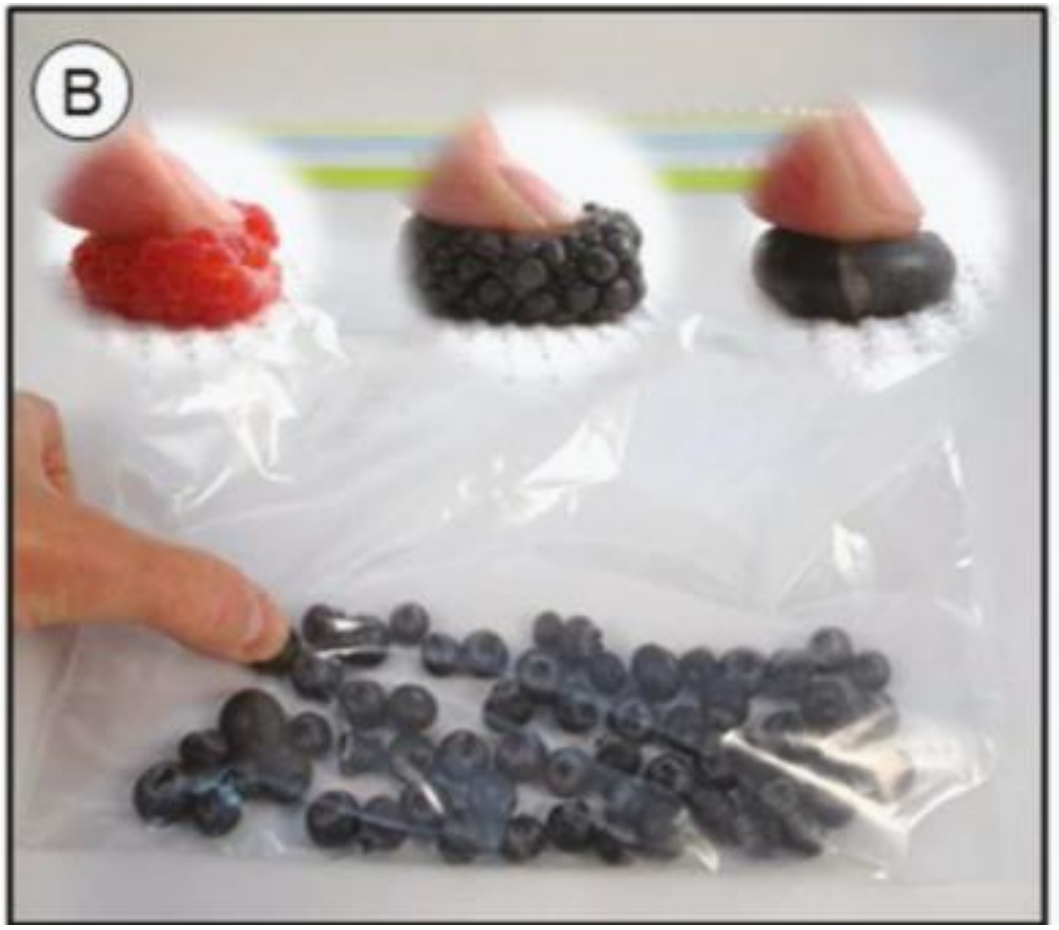
Informs harvest, spray, and marketing decisions

Collect fruit samples to understand intensity and stage of infestation

Van Timmeren et al. 2017

Lightly crush fruit

-DO NOT SMASH



Van Timmeren et al. 2017

Add salt solution

1 cup salt: 1 gal water

Sit for ~1 hour

Van Timmeren et al. 2017

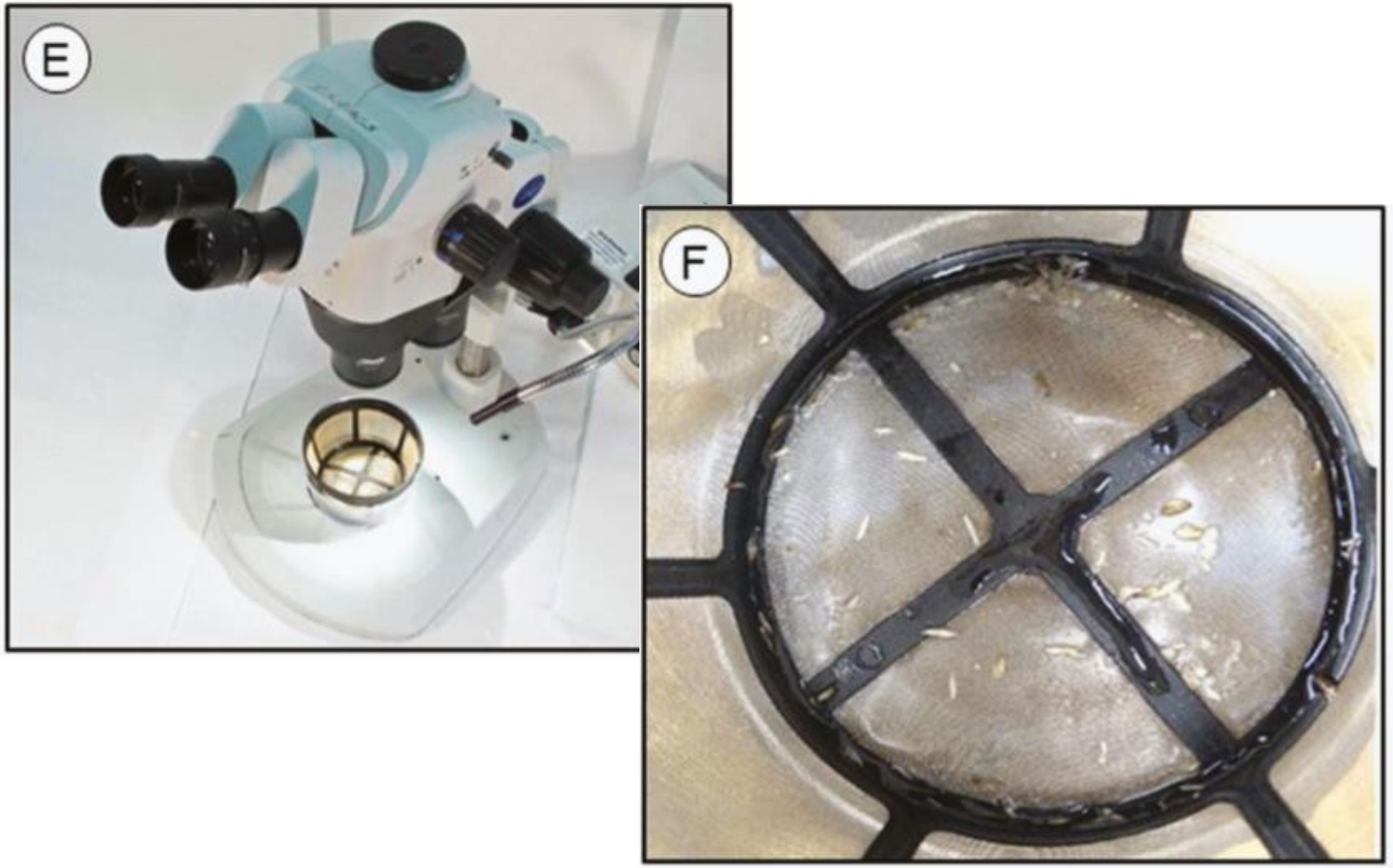
Separate the fruit, and filter the larvae

course filter (fruit)

fine filter (larvae)

Van Timmeren et al. 2017

Count & ID larvae



Van Timmeren et al. 2017

SWD pest pressure affected by…

- **Environment**
  Number of days below 0^{o}C affects populations
  Low spring temperature delays first catch
  High temperatures (over 30^{o}C) reduce activity
  Low humidity reduces infestation

- **Horticultural practices**
  Pruning
  Growing system
  Netting

- **Pest management**
  Biological control
  Chemical control

Does field management affect SWD?

