Spotted Wing Drosophila management in high tunnels

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Extension Entomologist
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THE OHIO STATE UNIVERSITY

Spotted wing drosophila

- New key pest of berries
  - Outdoors
  - High tunnels
- Concern in tomatoes?
  - Slight

Spotted wing Drosophila

- ***Drosophila suzukii***
- **Looks like common vinegar flies on overripe, fallen, decaying fruit**
- **The new species attacks <u>healthy</u> ripening fruit**

Fruit injury by Spotted wing Drosophila

Hosts

- **Early:** cherries
- **Mid:** raspberries, blueberries, blackberries, peach, plum
- **Late:** grapes, strawberry (ever-bearing), raspberries

Hosts: tomato?

- Study at Cornell by Zuefle & Loeb 2014
  - 15 varieties
  - Intact fruit & cracked fruit
  - Skin firmness
- Field collected:
  - 0% infested intact fruit
  - 4% infested cracked fruit
- In lab:
  - 12% infested intact fruit
  - 61% infested cracked fruit
- Remove cracked fruit

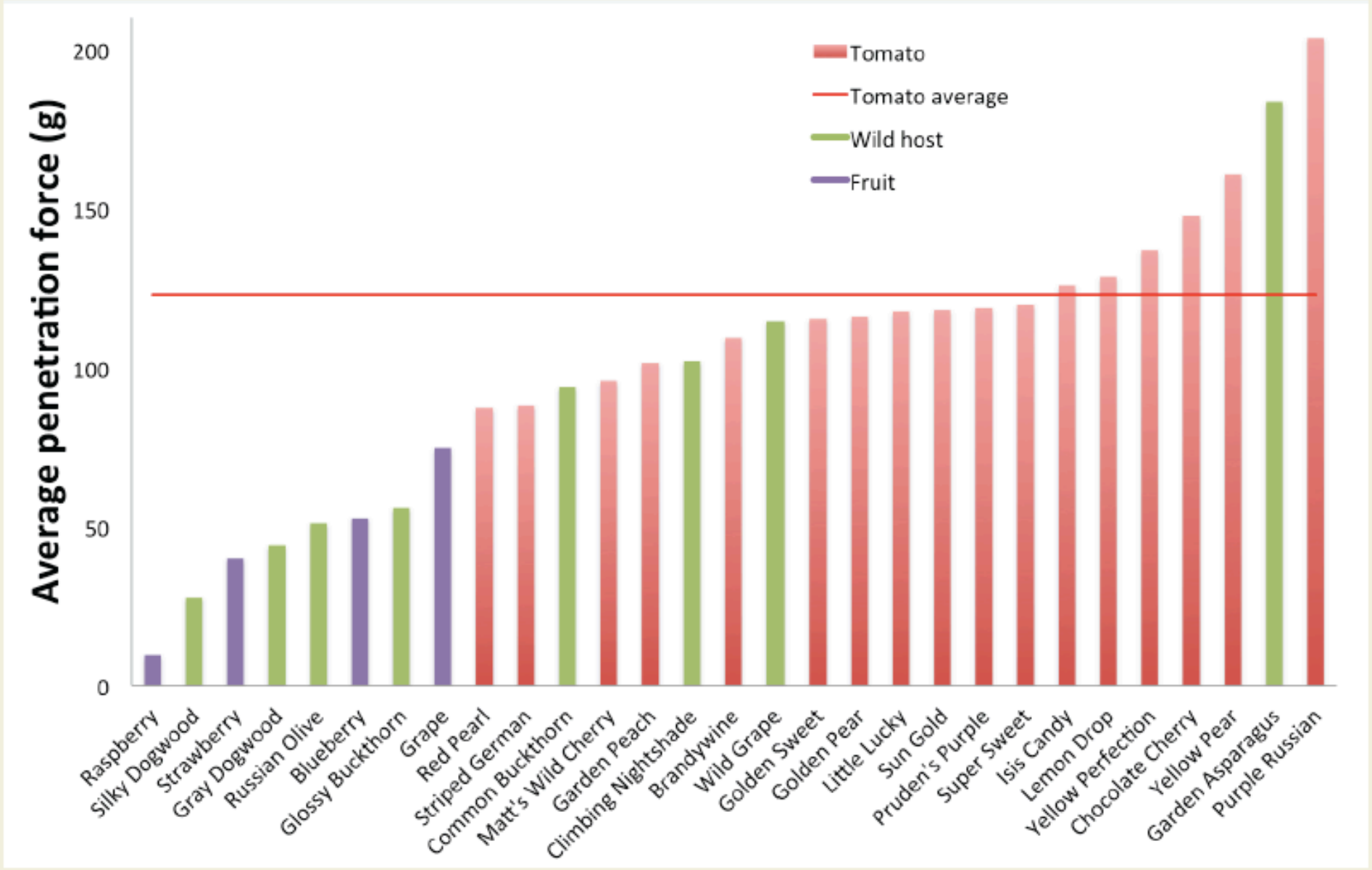
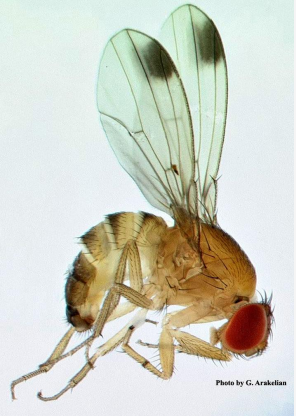


Figure 5. Average force (g) required to penetrate the skin of seventeen different tomato varieties, eight known wild hosts and 4 known cultivated fruit hosts of SWD. The solid red line indicates the average penetration force of all tomatoes.

Zuefle & Loeb



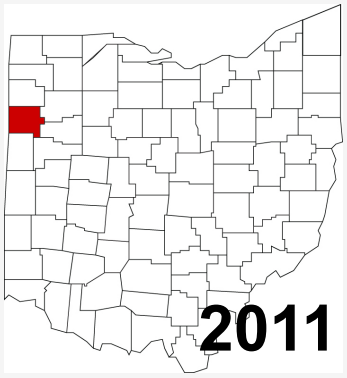
Origin

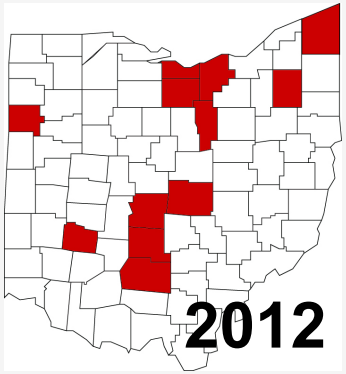
- From Asia
- In Hawaii since 1980
- 2008: California
- 2009: Florida, Washington, Oregon
- 2010: Michigan, Carolinas, Utah
- 2011: Ohio (Van Wert County)

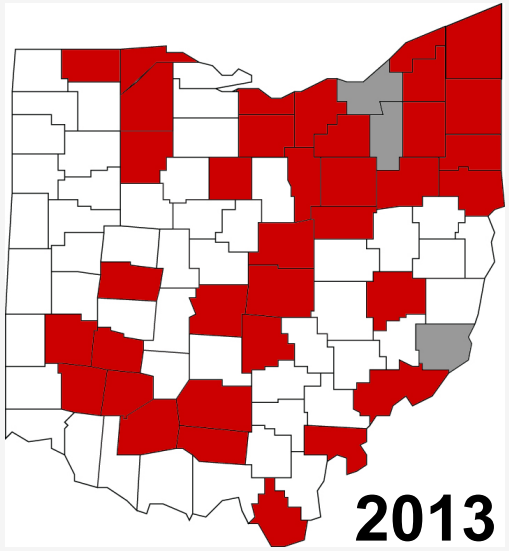
Ohio: SWD reports

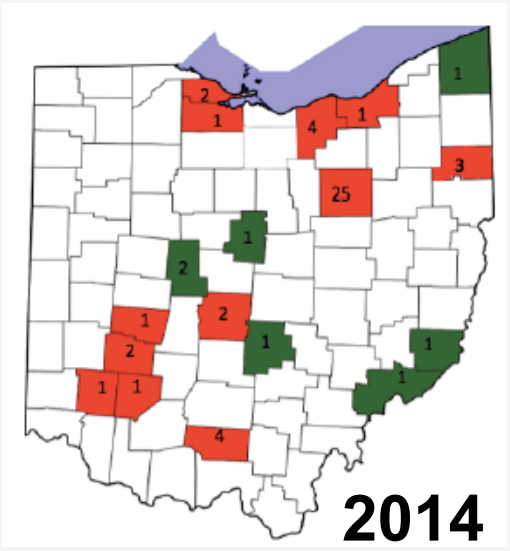
- Most reports
  - Blackberries
  - Raspberries
- Some reports
  - Blueberries
  - Peaches
  - Grapes

