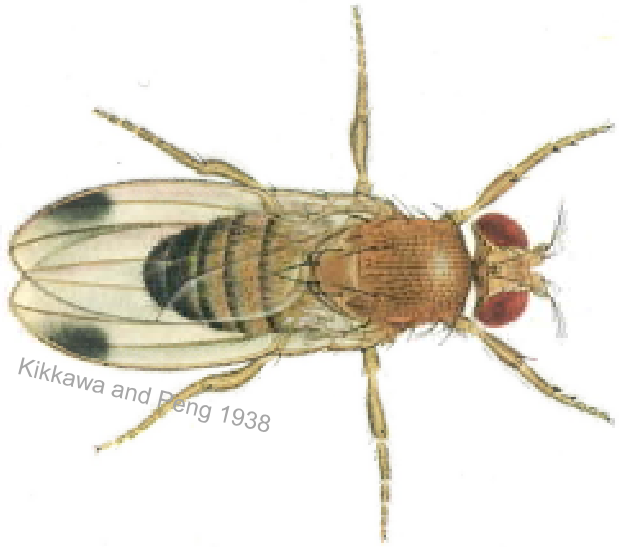
Spotted Wing Drosophila
Monitoring and Efficacy Trials in Cherry

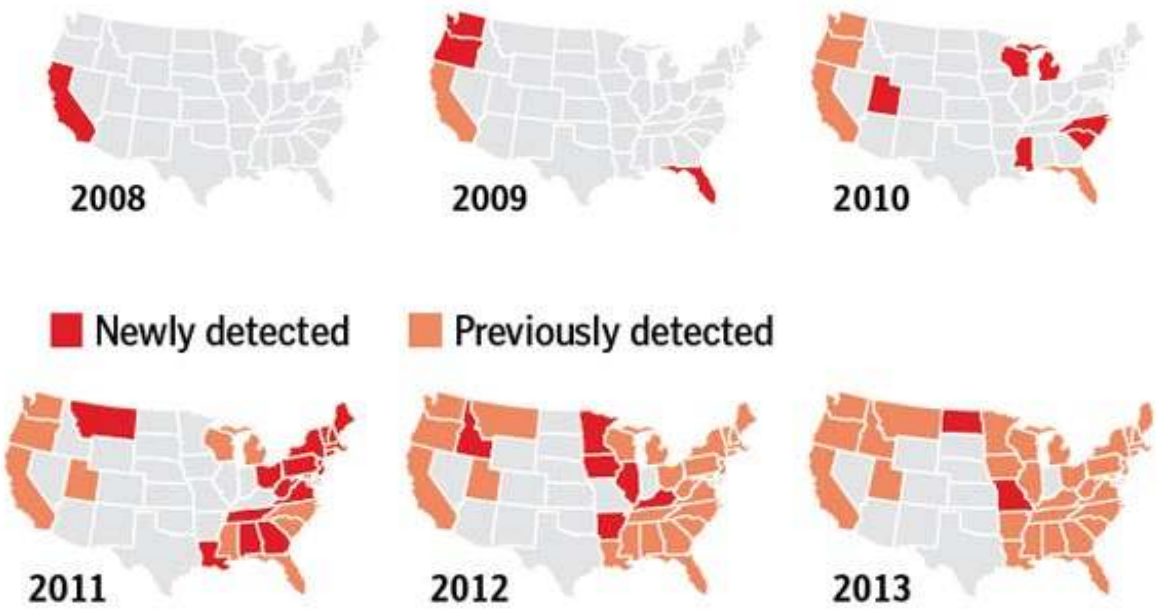


Larry Gut, John Wise, Nikki Rothwell,
Rufus Isaacs, Julianna Wilson

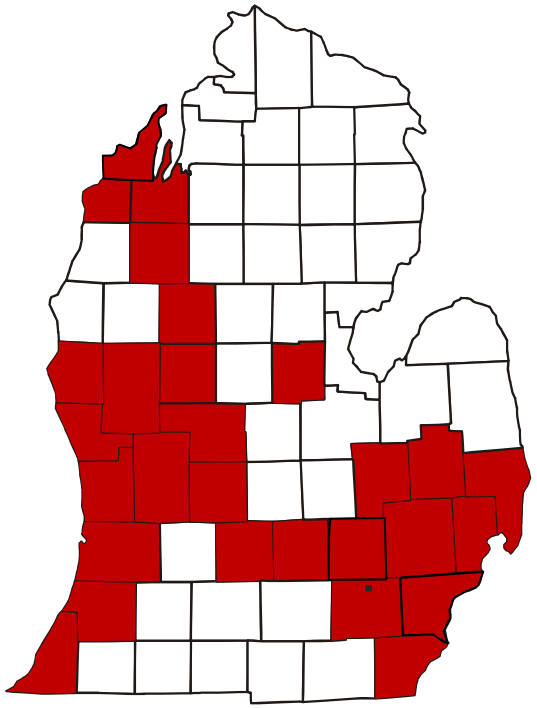
Outline

- A brief history of SWD, MSUE response
- Important biological characteristics
- What are we learning in cherry?
- Cherry recommendations

SWD distribution - U.S. and Michigan



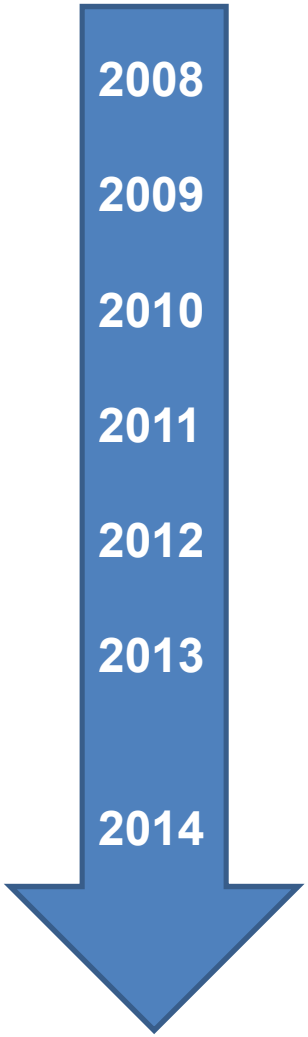
The Boston Globe and Hannah Burrack, NCSU