Wood chips

Weed fabric

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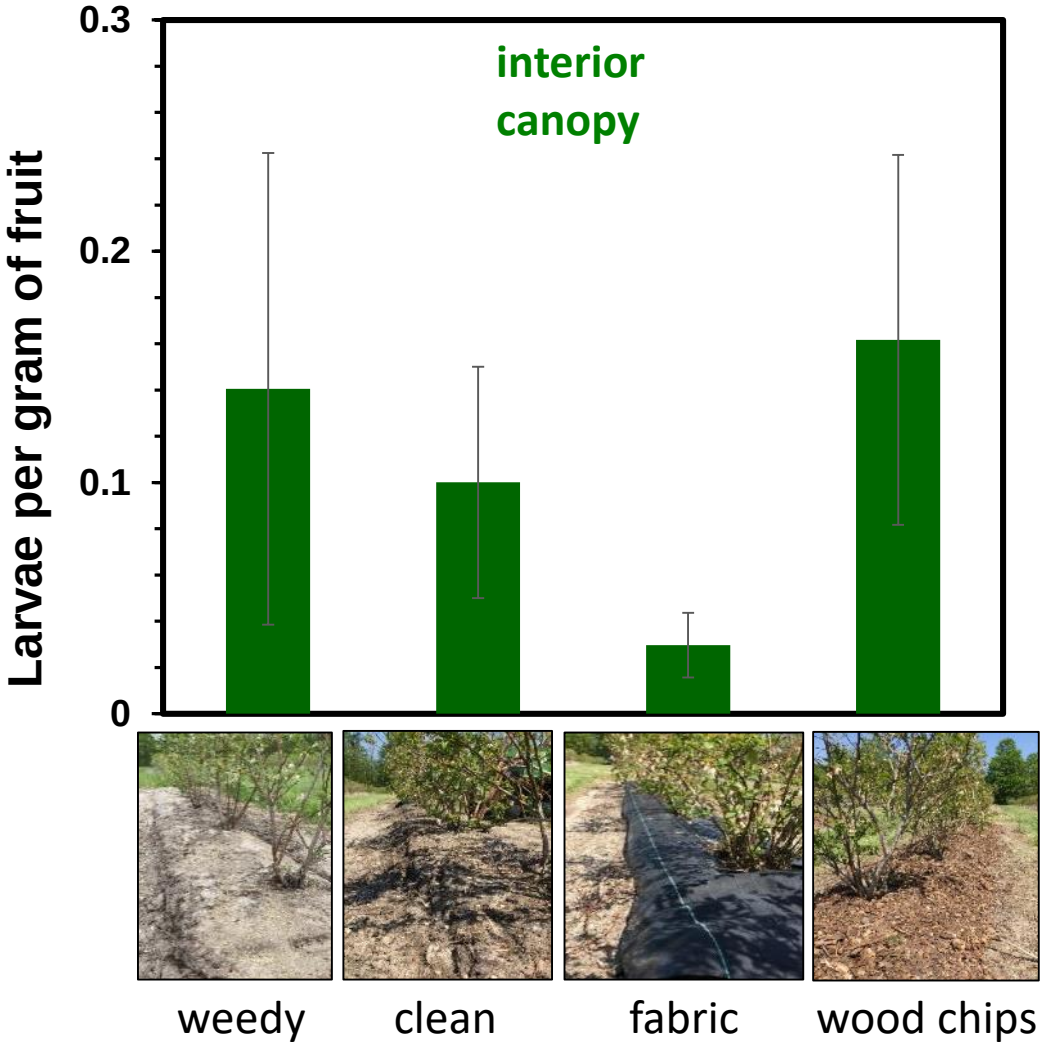
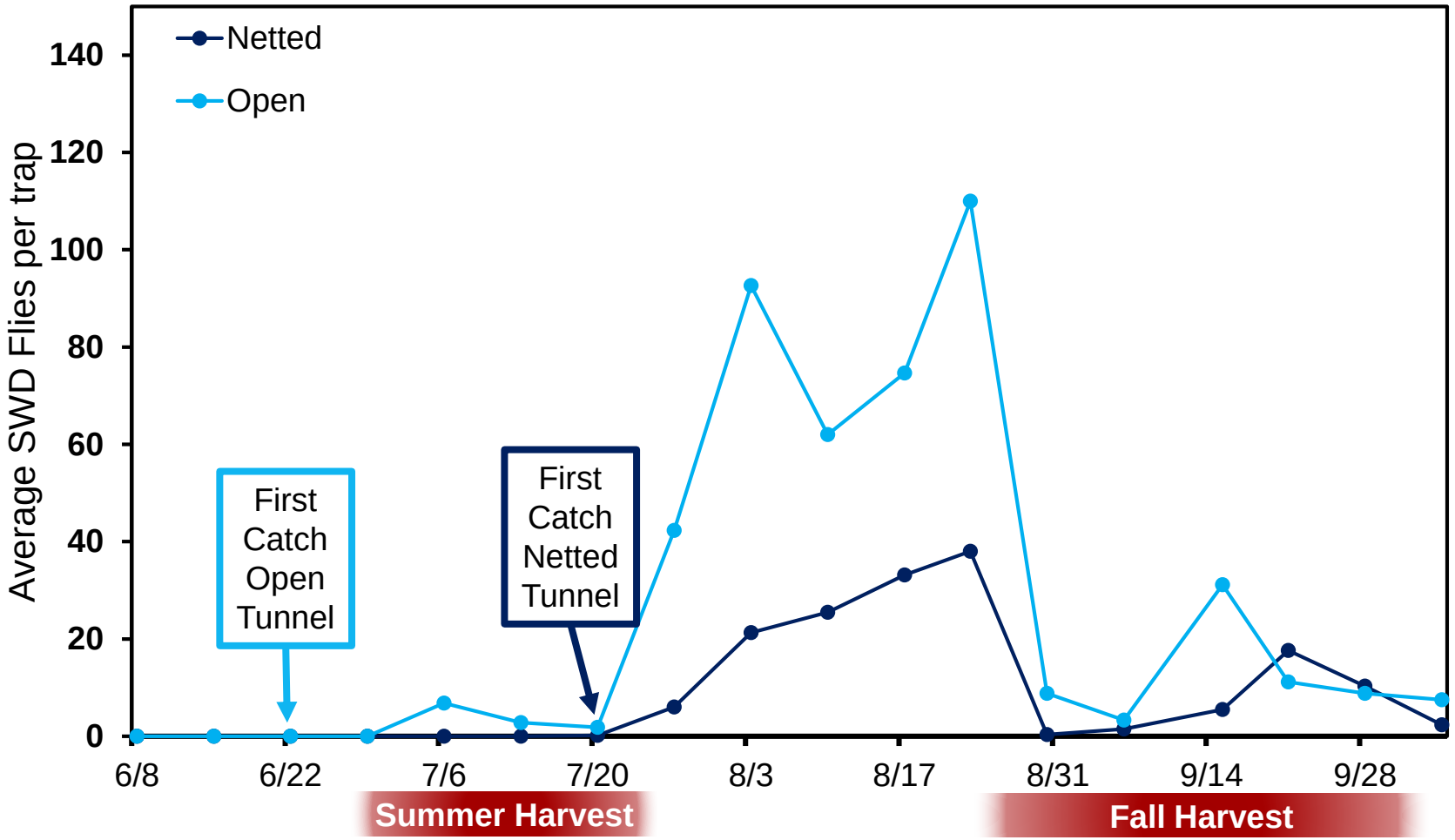
Black weed fabric delays and reduces SWD