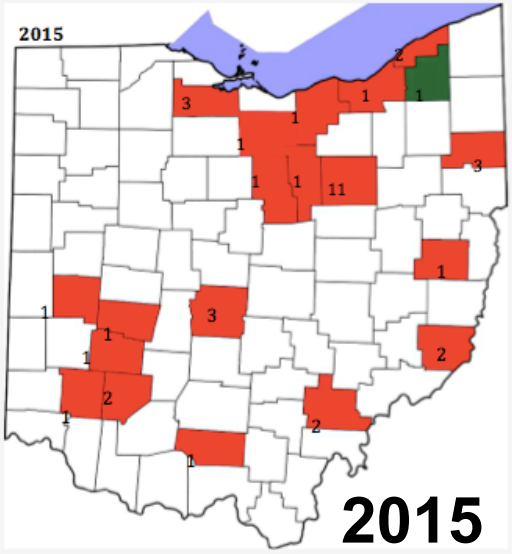
SWD detections in Ohio







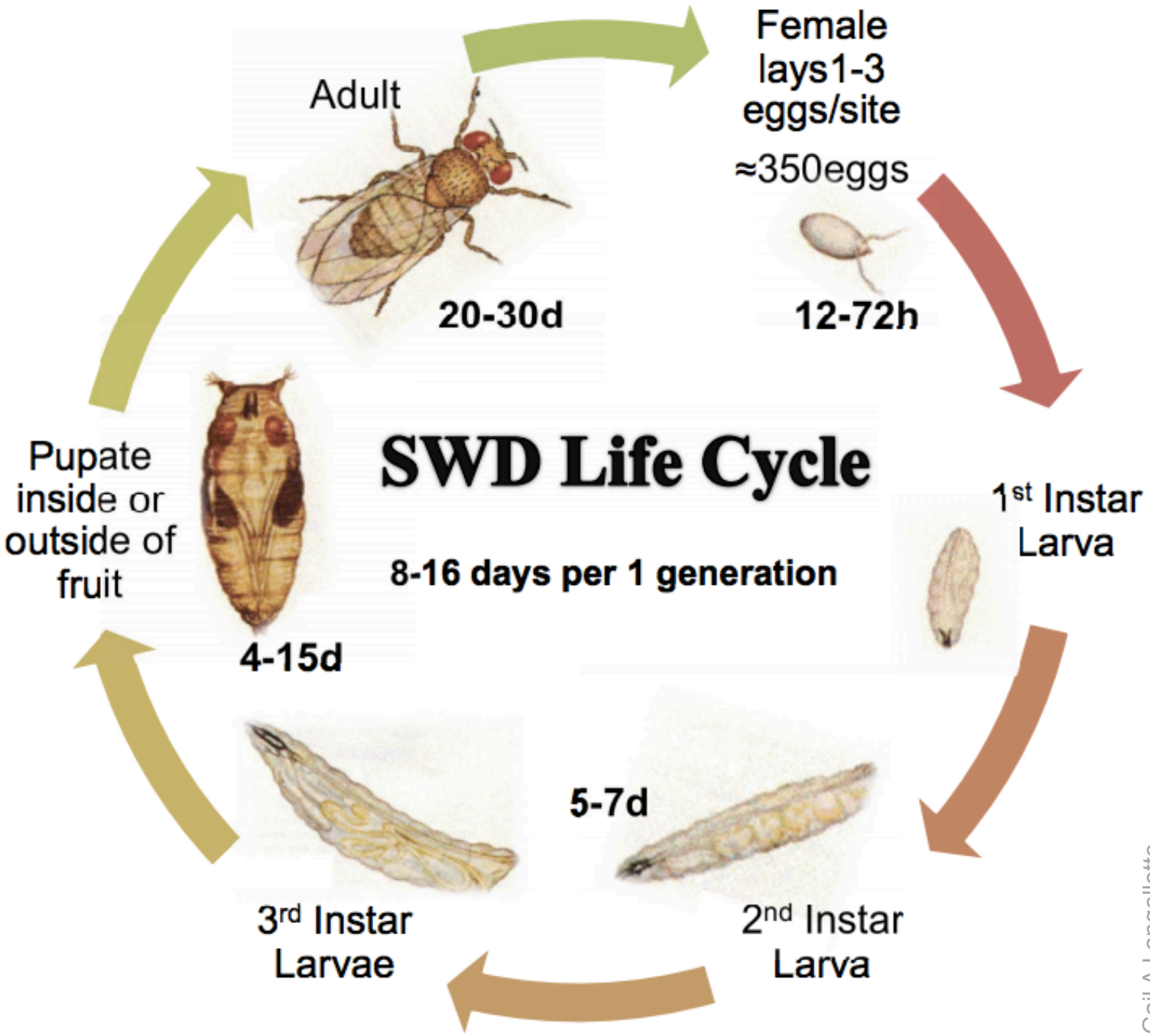




Trap network
Red: found
Green: not found

SWD status in Ohio

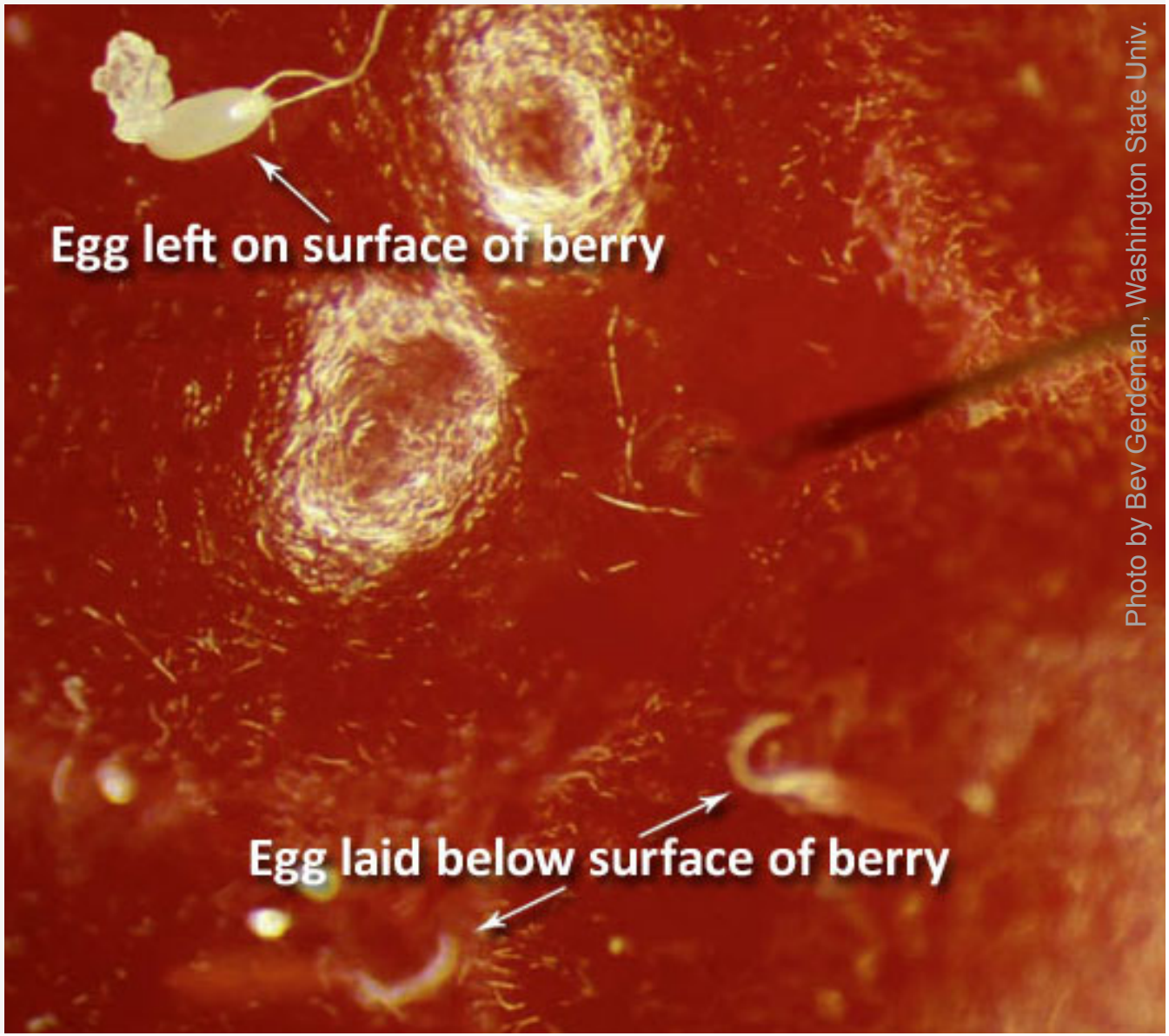
- Bad news
  - Widespread
  - Severe damage
- Good news
  - Under control if insecticide program used



Gail A Langellotto

SWD eggs

Egg being deposited by female fly



When talking to customers about worms in fruit…

- Say “Larvae”!
- Do not say “Maggots”!