MSU Extension Fruit Team

Also found in Mexico, Italy, Germany, UK, Spain, France, etc…

The Michigan Response timeline

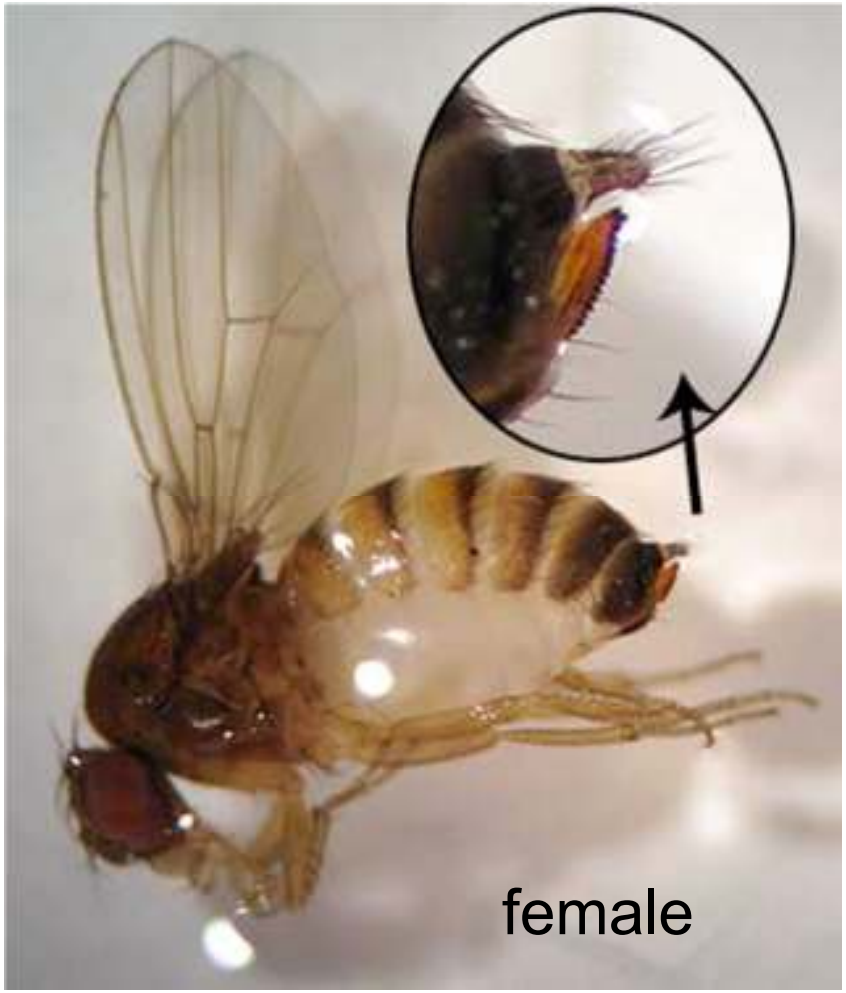


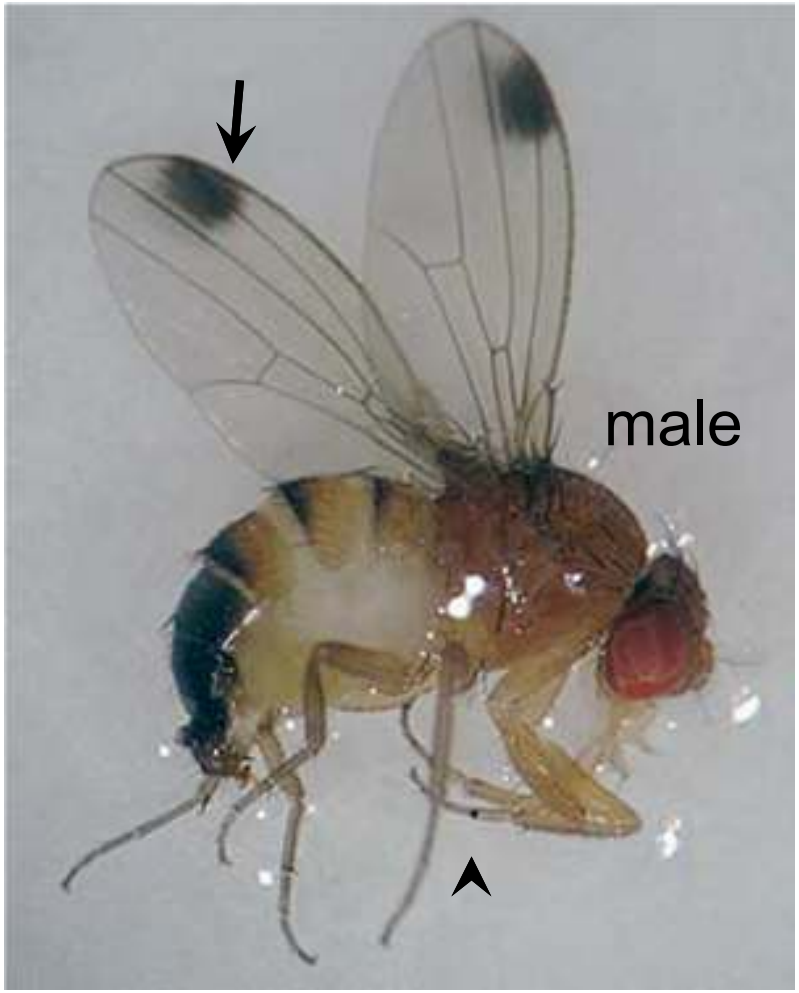
- Reports of a new vinegar fly pest in CA berries.
- In OR, WA, BC then in FL; R. Isaacs attended a workshop in OR to learn more.
- SWD Response Team formed. Initiated trapping network, IPM website,
- Detected in September, started a winter education program.
- First full season, first catch 7/5, some blueberry and raspberry damage.
- Workshops, first catch early June, infestation and economic loss in berry crops.
- More workshops, including during the Tree Fruit IPM School; first catch late May, intense management in berry crops, higher production costs but lower crop loss.
- More workshops. Delayed first catch. Focus on product selection, spray intervals, resistance management, re-coverage after rain.

Statewide, national, and international connections

- SWD Response Team
  - Coordinated initial EDRR plan
  - Helped when SWD was detected
- GLFW
  - Regional coordination across Great Lakes region
- WERA 1021
  - National committee on SWD
  - Helped coordinate grant proposals
- IOBC, Basecamp
  - International connections to share results
  - Learn from other regions' experiences

Key Identifying Characteristics





Spotted Wing Drosophila (*Drosophila suzukii*) has an ovipositor that enables it to pierce the skin of healthy fruit still attached to the plant.

***Drosophila suzukii* ovipositor**

- Spines black - color intensity increased sclerotization or hardness
- Largest spine located at tip of ovipositor; punctures the skin of the fruit, allowing insertion of the ovipositor.

Non-*suzukii* ovipositor

- Blunt tip of ovipositor
- Spines not blackened - less hardened or sclerotized
- Cannot pierce skin of healthy fruit

Life Cycle of SWD

Cini et al., 2012 ; Walsh et al., 2011 ; Mitsui, 2006 ; Kanzawa, 1939

Pupae:
3-15 days

Adults:
3-9 weeks
or longer if
the winter
morph

Inside fruit

Eggs:
2 hours to 3 days

Larvae:
3-13 days, 3
instars

One generation: 8-10 days at 25° C (77° F), 21-25 days at 15° C (59° F)

Other life history characteristics

- Females reach sexual maturity 1 to 2 days after emerging from their puparia, with the ability to produce more than 300 eggs in a lifetime, which during the growing season can be 3 to 9 weeks depending on ambient temperatures.
- Optimum temperatures for egg laying and swift development is between 20-25° C (68-77° F). SWD activity is reduced when temperatures exceed 30° C (86° F) or fall below 10° C (50° F).

What are we learning in cherry?

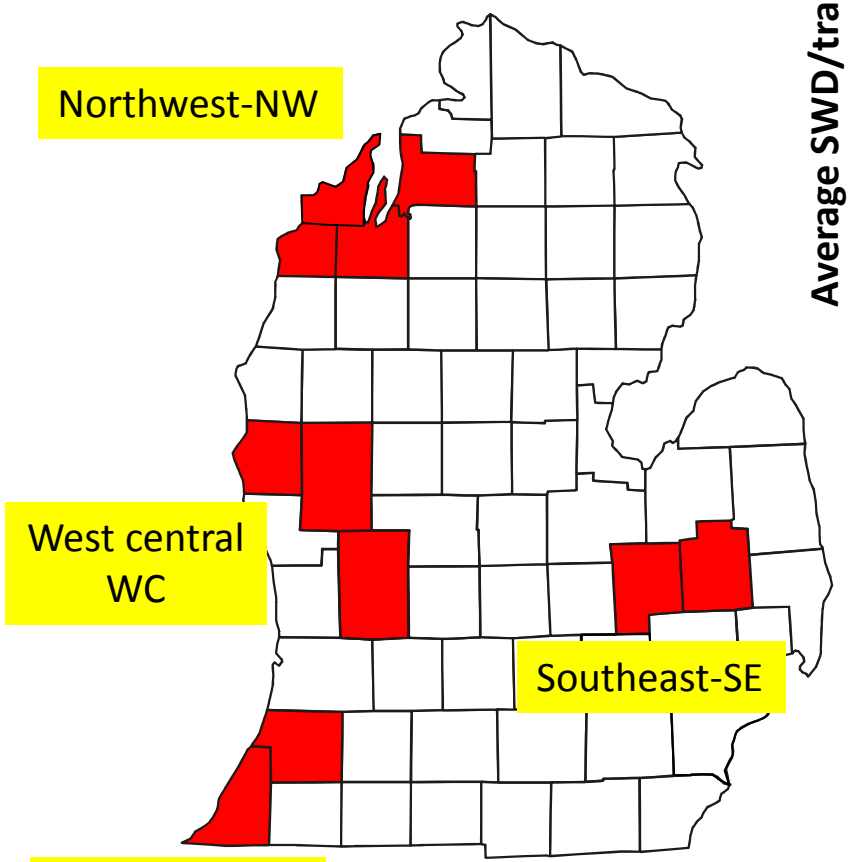
1) *How trap catch relates to cherry harvest: summary of the MSU SWD Statewide Monitoring Network.*

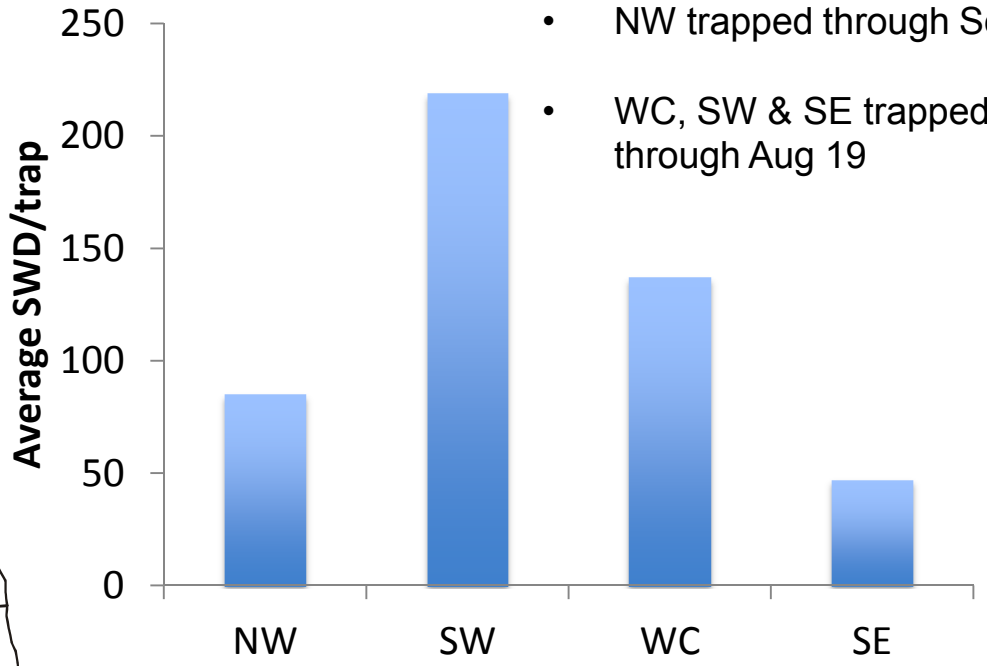
2) *Efficacy trials of insecticides available for SWD control in cherry*.