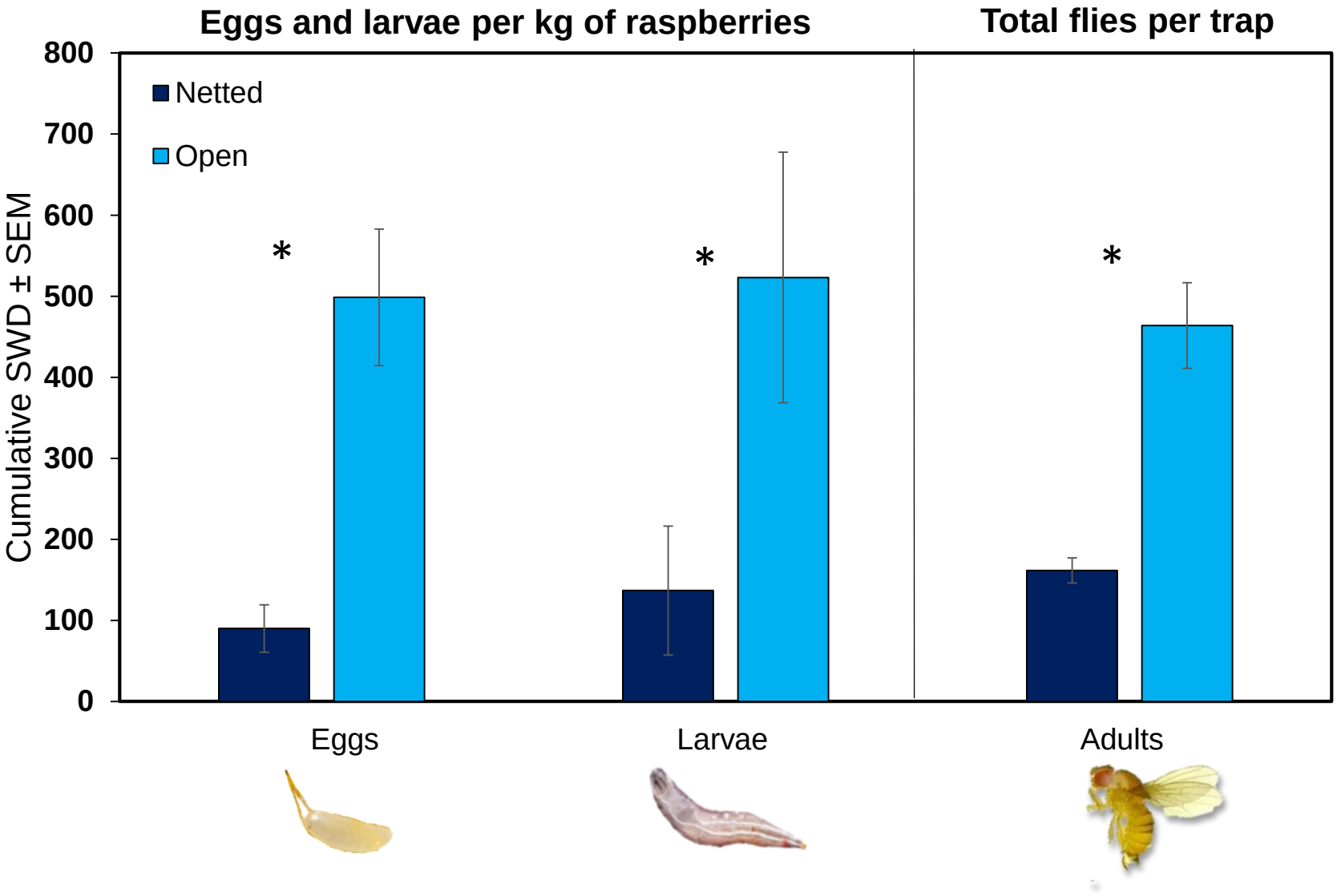


Exclusion netting in commercial raspberries

Exclusion netting reduced and delayed SWD



Exclusion netting reduced SWD infestation



Asterisk denote treatments are significantly different at α = 0.05

Dale Ila-Riggs,
New York berry grower

the Berry Patch

2 of 5 years - 0% blueberry infestation

Backup of attract+kill spheres

Harvest frequency

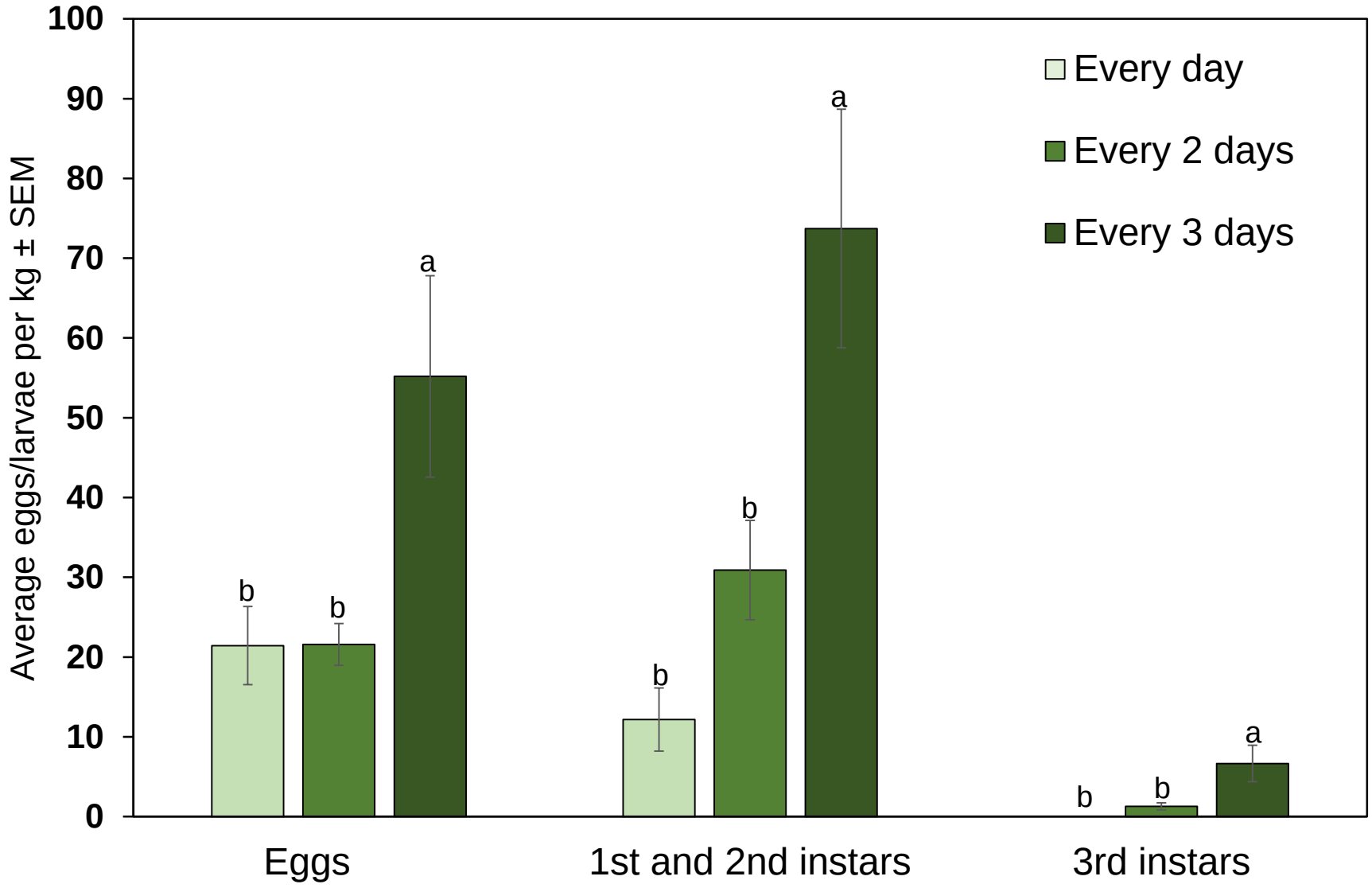
Harvesting is a powerful tool for disrupting the SWD life cycle

High tunnel organic raspberries

Harvested ripe berries every 1, 2, or 3 days

Compared SWD infestation

Increasing harvest frequency reduces detectable larvae

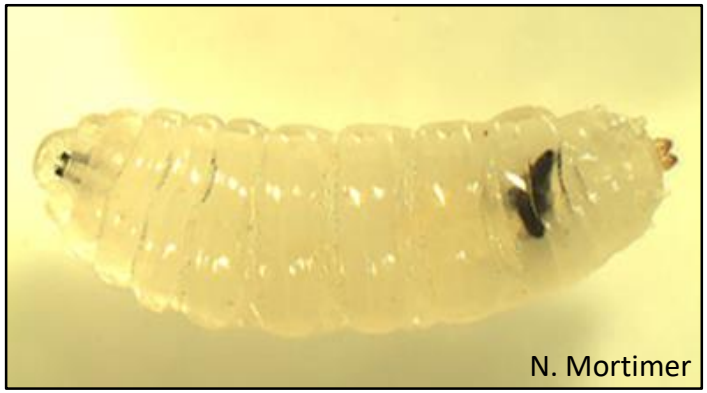


Two main native parasitic wasp species known to attack SWD in US

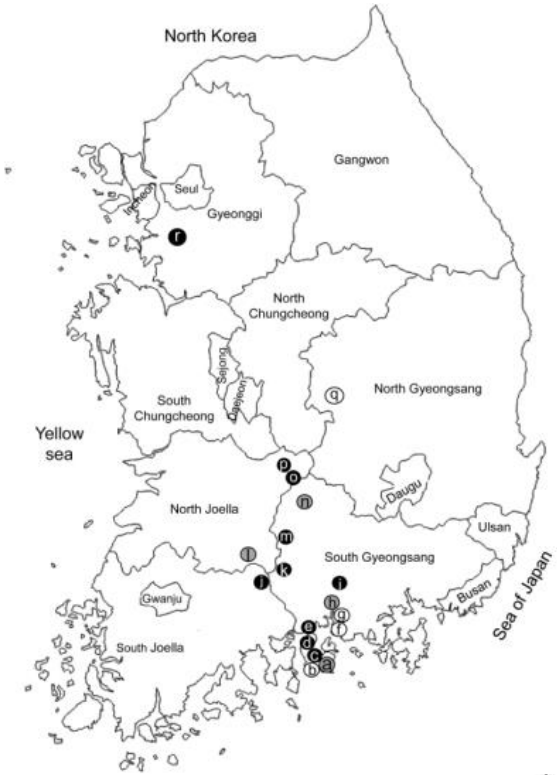
***Pachycrepoideus vindemiae* (Pteromalidae)**
Successful parasitism, very low levels in field (<2%)

***Trichopria drosophilae* (Diapriidae)**
Successful parasitism, very low levels in field (<2%)

UC Berkeley & USDA-ARS petitioned to release SWD parasitoids wasps from China. In revision.



Parasitoid collections



South Korea
(4 trips)

China
(1 trip)

Kent Daane (UC Berkeley) and Kim Hoelmer (USDA-ARS)

Ganaspis brasiliensis

Kent Daane (UC Berkeley)

In California, the highest parasitism was found in non-crop plants that are refuges for SWD

Chemical control

Insecticides for SWD control in blueberry