Monitoring spotted wing Drosophila

- **Critical: is this pest present on farm?**
- **Use bait traps to monitor adult flies**
- **Use salt test to monitor larvae in fruit**

Baits to trap adult flies?

- Attractants
  - Fermenting matter
- Differences?
  - Earliest catch?
  - Fewest non-targets?

Bait traps

- **Apple cider vinegar (2012-13)**
  + a drop of dish soap

- **Fermenting bait (2014)**
  - **Yeast + sugar + flour + water**
  - **Float on vinegar**

- **Commercial bait (2015)**

  by Trécé; over water + a drop soap

- **Commercial bait (2016)**

  by Scentry, over 25% vinegar + soap

Using traps in fruit crops

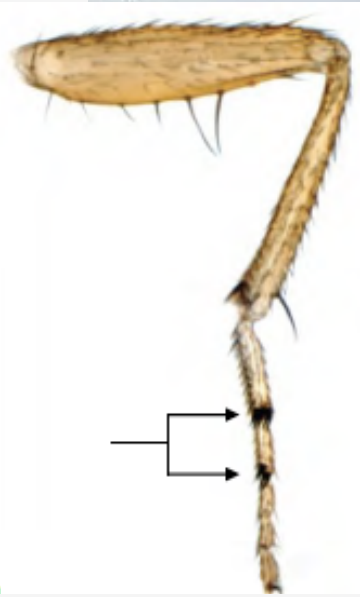
- Hang in canopy, near fruit clusters
- Holes facing outward
- On shady side
- 1-2 weeks prior to fruit ripening

Trap, then identify

- Threshold: a single SWD adult
- Need to separate:
  - Suspected SWD
  - All others
- Equipment:
  - Minimal: 30x magnifying lens
  - Better: Dissecting microscope

i.d. of adult male

- Spots on wings
- Spots can be absent on young (newly emerged) males
- 2 dark bands of combs on front leg



i.d. of adult female

- No spots on wings
- Saw-like ovipositor
  - Large, dark, more obvious

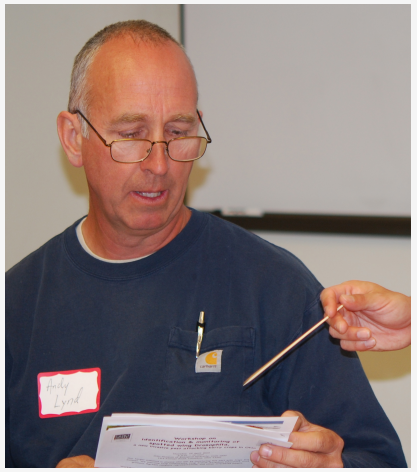
Seasonal trends in SWD traps

- 1st catch mid-July at most sites
- 1st catch June at few sites
- Higher catch when cool & wet
- Lower catch when hot & dry
- Peak catch in Sept.- October

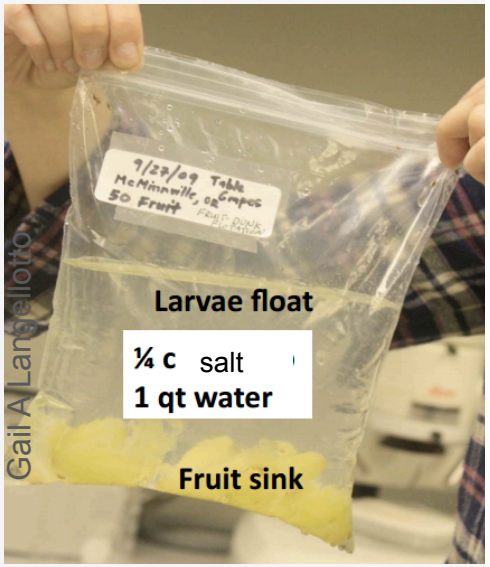
SWD outreach: need for more?

When?	What?	Where?
April 2013	workshop (3 hour)	Columbus
April 2014	workshop (3 hour)	Columbus
Early May 2015	webinar (1.5 hour)	-
Late May 2015	workshop (1.5 hour)	Wooster
April 2016	workshop (3 hour)	Wilmington



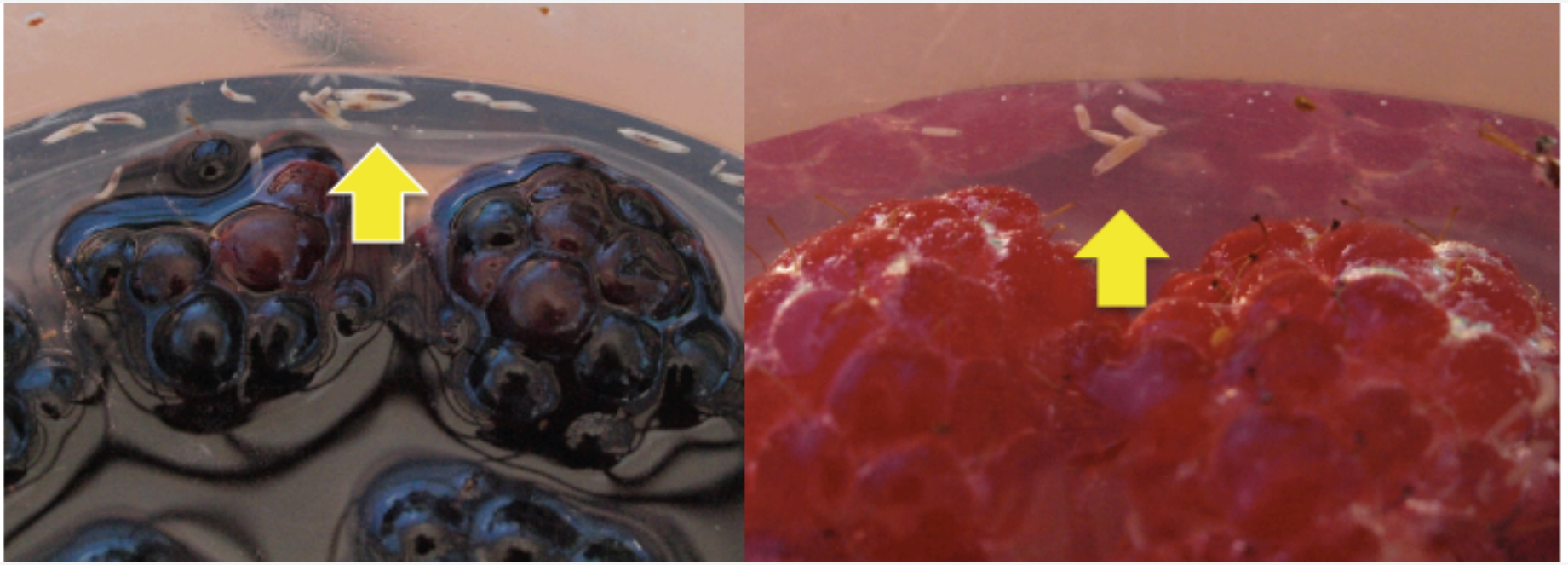


Test fruit for SWD larvae with salt test



- Get bag or jar
- Fill with warm water + salt
- Add fruit
- Examine top surface in 15 minutes
- Larvae will float

Salt test



Salt test: proportions

Salt	Warm water
1 Tablespoon	1 cup
¼ cup	1 quart (4 cups)
1 cup	1 gallon

Approach to SWD Monitoring

Time	Traps	Salt Test
Before 1st SWD detected	**Check weekly and sort sample within 24 hrs (5-10 min/trap)** **Report findings, even if 0**	**No Ripe fruit: No Test** **Ripe fruit: Test Optional**

Approach to SWD Monitoring

Time	Traps	Salt Test
Before 1st SWD detected	**Check weekly** and sort sample **within 24 hrs** (5-10 min/trap) Report findings, even if 0	No Ripe fruit: No Test Ripe fruit: Test Optional
After 1st SWD detected	Optional: Check weekly, keep samples, no need to sort for SWD	**Weekly**, best 1-2 days prior to insecticide spray

Biocontrol??