Trapping Network 2014

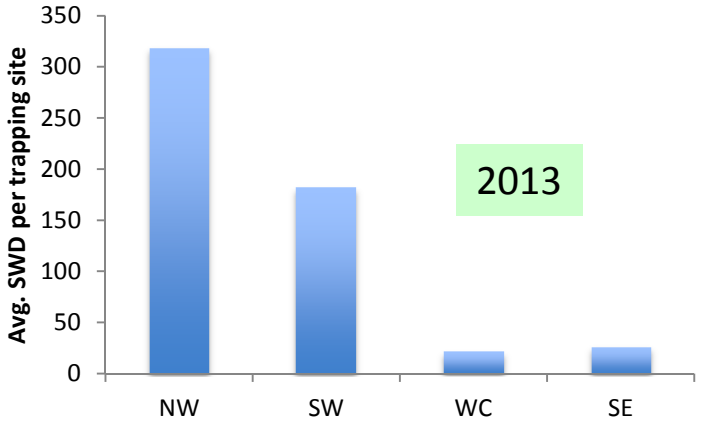
- Clear plastic container baited with a commercial lure
- Over 126 traps deployed (43 in cherry)
- Over 100,000 SWD captured/year, and identified
- Catches posted weekly online

Comparative catch in 4 cherry production regions, 2014

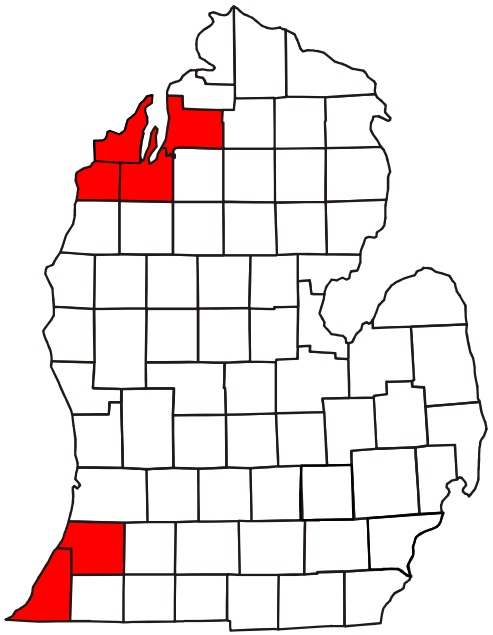


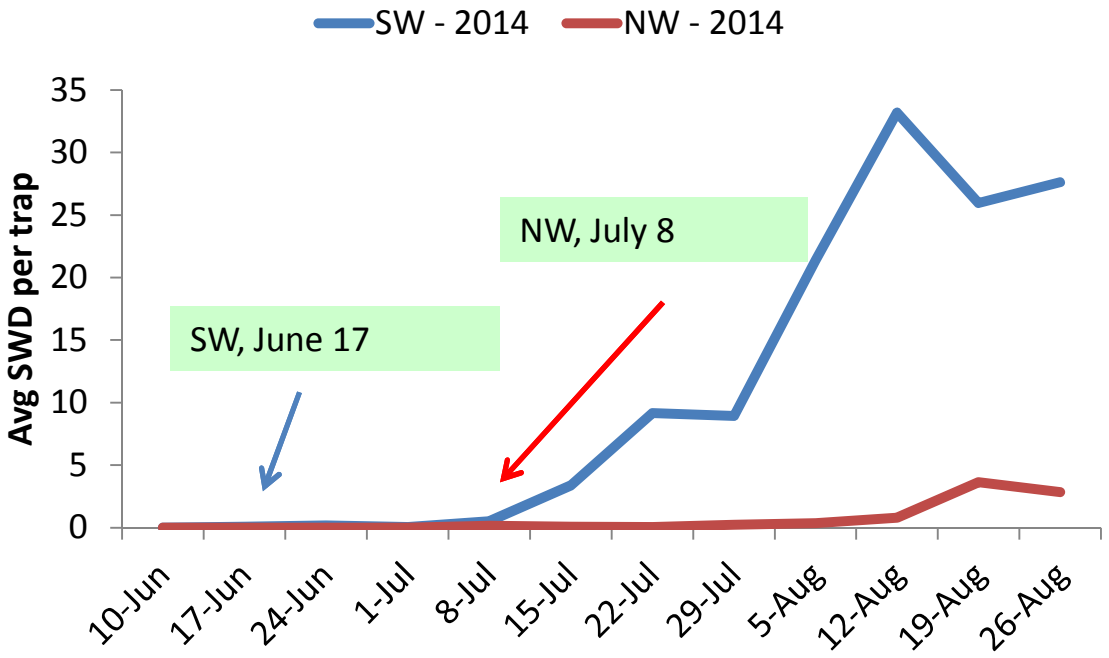


- NW trapped through Sept 2
- WC, SW & SE trapped through Aug 19



Timing of SWD activity in cherry, 2014

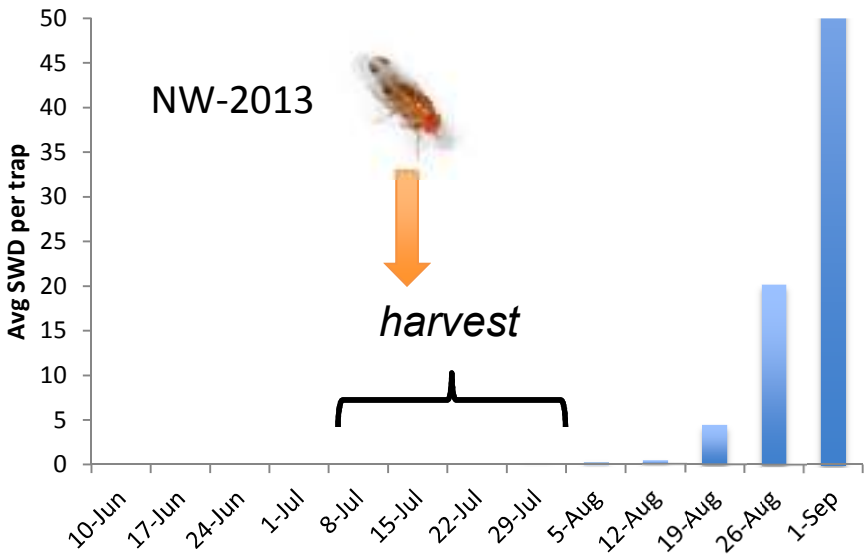


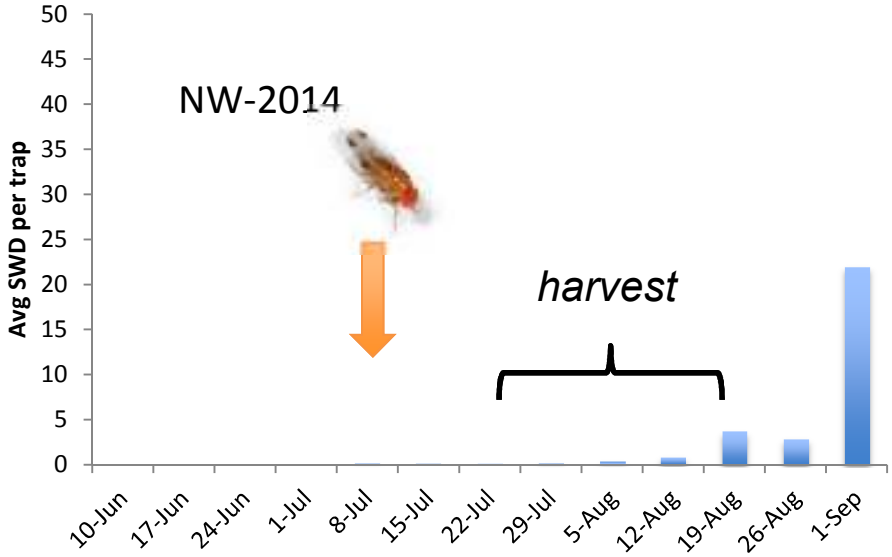


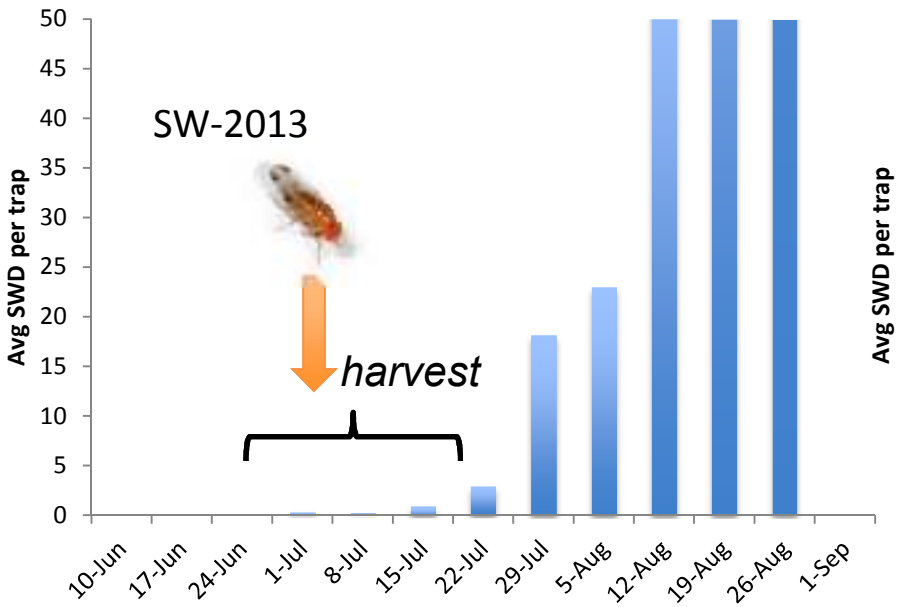
First SWD catch earlier each year, 3-4 weeks prior to population build-up

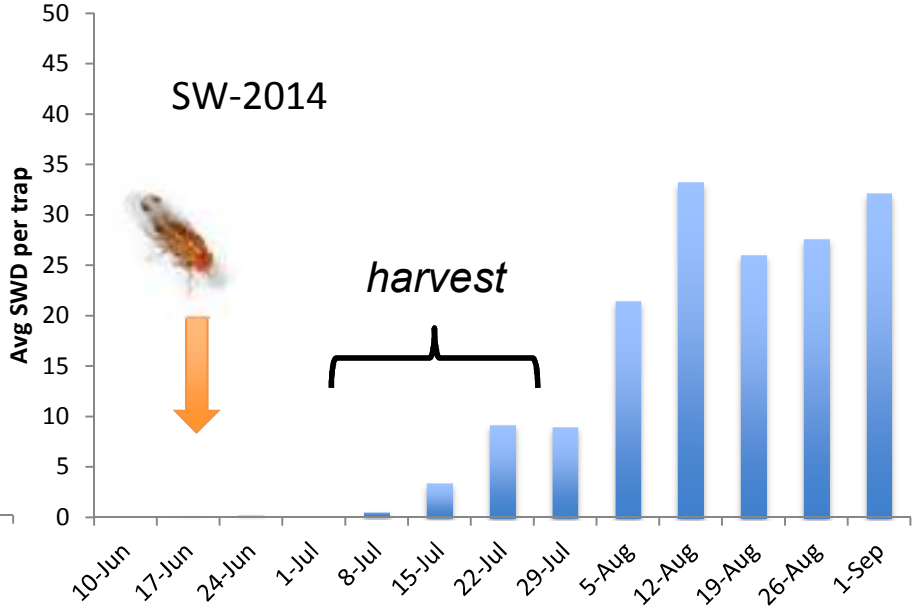
	Southwest	Northwest	Bait used in trap
2011	Aug 22	Sep 9	Apple cider vinegar
2012	Jul 15	ns	Yeast-sugar
2013	Jul 1	Jul 15	Yeast-sugar
2014	Jun 17	Jul 8	Lure

SWD timing and cherry harvest









SWD Baits and lures

- *Apple cider vinegar*
- *Wine*
- *Combination*

- *Yeast/sugar*

- *Commercial lure*

Four-component blend as a chemical lure for SWD

Research Article

SCI