Trade name	Class	Active ingredient	Rate	Season max.	Max. apps	Days btn spray	PHI* (d)	REI** (h)	Resid. (d)	RANK
Imidan	Org. phos.	phosmet	1.33 lb	7.13 lb	5	0	3	24	7-10	****
Malathion 8F[a]		malathion	2.5 pt	5 pt	2	5	1	12	5	***
Mustang Max	Pyrethroid	z-cypermeth.	4 oz	24 oz	6	7	1	12	5-7	****
Danitol		fenpropathrin	10.6-16 oz	32 oz	2	14	3	12	5-7	****
Brigade/Bifenture[b]		bifenthrin	5.3-16 oz	80 oz	-	7	1	12	5-7	***
Hero		z-cyp + bifenth.	4-10.3 oz	46.35 oz	-	7	1	12	5-7	***
Lannate SP	Carbamate	methomyl	0.5-1 lb	4 lb	4	3	3	48	7	****
Exirel	Diamide	cyazypyr	13-20.5 oz	60 oz	-	5	3	12	7	****
Delegate	Spin.	spinetoram	3-6 oz	19.5 oz	6	3	3	4	7	***
Entrust WP[c]		spinosad	1.25-2 oz	9 oz	6	6	3	4	3-5	**
Entrust 2SC[c]		spinosad	4-6 oz	29 oz	6	6	3	4	3-5	**
Cormoran	Neonic + IGR	acetamiprid + novaluron	20 oz	35 oz	-	7	8	12	7	***
Assail	Neonic.	acetamiprid	5.3 oz	26.6 oz	5	7	1	12	5-7	**
Pyganic[c]	Pyrethrum	pyrethrum	32-64 oz	59 oz	-	3	0.5	0	2	*
Grandevo WDG[c]	Biological	*Chromobacterium*	3 lb	-	-	-	0	4	3-5	**
Azera[c]	Biological	Neem+pyrethrum	32-56 pts	58 oz	10	3	0	12	2-5	*

[a] Malathion 8F (Gowan) has a 24c label for Michigan blueberries

[b] Bifenthrin pyrethroids may be more effective in hot temperature (90s) than other pyrethroids

[c] Use in organic production

Visit our website at www.ipm.msu.edu/SWD.htm

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Example blueberry SWD spray program

Traps used to determine SWD activity.