- Natives: ~2% parasitism
- Exploration in Korea
  - 4 parasitoid species
  - In quarantine @ Berkeley

Cultural controls for SWD

- Prompt harvest as soon as ripe
- Sanitation
  - Strongly recommended!
  - Destroy ALL leftover fruit
  - Do every 2 days
  - Culls in clear plastic bags in sun, 1 week

Cultural controls for SWD

- **Chill fruit as soon as harvested**
  - **Kills eggs & young larvae**
  - **8 days at 33 – 34 °F**

Cultural controls for SWD

- Keep plant rows narrow
  - Berries easy to see & remove
- Open up canopy
  - Thin to 3 – 4 strong canes per ft^2
  - Trellis
  - Improved spray coverage
  - Makes picking easier
- Allow ground to dry before irrigating

Cultural controls by crop & variety selection

Grow this	Do not grow this
Early-ripening blueberry varieties	Late-ripening blueberry varieties
Summer raspberries	Fall raspberries
June bearing strawberries	Ever-bearing strawberries
Black raspberries	-
Thick-skin grapes	Thin-skin grapes

Cultural control by removal of nearby wild hosts

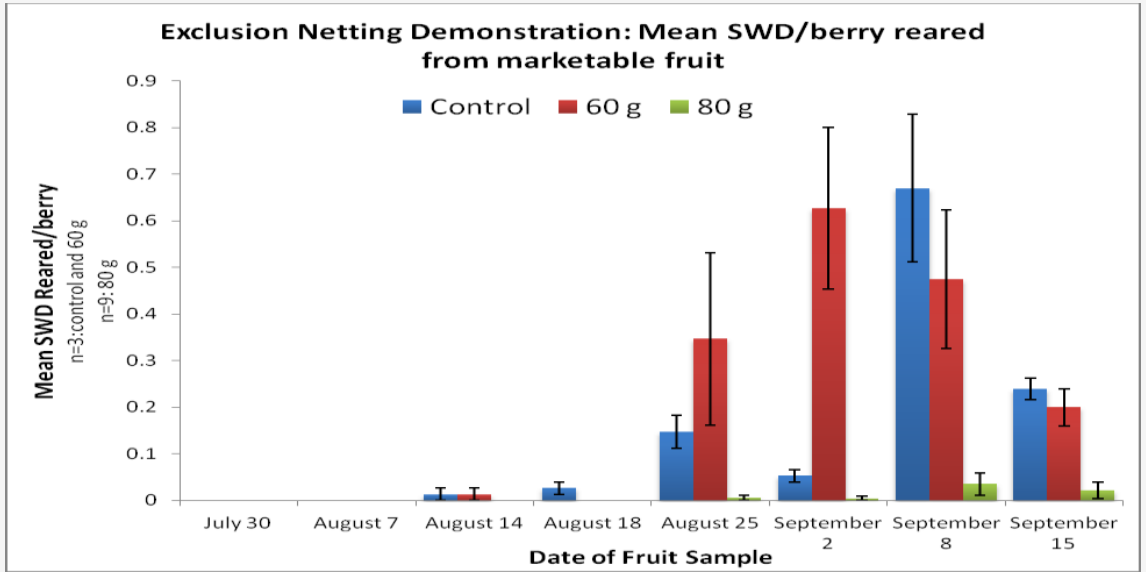
- Wild raspberry
- Wild blackberry
- Autumn olive
- Tartarian honeysuckle
- Bush honeysuckle
- Pokeweed
- Mock strawberry
- Silky dogwood
- Persimmon
- Rose hips

Mechanical control by netting

- Exclusion netting on outdoor crop
  - Also helps with birds & hail
- Netting added to high tunnels

Mechanical control by netting

- Can use row cover material
- Openings < 1 mm (18 mesh)
- Most using ProtekNet
  - 80 gram
  - 60 gram
- Can be ventilation issues



Dale Ila M. Riggs, 2014 (New York)

Mechanical control by netting

- On outdoor crop
- Feasible but takes planning
- Study in blueberry, NY
  - by Dale lla M. Riggs
  - Use existing bird net support system
  - Install after pollination
- Can add bee pollinators

Mechanical control by netting

- High tunnel studies
  - By Rufus Isaacs in MI
  - By Donn Johnson in AR
  - By Schattman & Link in VT

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Insect Exclusion Netting for SWD Control

Heather Leach and Rufus Isaacs

Large doors allow tractor mounted sprayer

Small doors adequate for backpack sprayer

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Insect Exclusion Netting for SWD Control

Heather Leach and Rufus Isaacs

- 3 high tunnels growing red raspberries covered in 80 gram netting
- Netting significantly delays and reduces SWD infestation
- Overall insect abundance decreased
- Increasing trends in temperature, but not significant
- No effect on fruit quality (brix, weight, diameter)

Large doors allow tractor mounted sprayer

Small doors adequate for backpack sprayer

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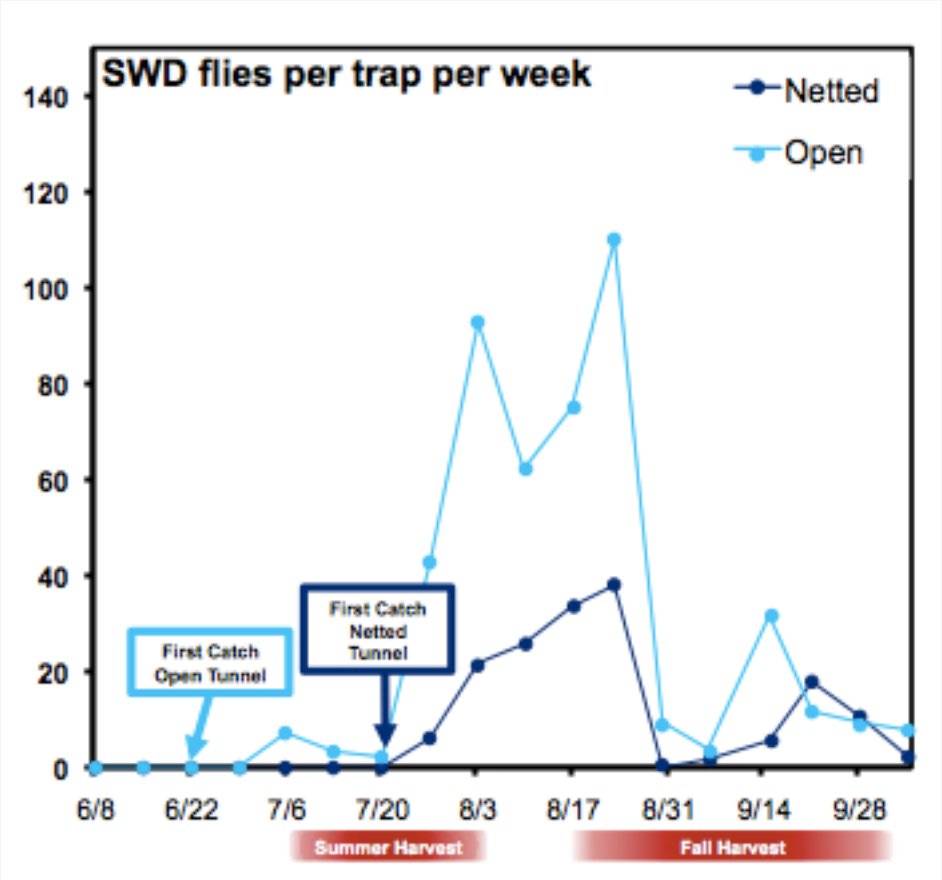
Insect Exclusion Netting for SWD Control

Heather Leach and Rufus Isaacs



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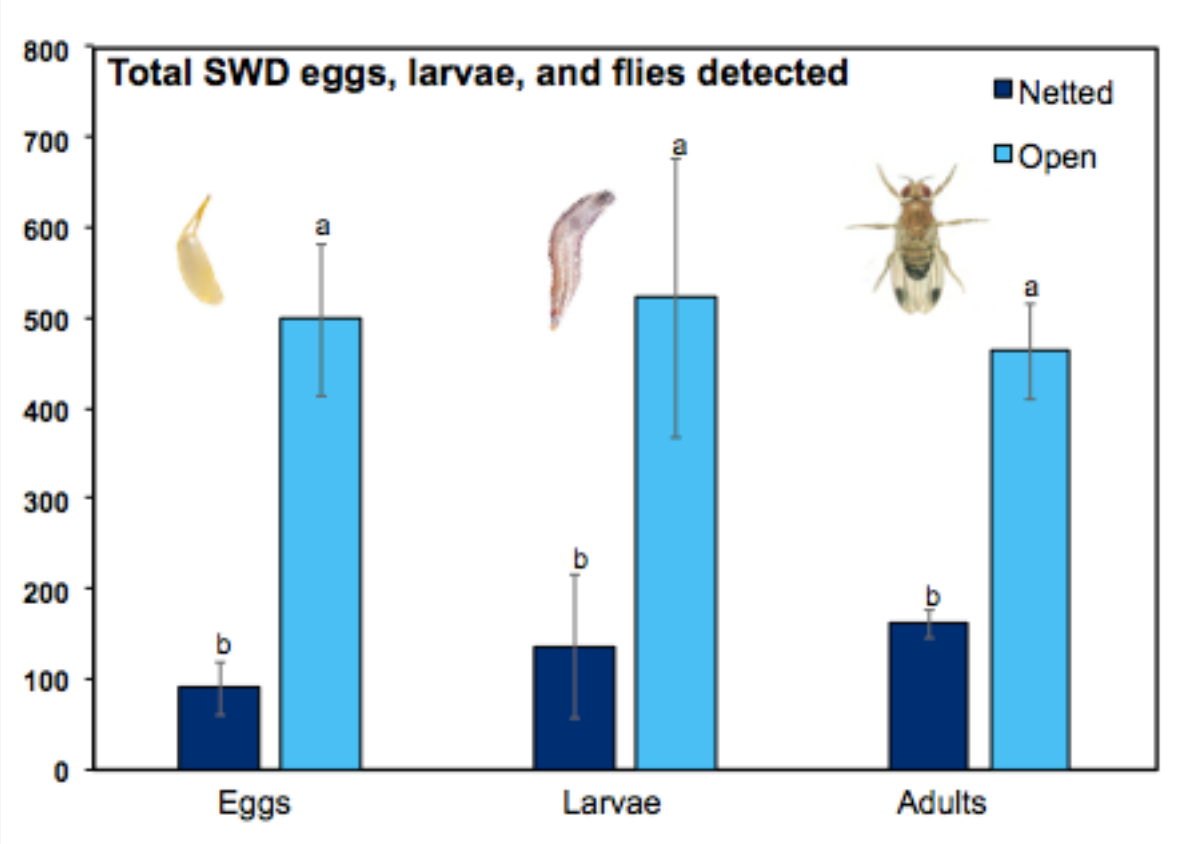