Received: 4 January 2013 Revised: 8 March 2013 Accepted article published: 30 April 2013 Published online in Wiley Online Library: 22 July 2013

(wileyonlinelibrary.com) DOI 10.1002/ps.3568

A four-component synthetic attractant for *Drosophila suzukii* (Diptera: Drosophilidae) isolated from fermented bait headspace

Dong H Cha,[a]* Todd Adams,[b] Christ
John J Adamczyk Jr,[c] Helmuth Rog

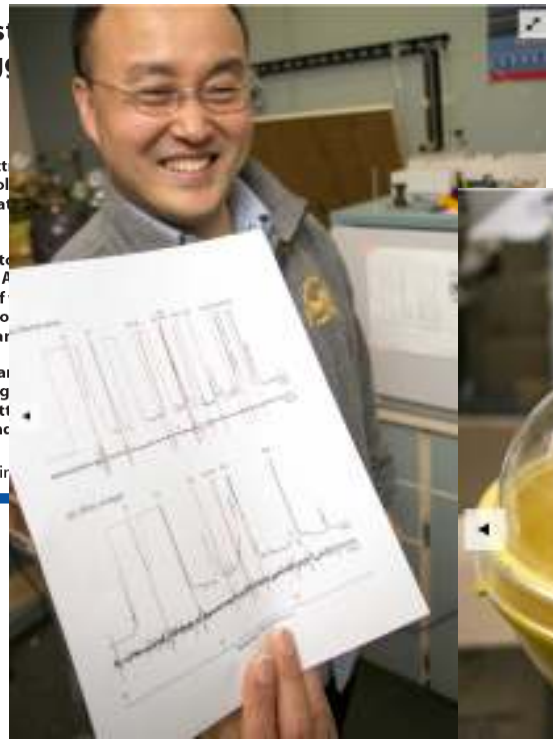
Abstract

BACKGROUND: A mixture of wine and vinegar is more att
***suzukii* (Matsumura) (Diptera: Drosophilidae), and ethanol**
to ethanol and acetic acid, 13 other wine and vinegar volat
finding.

RESULTS: Out of the 13 antennally active chemicals, aceto
of acetic acid and ethanol in field trapping experiments. A
and methionol was as attractive as the starting mixture of
Mississippi. Subtracting ethyl lactate from the five-compo
subtracting any other compound from the blend significar

CONCLUSION: These results indicate that acetic acid, ethar
attracted to wine and vinegar, which may be food-finding
that this four-component blend can be used as a highly att
Published 2013. This article is a U.S. Government work and