Protect ripening/ripe berries from first catch to last pick.

Tight spray intervals (~7 days).

Good spray coverage

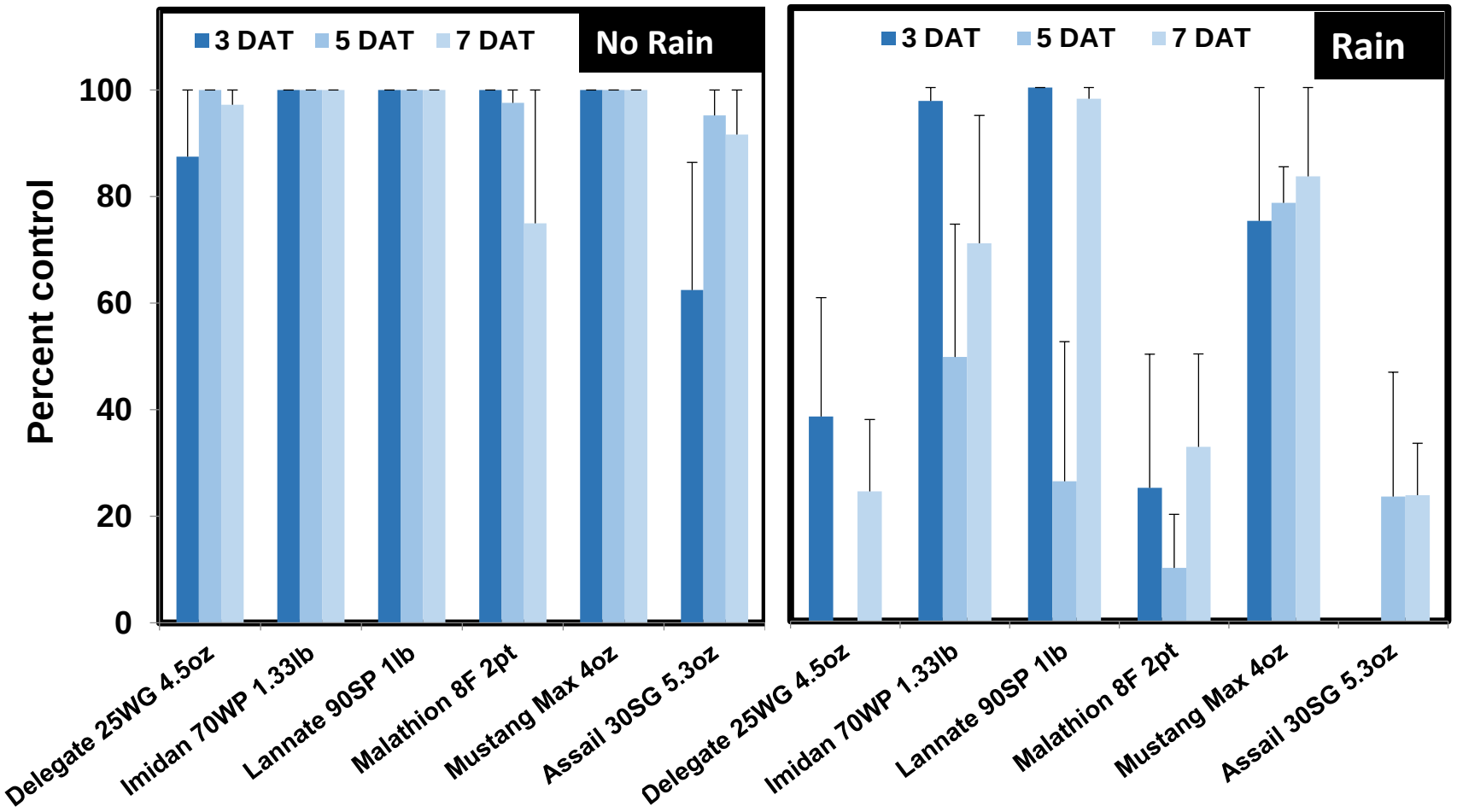
Reapplication after rain

Rotate chemical classes

Timing	Product	
First SWD, if ripe fruit	Lannate	methomyl
week 2	Danitol	fenpropathrin
week 3	Delegate	spinetoram
week 4	Mustang Maxx	zeta-cypermethrin
week 5	Imidan	phosmet
week 6	Danitol	fenpropathrin
week 7	Imidan	phosmet
week 8	Mustang Maxx	zeta-cypermethrin

Organic growers depend on Entrust (spinosad), rotated with Grandevo/Pyganic

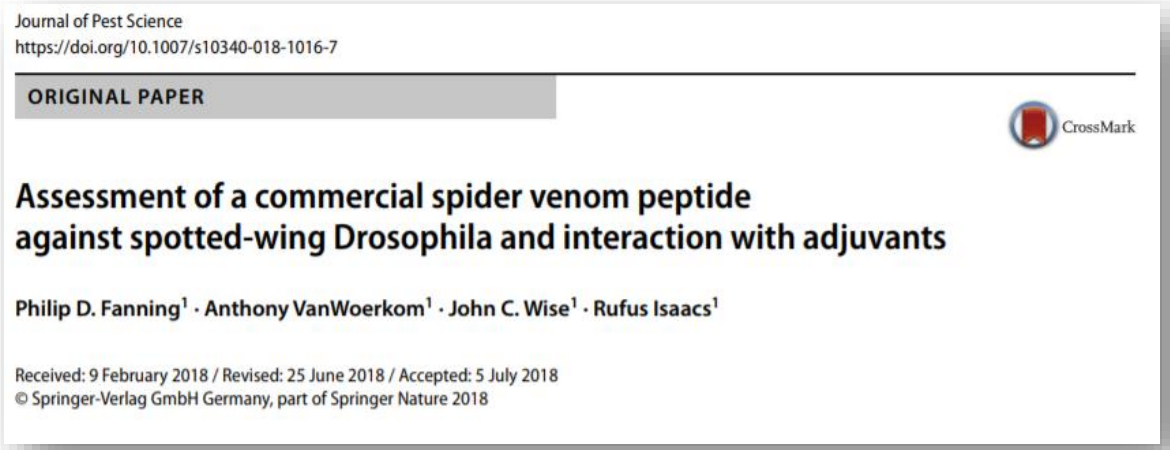
Rainfall compromises efficacy



0.8 inches of rain on treated bushes
1 day after application

New insecticide registrations

- **Cormoran DC** (novaluron + acetamiprid). Active on aphids, fruitworms, blueberry maggot, SWD, etc. 8 day PHI
- **Verdepryn 100SL (formerly Harvanta)** (cyclaniliprole) expected in 2019. This is a diamide insecticide, active on CBFW, SWD, Japanese beetle, and probably many more.
- Also expecting **Spear-T** (based on spider venom) from Vestaron Corp.