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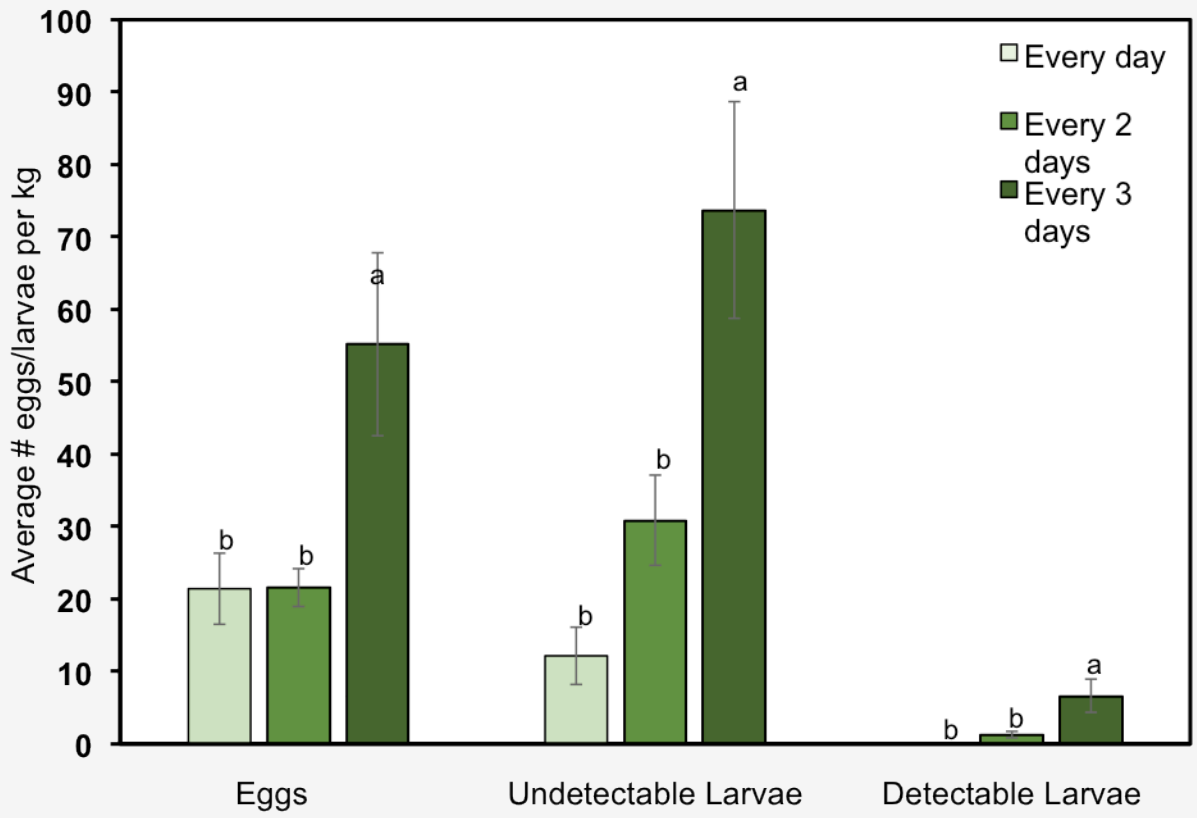
Harvest Frequency for SWD Control

Heather Leach and Rufus Isaacs

- Plots harvested either every day, every 2 days, or every 3 days
- Increasing harvest frequency to every day or every other day can significantly lower the number of SWD larvae in fruit
- 1st and 2nd instars considered undetectable larvae, 3rd instars considered detectable larvae



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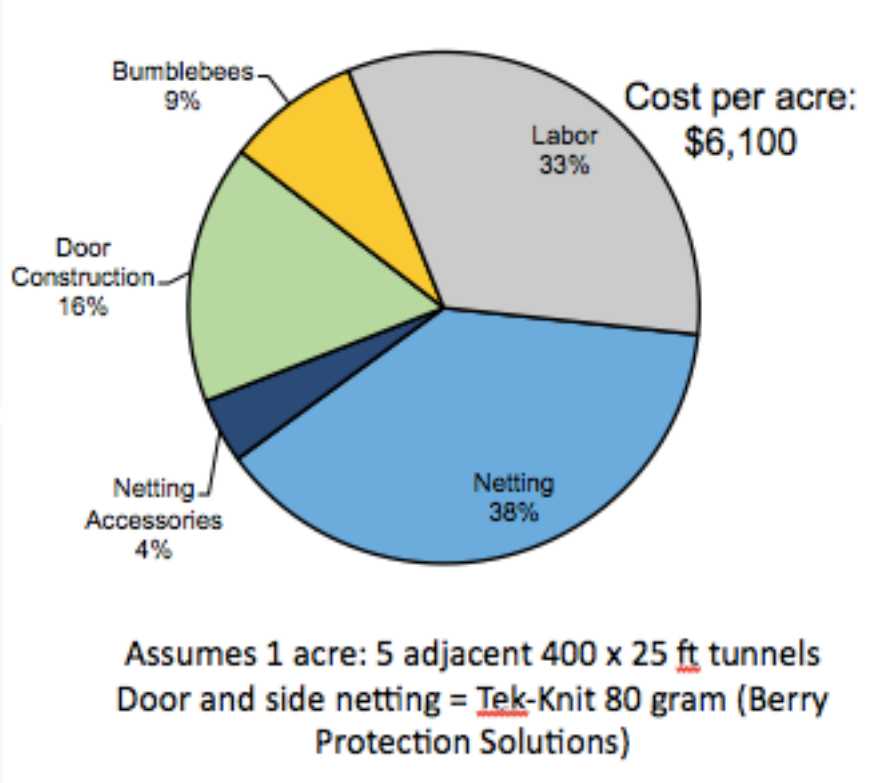


Lifespan about 7 years

Exclusion netting for control of spotted wing drosophila (SWD) in commercial blueberries and raspberries