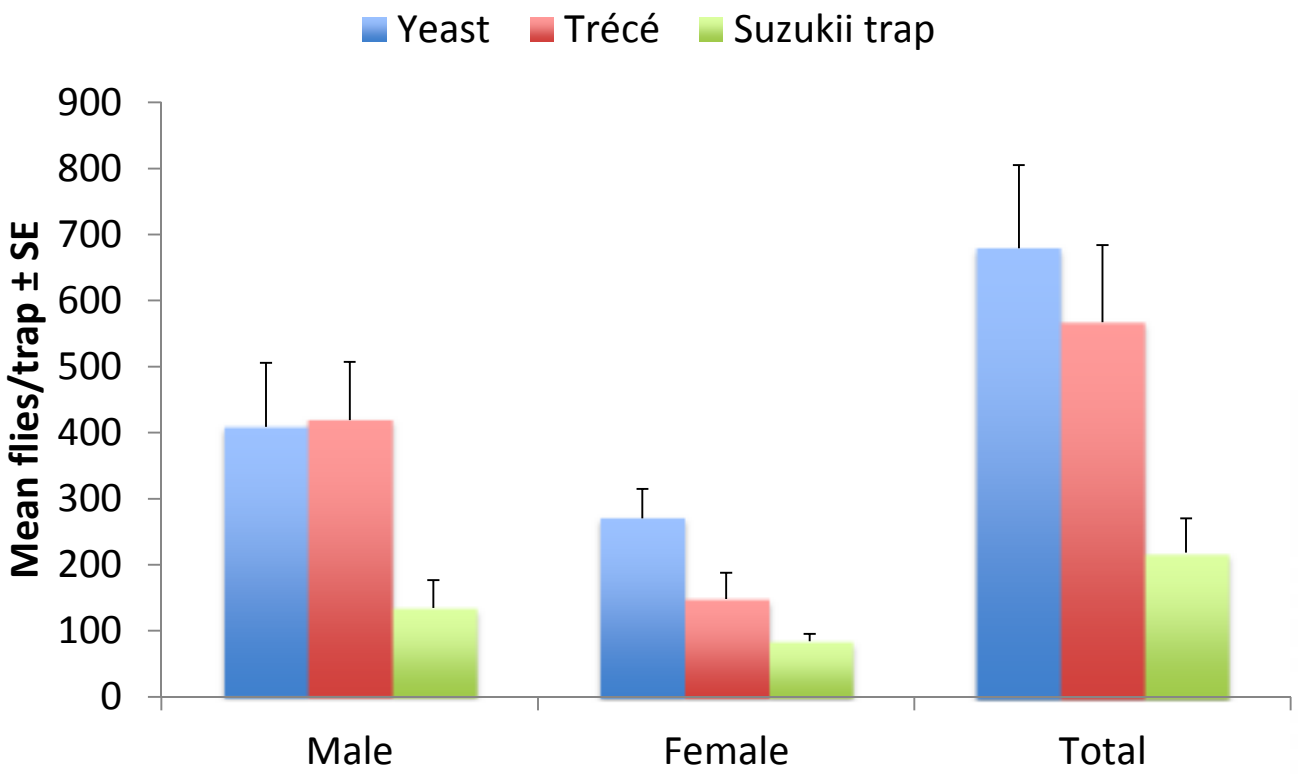
Keywords: *Drosophila suzukii*; spotted wing drosophila; feedin



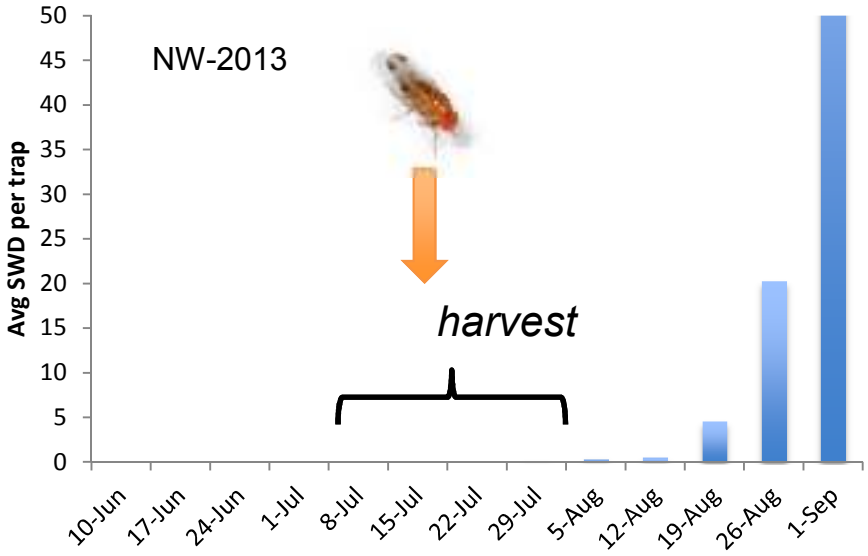
4 key components in headspace of wine and vinegar

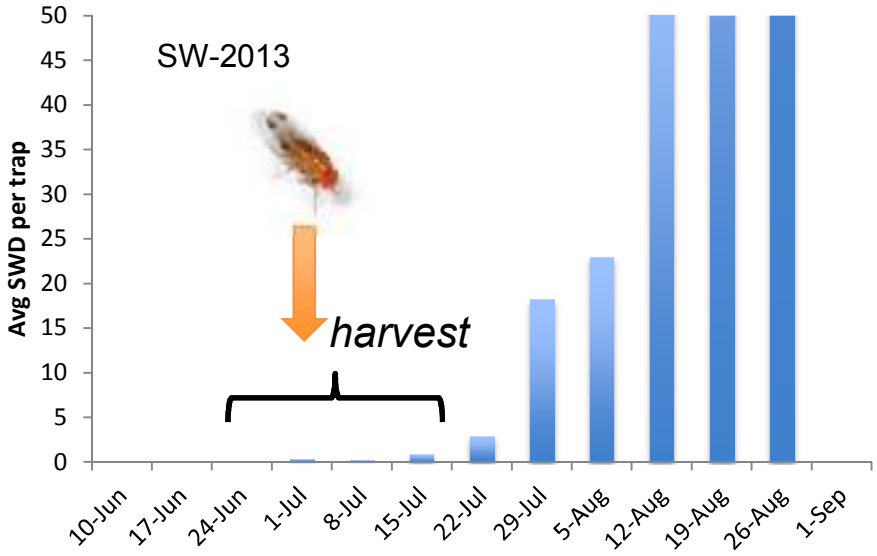
- acetic acid
- ethanol
- acetoin
- methionol