Journal of Pest Science
https://doi.org/10.1007/s10340-018-1016-7

ORIGINAL PAPER

CrossMark

Assessment of a commercial spider venom peptide against spotted-wing Drosophila and interaction with adjuvants

Philip D. Fanning[1] · Anthony VanWoerkom[1] · John C. Wise[1] · Rufus Isaacs[1]

Received: 9 February 2018 / Revised: 25 June 2018 / Accepted: 5 July 2018

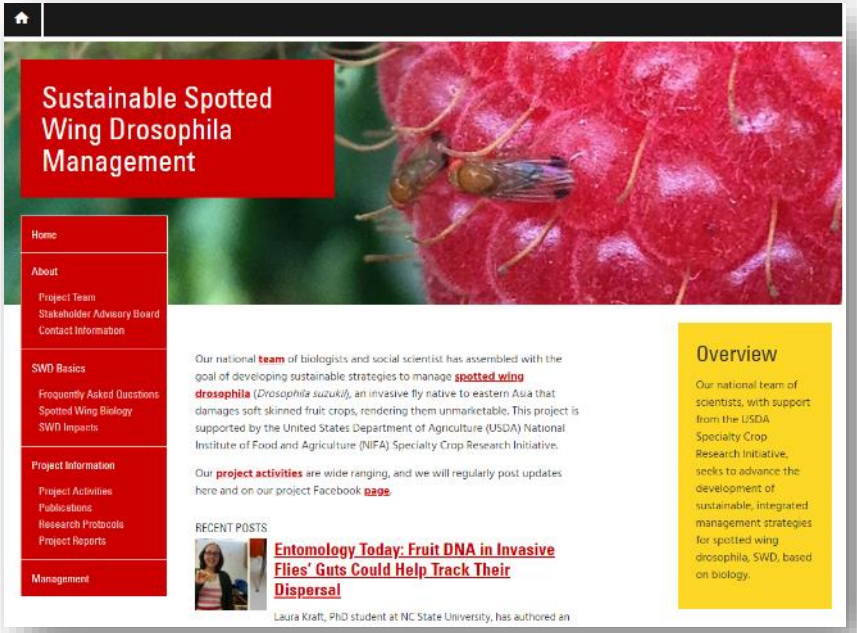
Current SWD management approaches

1. **Make fields less favorable for SWD**
   - Cultivar selection
   - Weed fabric
   - Pruning
   - Netting
2. **Monitor SWD flies in spring to detect first activity**
3. **As fruit being to ripen, sample larvae**
4. **Protect ripening and ripe susceptible fruit**
   - Weekly application
   - Good coverage
   - Reapplication after rain
   - Rotate chemical classes
   - Consider adult and larval control
5. **Post-harvest methods**

https://eorganic.info/spottedwingorganic

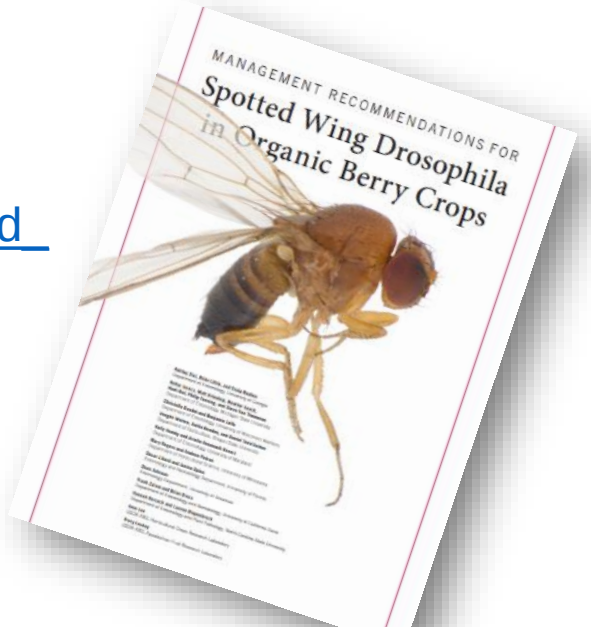
Led by Dr. Ash Sial, University of Georgia

https://swdmanagement.org/



Led by Dr. Hannah Burrack, NCSU

www.ipm.msu.edu/invasive_species/spotted_wing_drosophila/factsheets



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Thanks to:

Steve Van Timmeren

Philip Fanning

Heather Leach

Julianna Wilson

John Wise

Summer students

Grower cooperators

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Michigan State University AgBioResearch