Rachel Schattman & Hannah Link
Univ. of Vermont

Exclusion in high tunnels

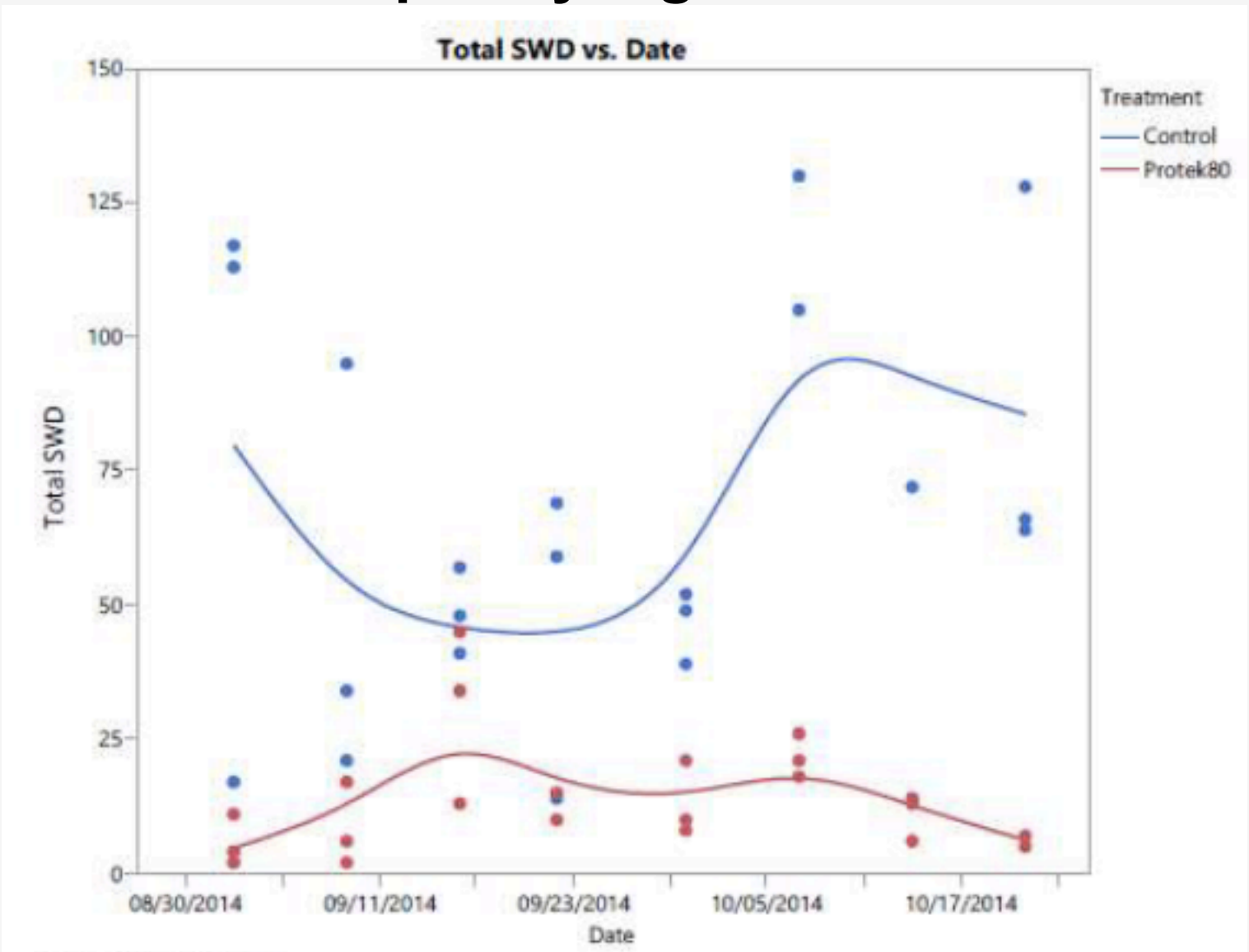
Schattman & Link, Univ. of Vermont

Evaluated:

- **ProtekNet 80**
- **ProtekNet 60**
- **a partial control (PN80)**
- **control**

Schattman & Link, Univ. of Vermont

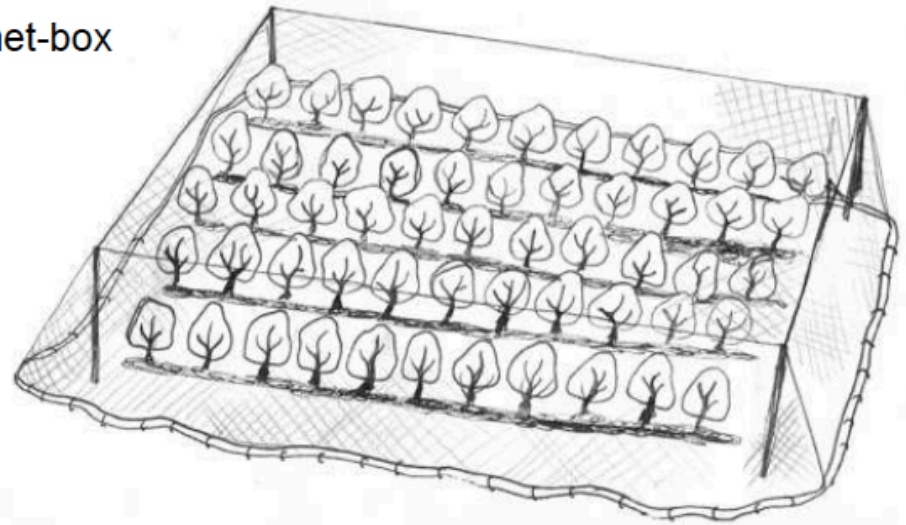
Results: Netting reduced total SWD population in raspberry high tunnels



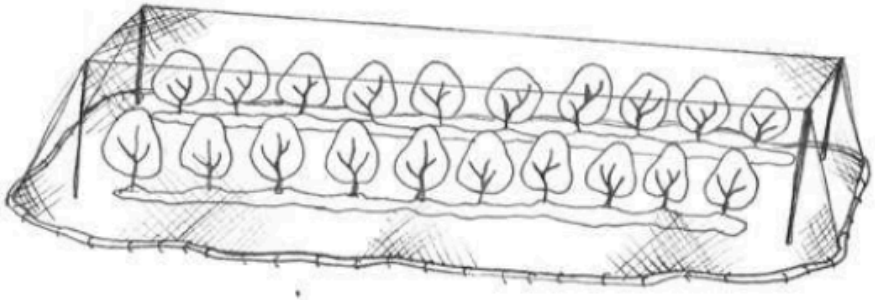
Schattman & Link, Univ. of Vermont

Trellis Systems

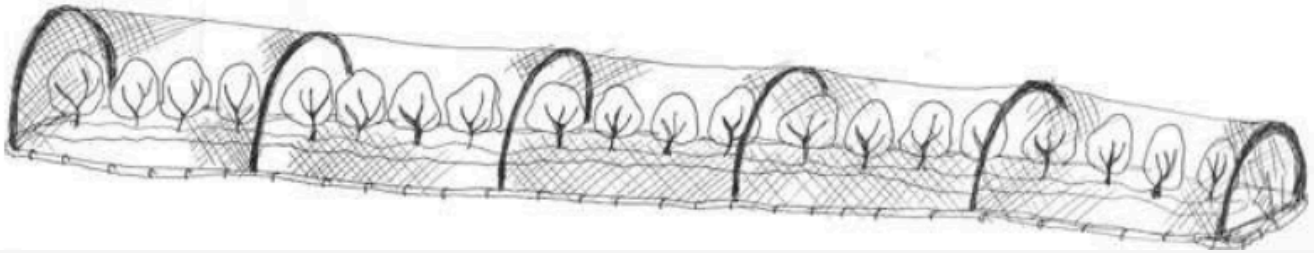
Large net-box



Small net-box



Medium tunnel



Most important qualities of a netting system:

1. Labor efficiency and ability to mow between the rows.
2. Readily available material and expense.

Insecticide strategy for SWD control

When to start spraying?

- If the adult flies are detected
- Fruit is susceptible to injury once it has started to turn color

Insecticide choices for SWD control

Efficacy	Group	Product
Most effective	spinosyns	Delegate
	diamides	Exirel
	organo-phosphates	Imidan, Diazinon
	pyrethroids	Mustang Max, Brigade, Pounce, Hero, Danitol, Baythroid, Asana, Warrior
	carbamates	Lannate
Effective	organo-phosphates	Malathion
	carbamates	Sevin
	spinosyns	Entrust [OMRI]
Moderately	neonicotinoid	Assail, Actara, Provado
Slightly	pyrethrins	Pyganic [OMRI]

How often to spray?