MSU bait comparison - 2014



Next steps in biology and trapping studies

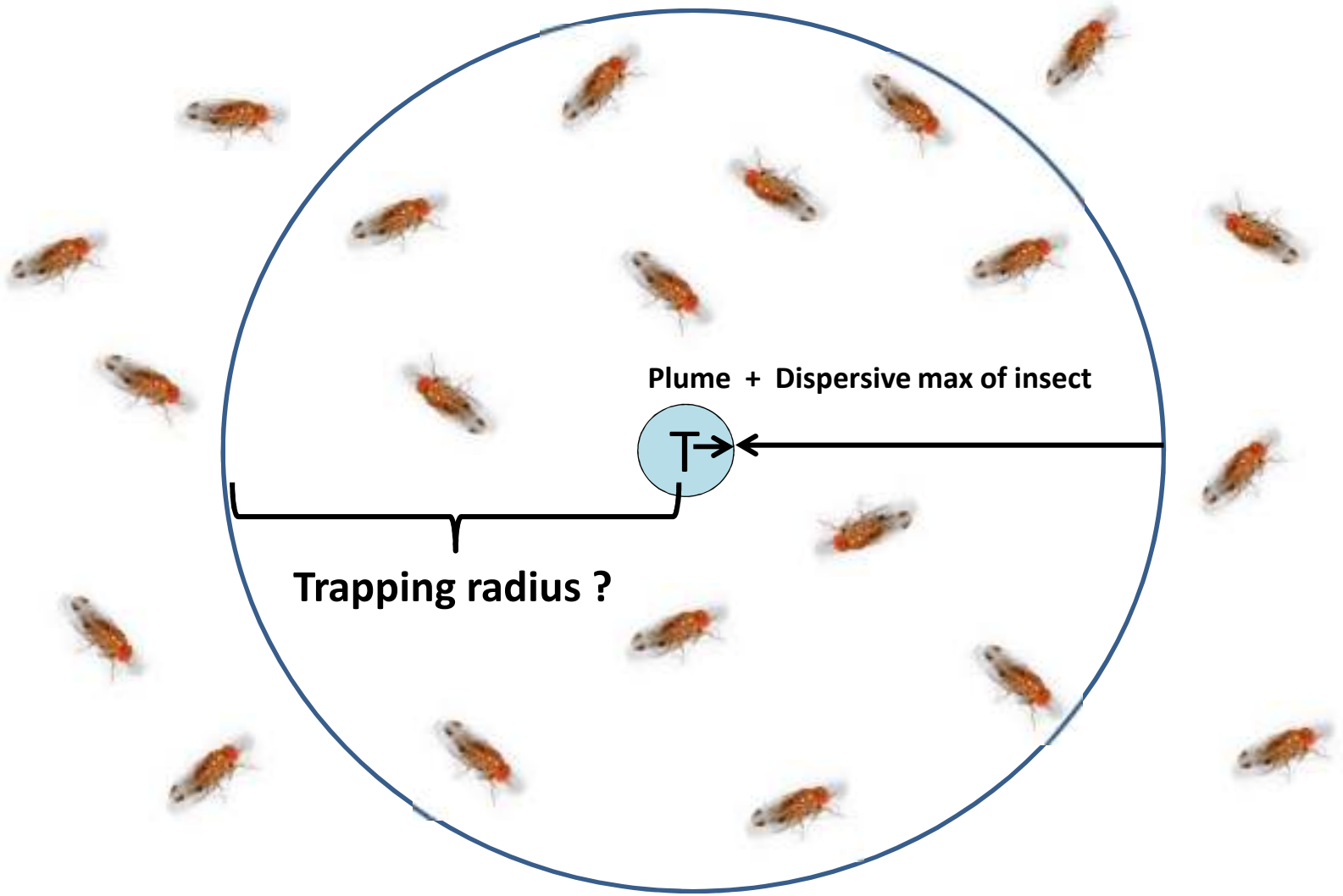




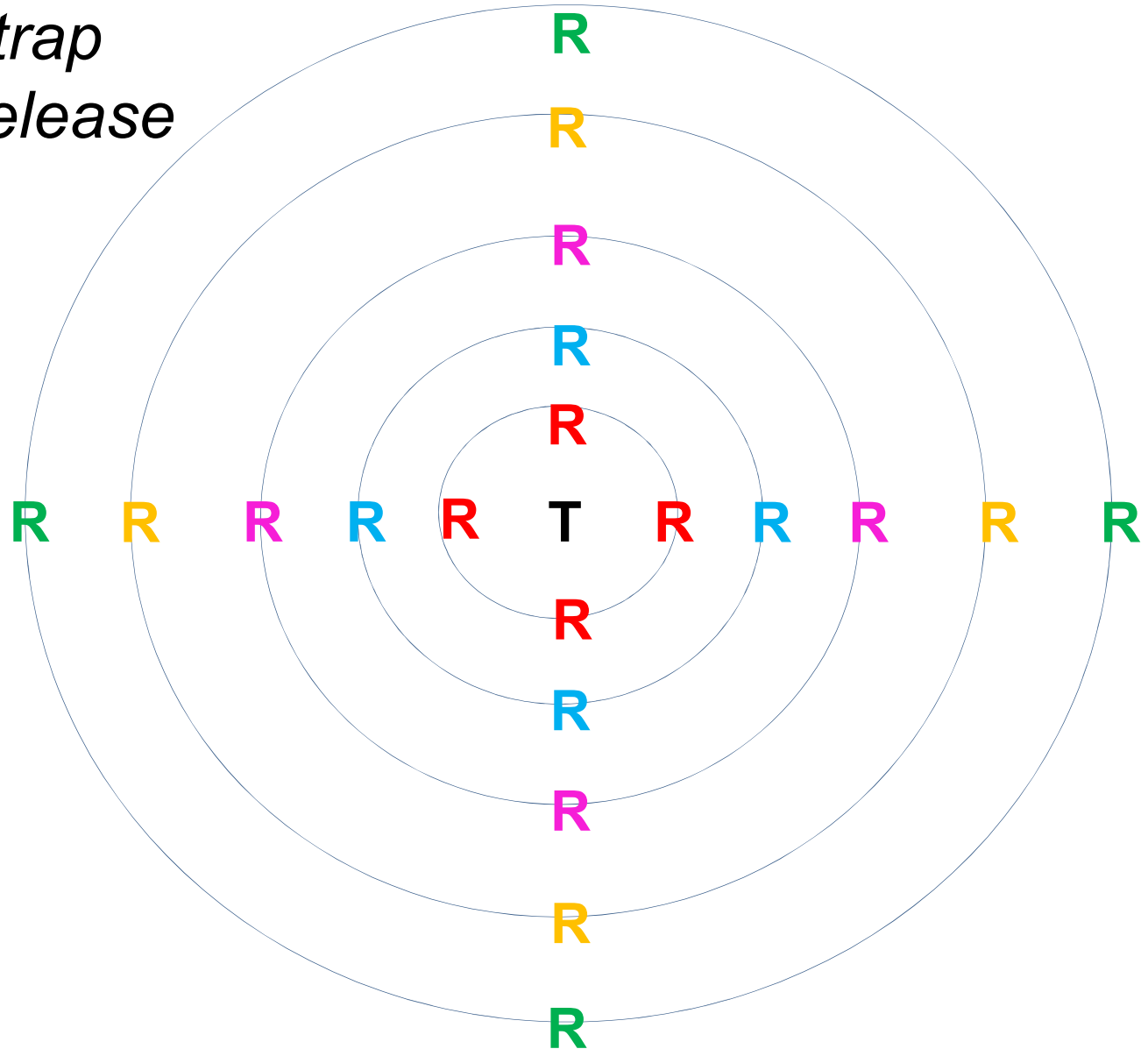
- Developing a phenological model with respect to cherry
  - Overwintering biology and impact of cold temperatures
  - Timing of activity; role of temperature and photoperiod

- Improving traps and our understanding of what the data means
  - Traps that are more selective – based on odor/color cues
  - How trap catch relates to potential fruit infestation

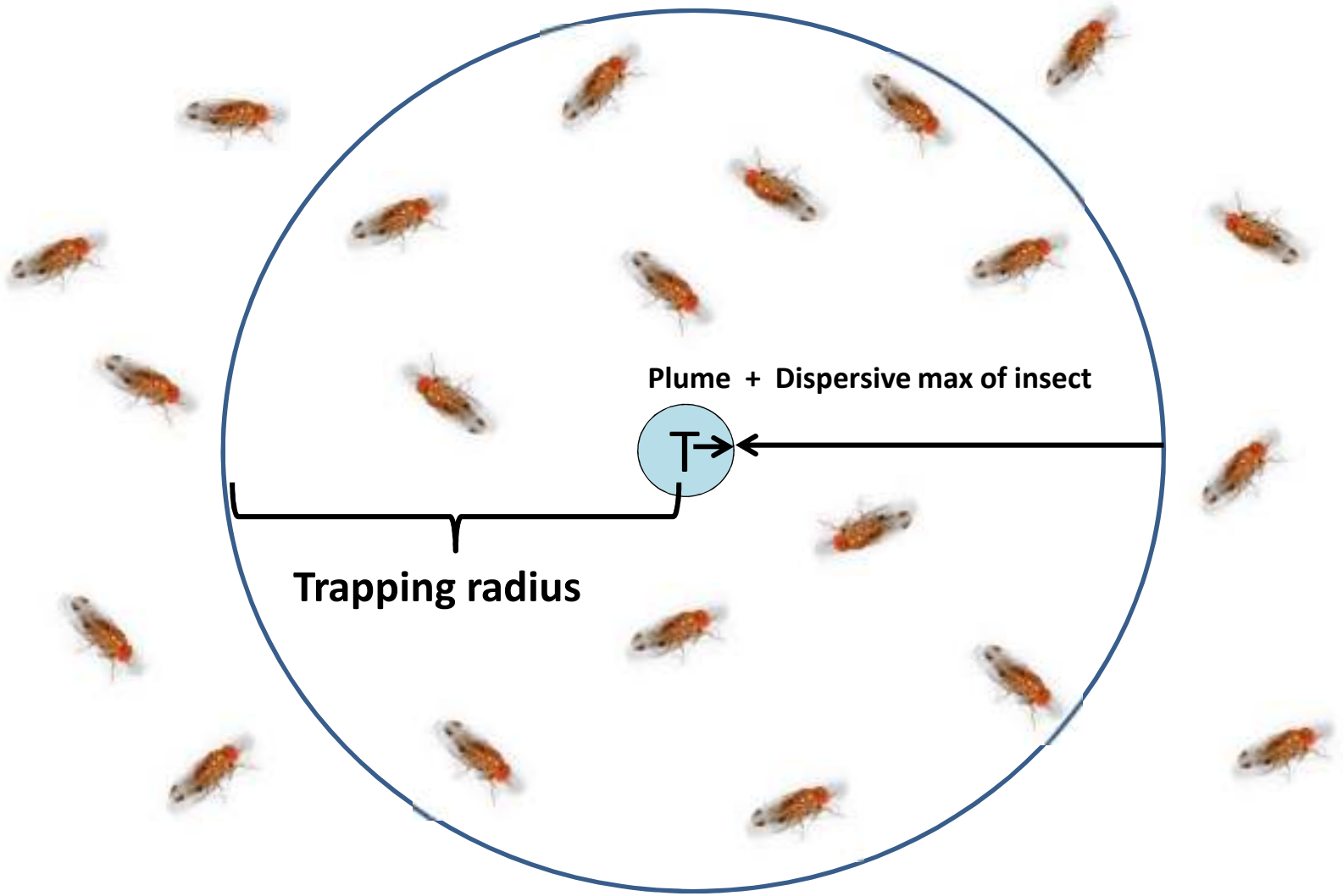
Trap radius as it relates to population size