MICHIGAN STATE UNIVERSITY Extension

Project GREEEN

Michigan Department of AGRICULTURE & Rural Development

Michigan State Horticultural Society

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Plant Health AUSTRALIA

cesar

Hort Innovation

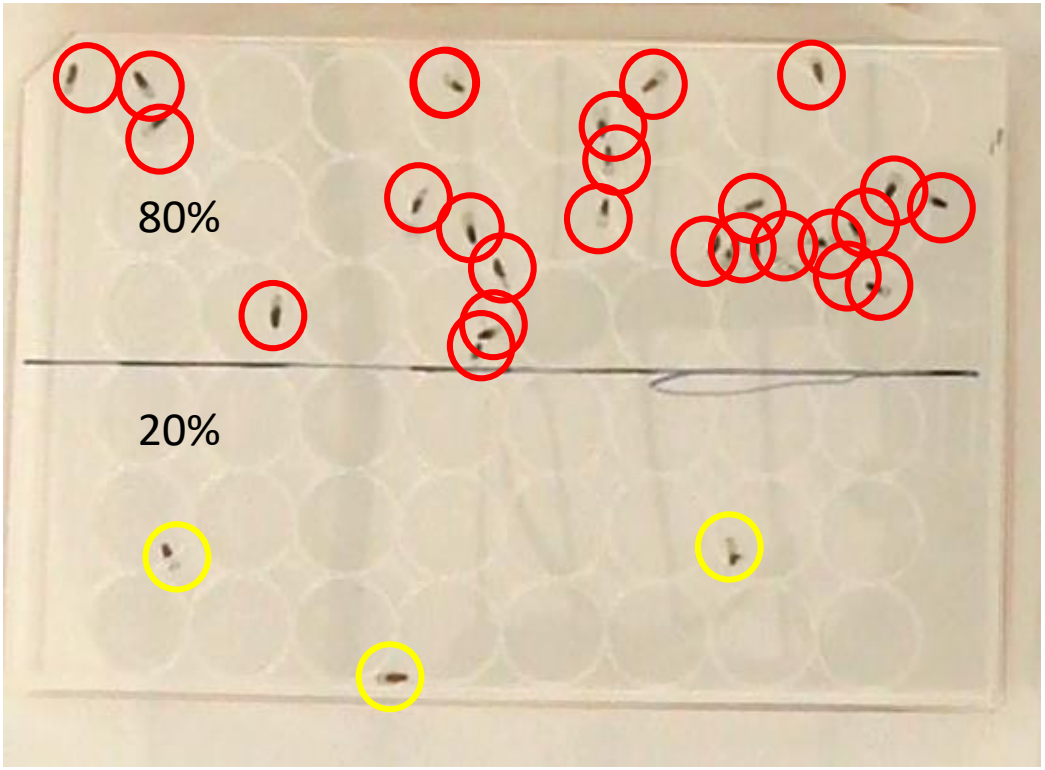
TunnelBerries
Sponsored by USDA-SCRI

Sanitation

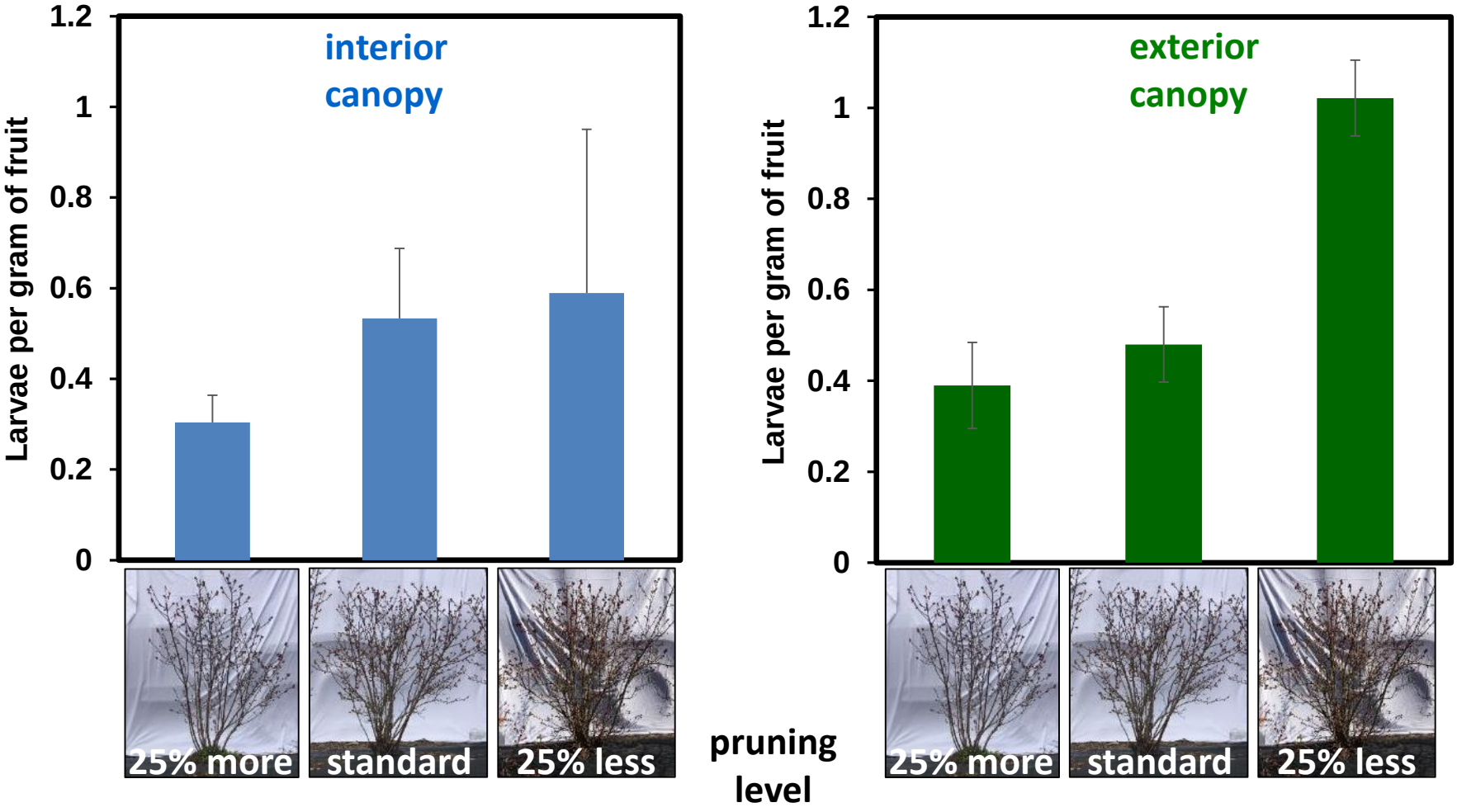
- Flies can emerge from unbagged infested fruit.
- Need an effective disposal method.
- Clear bags have the highest internal temperature and can surpass the lethal temperature of SWD larvae (30° C)
- Some emergence still occurred after 32h. To kill all larvae, bags should be sealed tightly for more than 32 h.

SWD avoids dry conditions

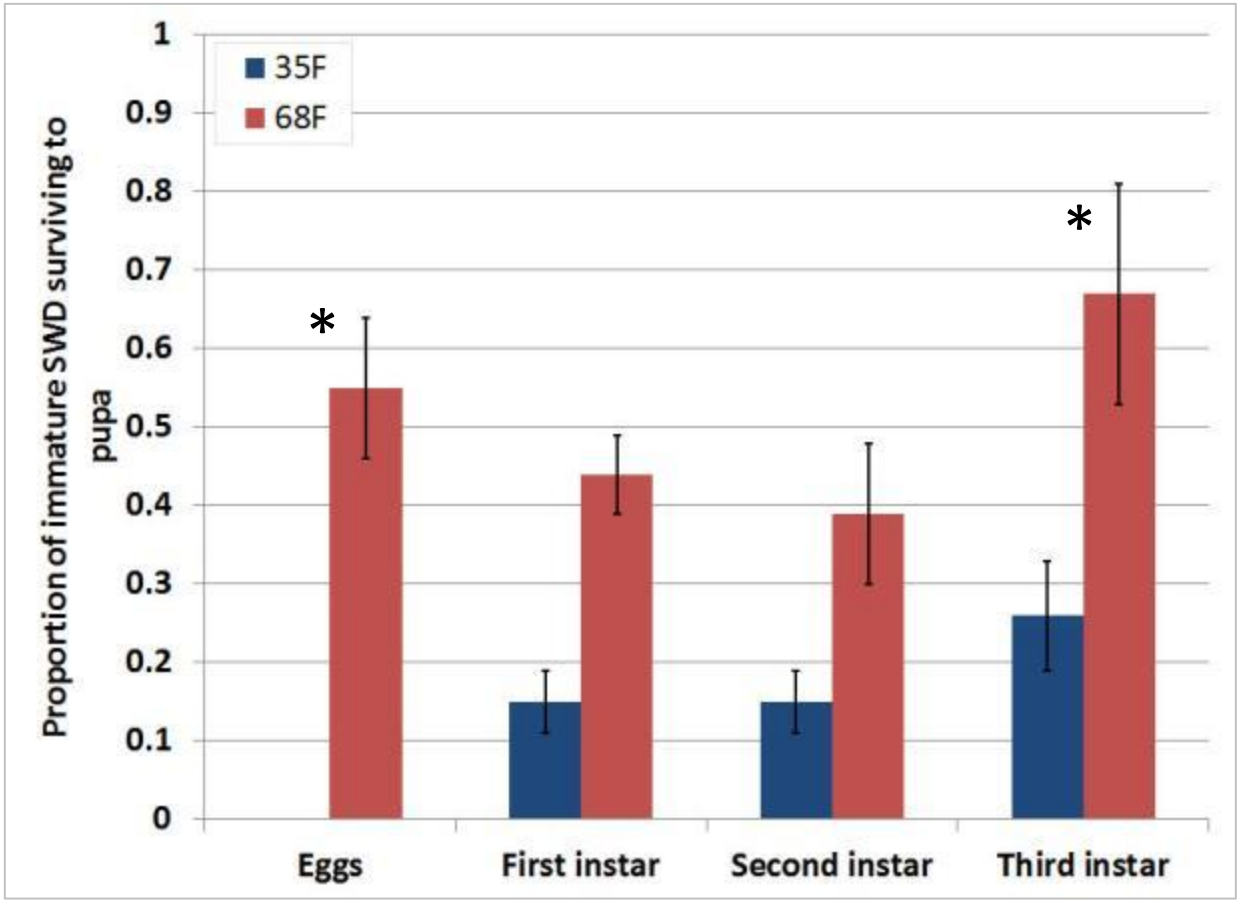
- SWD need humidity for survival.
- Can horticultural practices reduce SWD pressure?