When residues no longer active

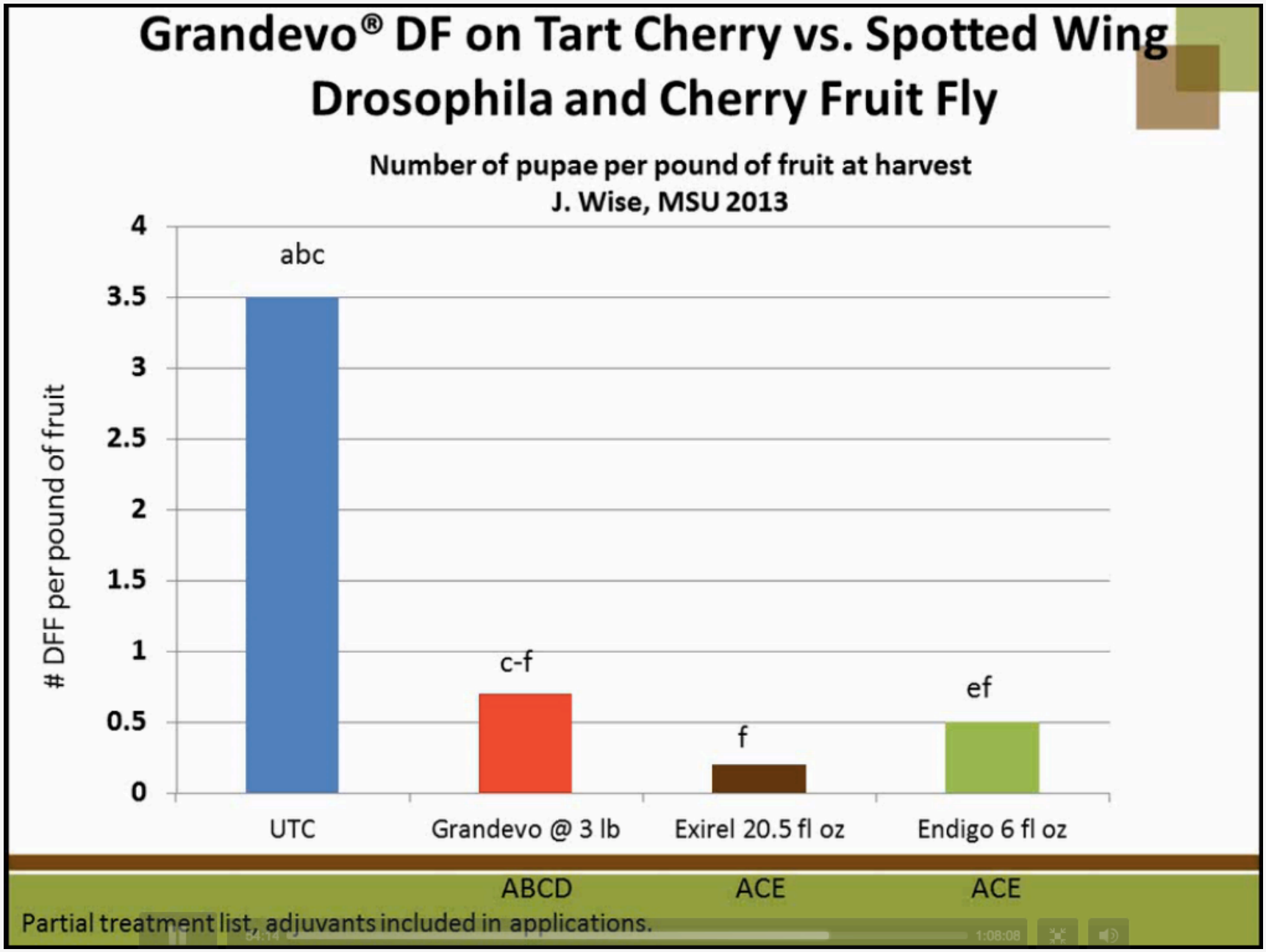
Product	*Residual activity*
Exirel	5 days
Delegate	5-7 days
Imidan, Diazinon	7 days
Pyrethroids: Asana Brigade Danitol Hero Mustang Max Warrior	7-10 days
Malathion	5-7 days
Lannate	3-6 days
Entrust	3-5 days
Pyganic	1-3 days

Insecticides for SWD on brambles

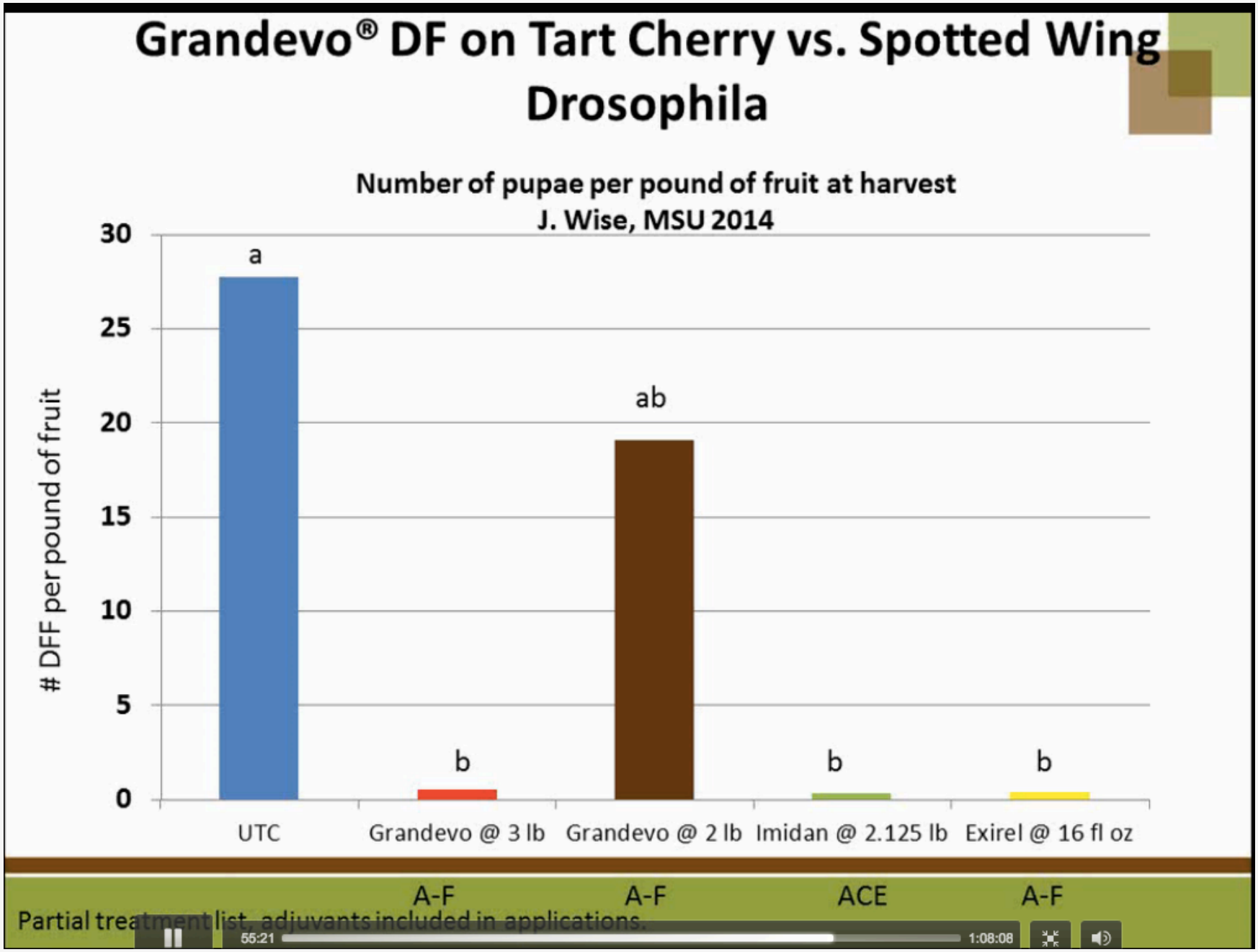
Product	*Pre-harvest interval*	*Maximum number of applications allowed (if used at max rate)*
Delegate	1 day	3
Mustang Max	1 day	6
Malathion	1 day	3
Entrust [OMRI]	1 day	4
Danitol	3 days	2
Brigade	3 days	2
Hero	3 days	2
Pyganic [OMRI]	0 days	-

New options for organic growers

- Grandevo
  - –2(ee) labels for SWD
    - Control on stone fruit
    - Suppression on bushberries
    - Suppression on caneberries
  - –3 lbs / acre
- Venerate
  - –No 2(ee) labels for SWD
  - –4 – 8 qt/A