Single trap
Multiple release



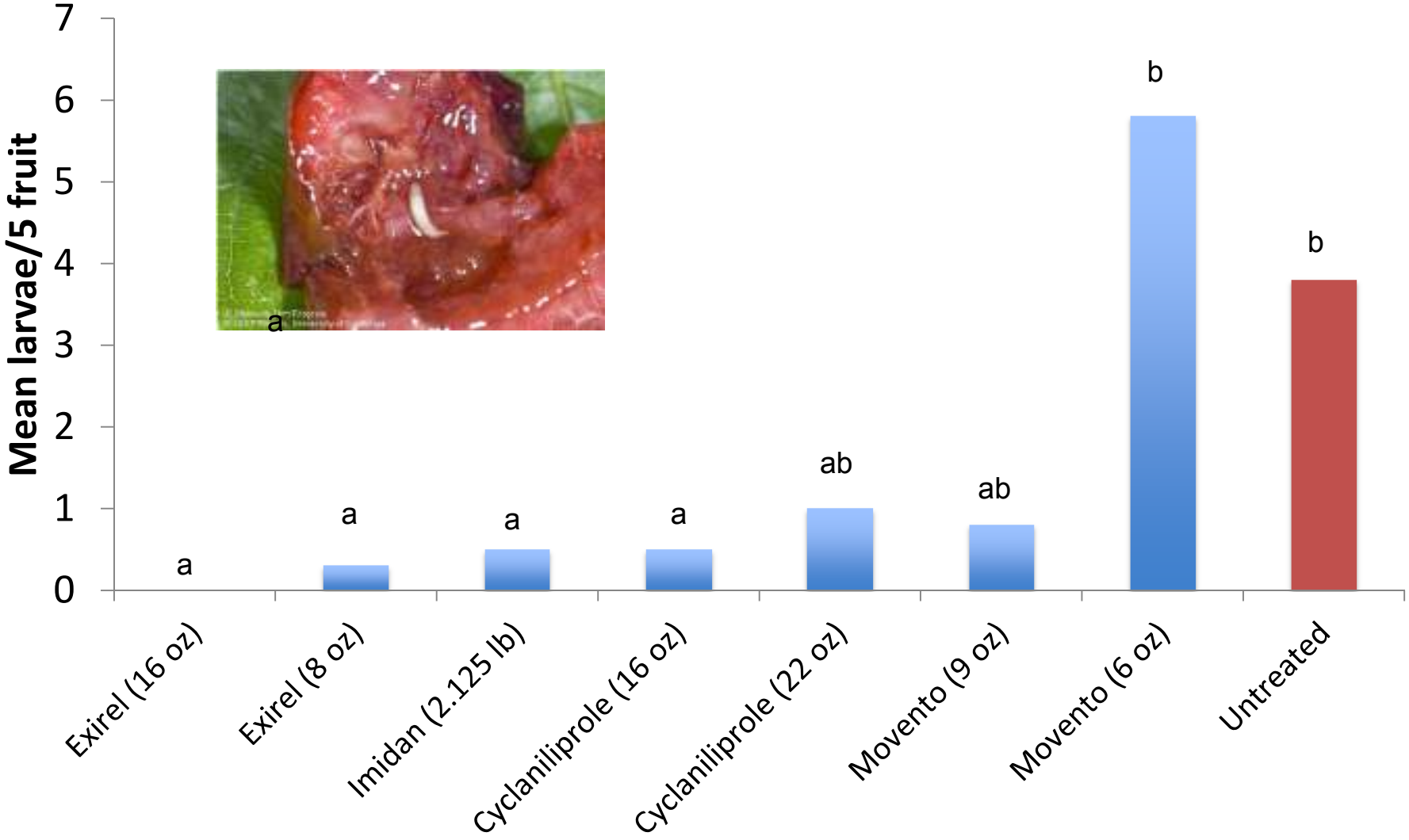
Trap radius related to fruit infestation



Field-based insecticide bioassays

- Treatments applied to cherry trees with airblast sprayer.
- Cherries collected 1 and 7d post-treatment.
- 5 cherries placed in container
- Add 5 male, 5 female SWD – hold for 7d.
- Count larvae/pupae after 9d, calculate % mortality