Opening crop canopies improves SWD control



Post-harvest chilling

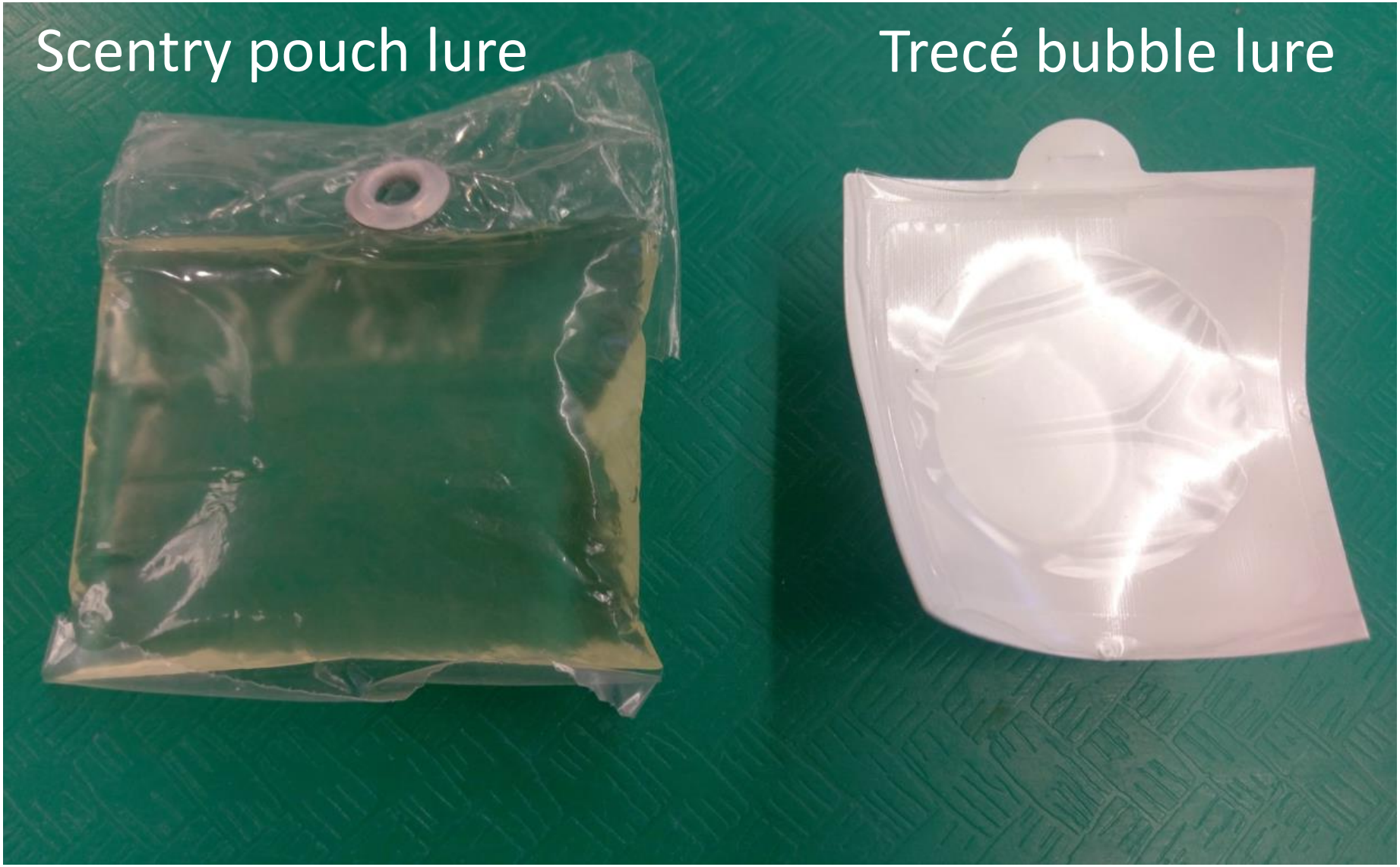


No eggs (of 434) survived to pupation in blueberries held at ***35°F for 72 hrs****, but some of all other life stages did*

No sig. difference in survival for first and second instars

Aly et al. (2017) Journal of Economic Entomo

SWD bait development



Many other trap designs

2015-2018 IPM Training on SWD

- Knowledge and skills gained to retool IPM programs
- SWD control costs reduction from $372 in 2013 to $191/acre in 2017.

Led by Dr. Carlos Garcia-Salazar

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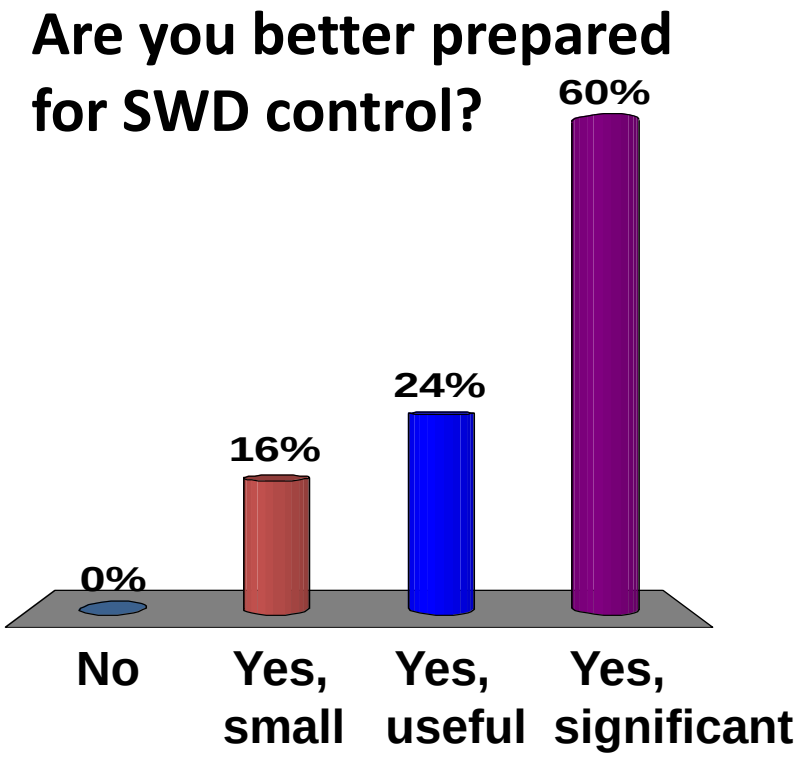

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