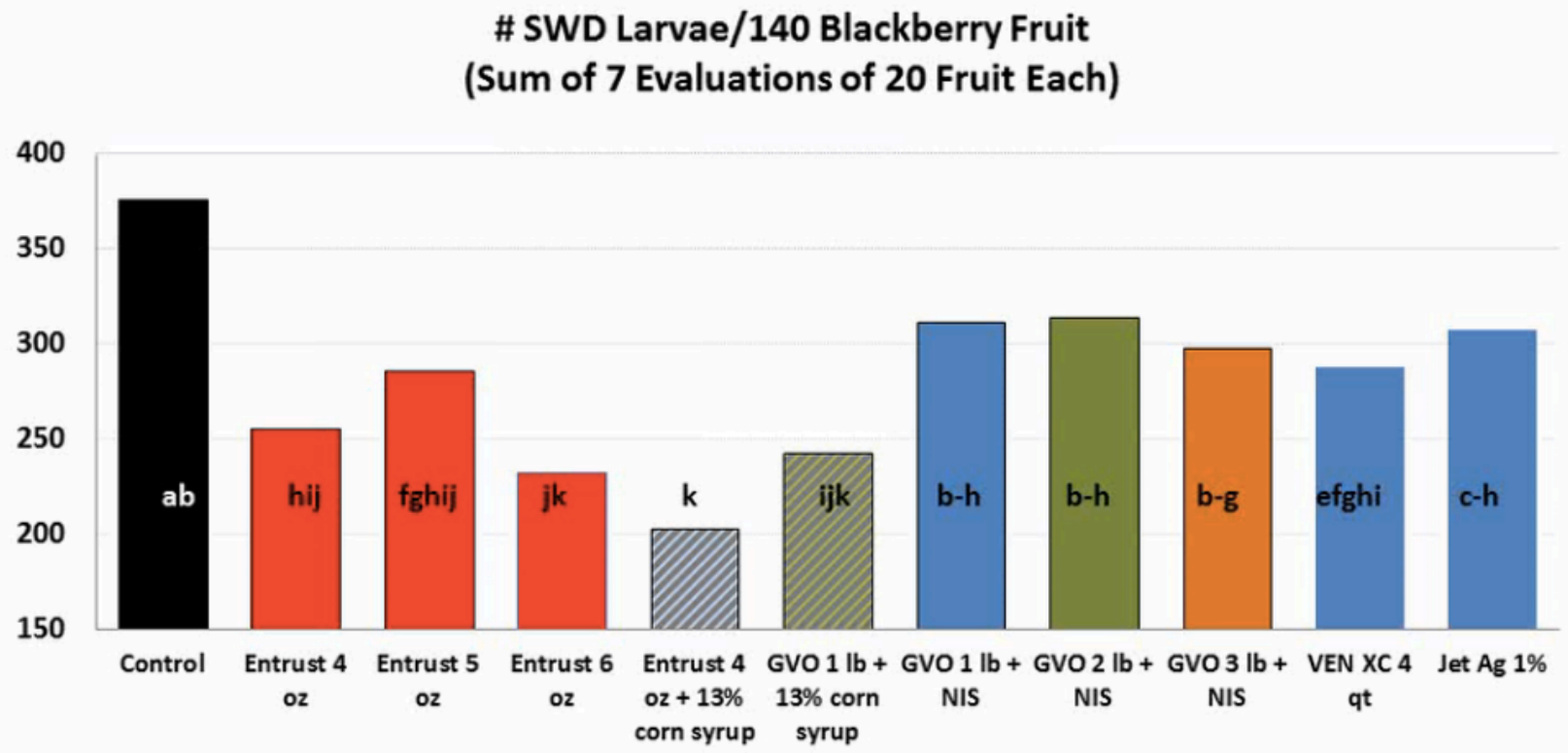


Slide by Tim Johnson, Marrone Bio Innovations



Slide by Tim Johnson, Marrone Bio Innovations

Control of Spotted Wing Drosophila on Blackberry in Washington State



Six applications in **150 GPA**, means separated by SNK (P=0.05) following data transformation.
Trial conducted by Agricultural Development Group.

Slide by Tim Johnson, Marrone Bio Innovations

Sucrose adjuvant to increase efficacy

(Cowles et al. 2015)

- Add sucrose (sugar)
- Assume 50 gal water/acre
- Use 1 pound/acre

Summary: Management of SWD on brambles

1. Use bait traps, check weekly
2. If any SWD in traps, start spray program when berries start to color
   - Spray* until final harvest
3. Do a salt test with ripe fruit, weekly, to see if program effective
4. Spray more often if control not good

* every 7 days if conventional: Delegate & Mustang
* every 5 days if organic: Entrust & Pyganic, + sugar

Chart for SWD on all crops

u.osu.edu/pestmanagement/files/2014/12/SWD_Ohio_handoutV14-1dmqcv7.pdf

Efficacy	Mode of action group	Product	Residual activity (days)	Pre-harvest interval (PHI)						
				raspberry, blackberry	blue-berry	straw-berry	grape	cherry	peach	plum
Very effective	5	§ Delegate	5-7	1 day	3 days	X	7 days	7 days	14 days	7 days
	5	§ Radiant	5-7	X	X	1 day	X	X	X	X
	28	Exirel	5	X	3 days	X	X	3 days	3 days	3 days
	3A	! Mustang Max	7-10	1 day	1 day	X	1 day	14 days	14 days	14 days
	3A	! Brigade	7-10	3 days	1 day	0 days	30 days	X	X	X
	3A	! Hero	7-10	3 days	1 day	X	30 days	X	X	X
	3A	! Danitol	7-10	3 days	3 days	2 days	21 days	3 days	3 days	3 days
	3A	! Asana	7-10	7 days	14 days	X	X	14 days	14 days	14 days
	3A	! Baythroid	7-10	X	X	X	3 days	7 days	7 days	7 days
	3A	! Warrior	7-10	X	X	X	X	14 days	14 days	14 days
	3A	! Pounce	7-10	X	X	X	X	3 days	14 days	X
	1B	Imidan	7	X	3 days	X	14 days	7 days	14 days	7 days
	1B	!§ Diazinon	7	7 days	7 days	5 days	X	21 days	21 days	21 days
	1A	! Lannate	3-6	X	3 days	X	X	X	4 days	X
Effective	1B	Malathion	5-7	1 day	1 day	3 days	3 days	3 days	7 days	X
	5	Entrust [OMRI]	3-5	1 day	3 days	1 day	7 days	14 days	14 days	7 days
Moderately effective	1A	Sevin	10	7 days	7 days	7 days	7 days	3 days	3 days	3 days
	4A	§ Assail	1-3	1 day	1 day	1 day	3 days	7 days	7 days	7 days
Slightly eff.	3A	Pyganic [OMRI]	1-3	0 days	0 days	0 days	0 days	0 days	0 days	0 days
Not effective	4A	Actara	1-3	3 days	3 days	X	5 days	14 days	14 days	14 days
	4A	Admire Pro	1-3	3 days	3 days	7 days	0 days	7 days	0 days	7 days

! Restricted-Use Pesticide

§ Not allowed in greenhouses or high tunnels

X means that the product is NOT ALLOWED for use on that crop.

Insecticides for high tunnels?

For products used for SWD control:

- Label prohibits in greenhouses:
  - Delegate
  - Diazinon
- Label allows in greenhouses:
  - Malathion
- Label 'silent' on greenhouses

therefore ok to use:

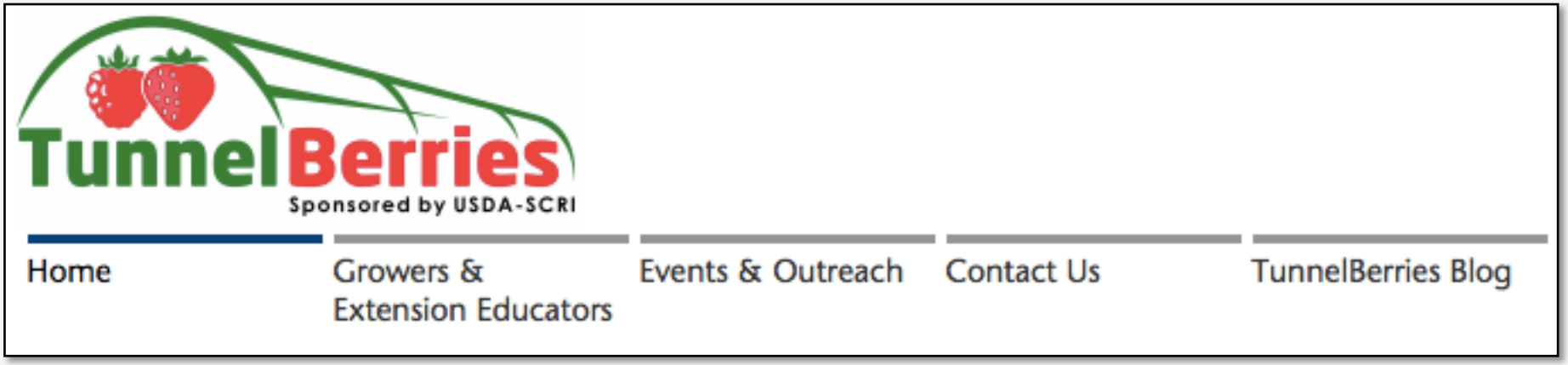
- pyrethroids: Asana, Baythroid, Brigade, Danitol, Hero, Mustang, Pounce, Warrior
- Lannate
- Imidan
- Entrust

Additional info on SWD

On website: u.osu.edu/pestmanagement

- 2-page color info sheet
  - Includes insecticides for commercial farms
- Instructions for trapping
- Instructions for salt tests
- Insecticide list for home gardens
- Information about chilling fruit
- Microscope recommendations
- Slide show
- Links to references

On-line resources



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RUTGERS THE STATE UNIVERSITY OF NEW JERSEY

University of New Hampshire

- Selecting tunnel structures & plastics
- Optimizing productivity & pest management
- Increasing profits
- Minimizing plastic waste generation

the end

website: u.osu.edu/pestmanagement
e-mail: welty.1@osu.edu
office phone: 614-292-2803
cell phone: 614-746-2429