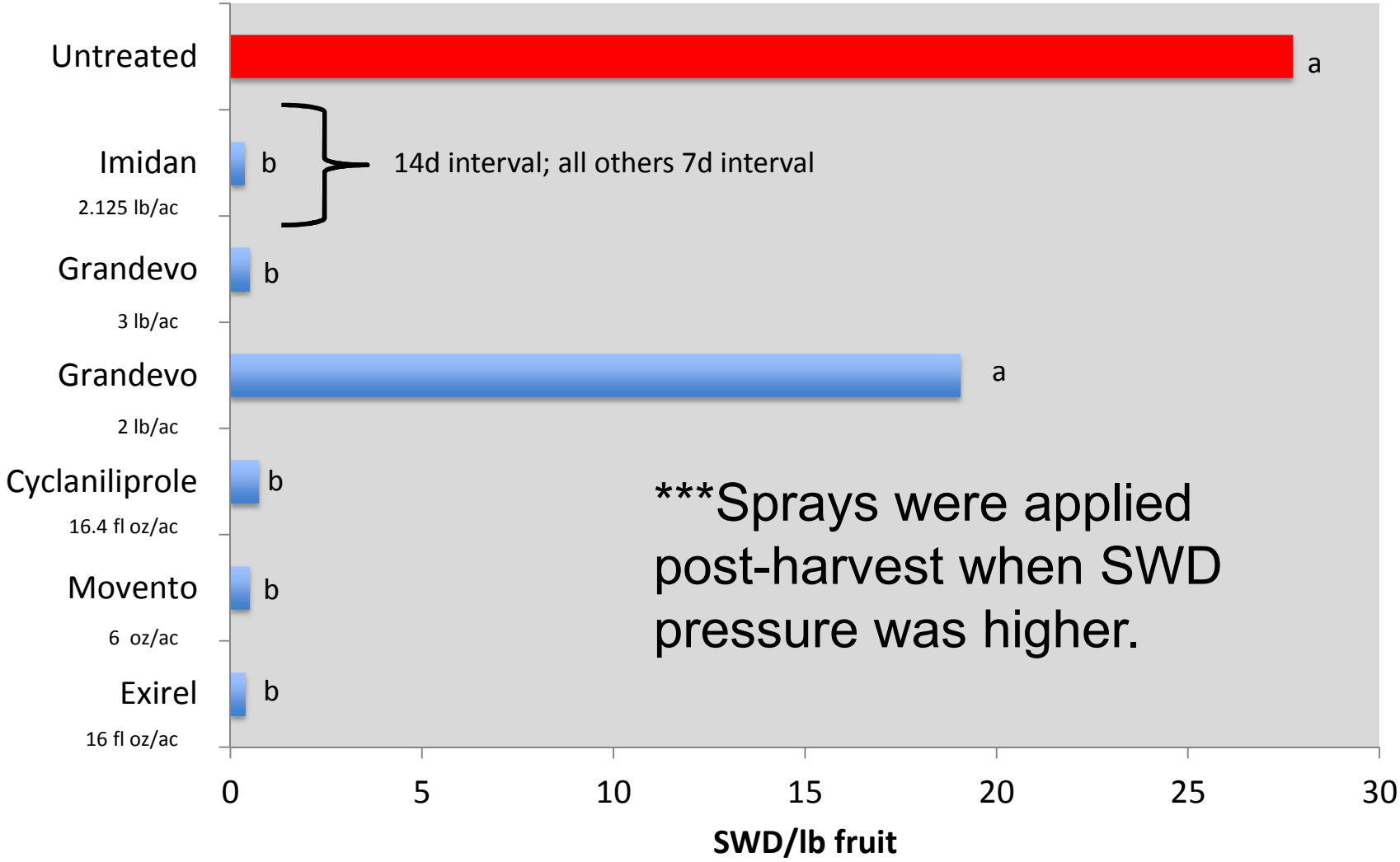
Relative efficacy – TNRC bioassay



TNRC insecticide efficacy trials

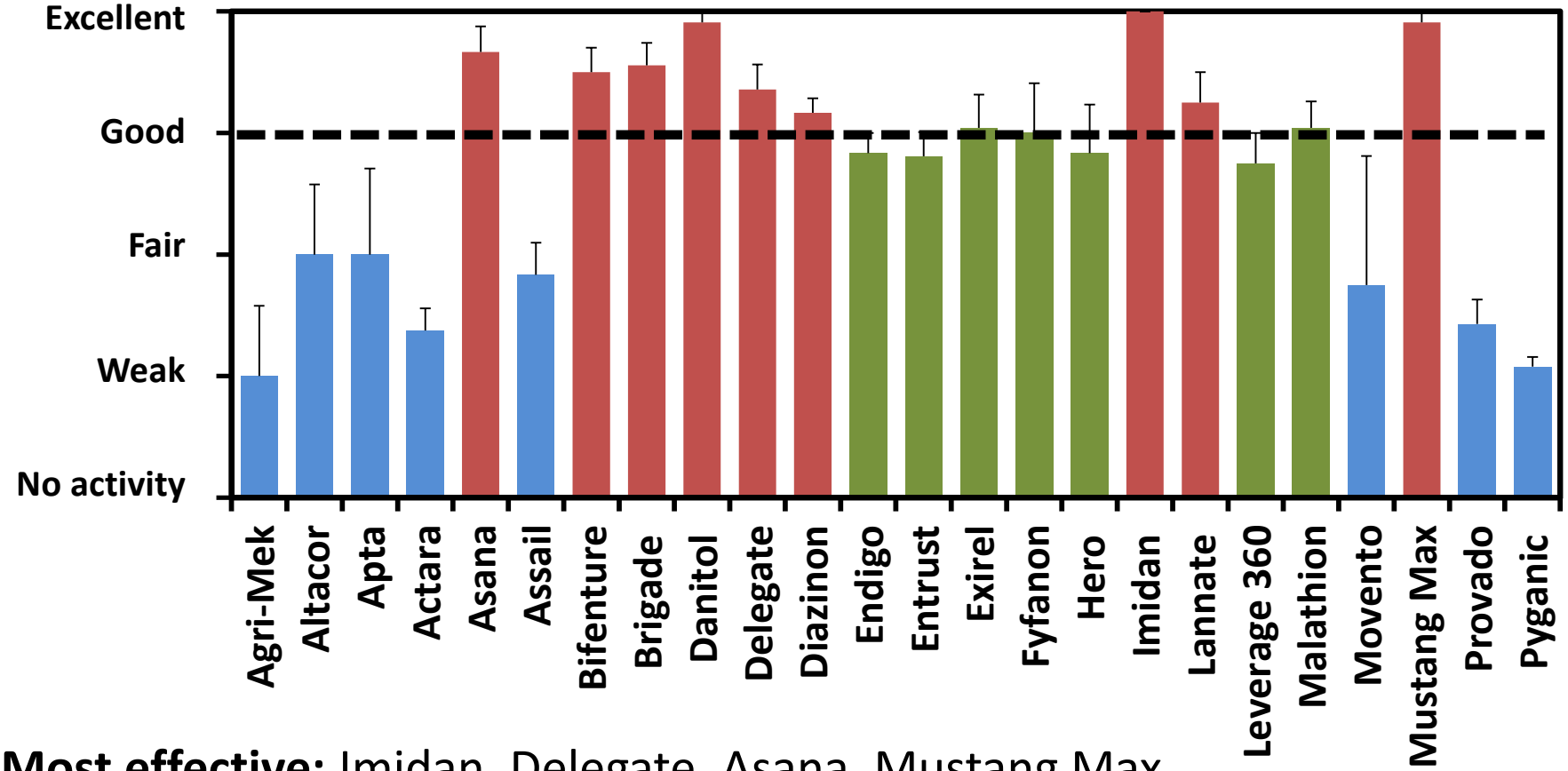
- Single-tree plots in ‘Montmorency’ planting
- Treatments applied by airblast sprayer (3-4 reps).
- Sprays timed for first fly catch
- Applied at 7d or 14d covers (3-6 applications)
- Fruit harvested by limb shaking, weighed in lbs
- Infestation determined by rearing SWD from all sampled fruit (2014)

Control of SWD in tart cherry - TNRC 2014 Field Trial



2014 summary rankings of insecticide efficacy against SWD
8 states, 15 state x crop combinations

Van Steenwyk, Shearer, Beers, Tanigoshi, Spitler, Isaacs,
Drummond, Collins, Loeb, Rodriguez-Saona, Nielsen, Polk, Sial



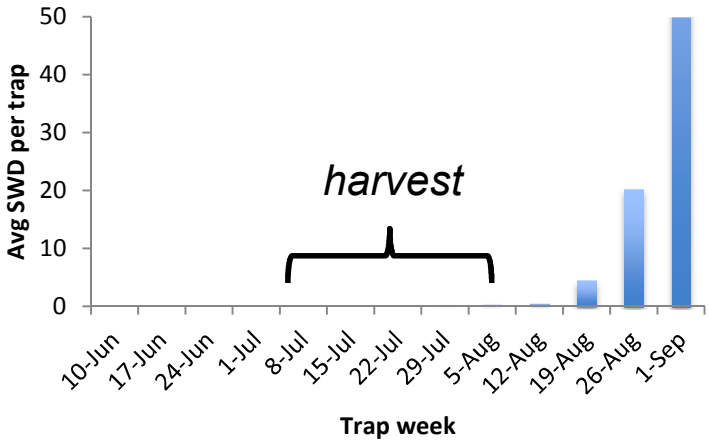
Most effective: Imidan, Delegate, Asana, Mustang Max, Brigade/Bifenture, Danitol, Lannate, Diazinon

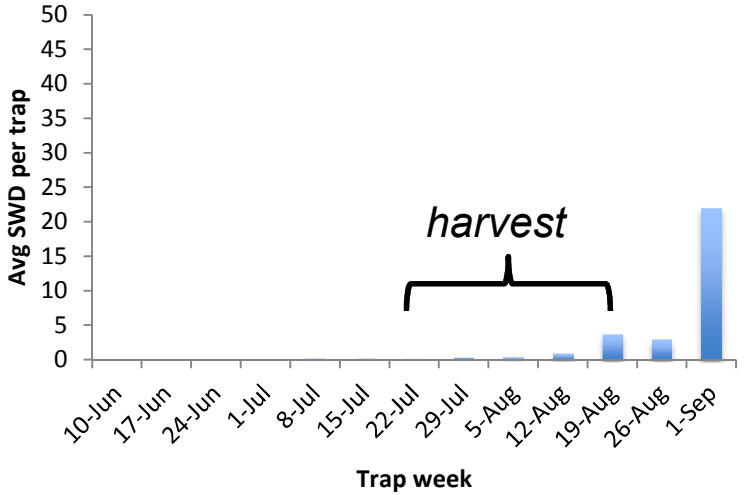
Insecticides for SWD control in cherry

Trade Name	Class	PHI	Relative efficacy	Rate
Pounce	pyrethroid	3	f	12.8 oz
Danitol	pyrethroid	3	g	21.3
Exirel	diamide	3	e	13.5-20.5 fl oz
Delegate	spinosyn	7	e	4.5-7 oz
Imidan	OP	7	e	2.125 lb
Baythroid XL	pyrethroid	7	g	2.4-2.8 oz
Rimon	benzoylurea	8	f	20-40 oz
Mustang Max	pyrethroid	14	e	4 oz
Warrior	pyrethroid	14	e	3.4-5.1 oz
Apta	METI	14	suppression	21-27 fl oz

Next step in efficacy trials

- *Determine residual activity of registered options*
- *Determine if a single application protects harvested fruit*





- Treat at first significant catch
- Single application only for Mustang Max, Warrior, Apta (14d PHI)
- Single application and two applications (7d apart) for Delegate, Imidan and Baythroid (3d, 7d PHI)
- Collect fruit and measure infestation at 7d,14d post-treatment

SWD information from MSU

Online resources

Weekly reports during the season

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

SWD information from MSU

INSECTS

Obliquebanded leafroller	See "Third Cover"
Cherry fruit fly	See "Third Cover"
Spotted wing drosophila[1]	**9e, 35, 44e, 64e, 72f, 73g, 85e, 86e**

Comments:

[1] See 'Invasive and Emerging Pests" section for information on spotted wing drosophila.

INSECTICIDES

9. Imidan 70 W (2.125 lb)
35. Pounce 25 WP (12.8 oz)
44. Danitol 2.4 EC (21.3 oz)
64. Entrust 80 WP (1.25 - 2.5 oz) ▲ ***RR***
64. Entrust 2 SC (4 - 8 fl oz) ▲ ***RR***
72. Rimon 0.83 EC (20 - 40 oz)
73. Baythroid XL (2.4 - 2.8 oz)
85. Delegate 25 WG (4.5 - 7 oz) (6 - 7 oz for SWD) ***RR***
86. Mustang Max 0.8 EC (4 oz)

It's I.P.M. Jim, but not as we know it…

Monitoring
Identify first activity, changing activity, control program performance

Cultural control
Post-harvest? fruit chilling, processing systems (soft-sorters)

Biological control
Natural levels generally low (20-30%), overseas exploration underway for classical biological control

Chemical control
Effective products are available, must be timed based on fly presence and ripening/ripe fruit, coverage is essential, additives for less washoff or more uptake are promising. Resistance management and MRLs are growing concerns.

R. Isaacs

Thanks to:

- Funders:
  - MI Cherry Committee
  - MI Horticultural Society
  - MI Project GREEEN
  - MI Project GREEEN AABI

- Terrific staff
  - Gut lab: Michael Haas, Peter McGhee
  - Rothwell lab: Karen Powers, Elise Carolan, Chri Beiser
  - Isaacs lab: Steve Van Timmeren, Keith Mason

- MSU field team:
  - Educators: Mark Longstroth, Diane Brown, Carlos Garcia, Bob Tritten, Amy Irish-Brown