



Integrated Pest Management options for Spotted Wing Drosophila



LUCE Integrated Pest Management Program

Jaime Piñero

State IPM Specialist
Lincoln University
Jefferson City, MO 65102

Tel: (573) 681-5522
pineroj@lincolnu.edu



SPOTTED WING DROSOPHILA

CLINIC



Midwest states have been invaded by Spotted Wing Drosophila (SWD), a small vinegar fly that has the ability to pierce the skin of healthy fruits and vegetables, and the maggots develop inside the fruits.

Information on SWD monitoring and management options available on Friday (Jan. 10) and Saturday (Jan, 11).

ROOM 211



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Host Plants

Tree fruits, small fruits, some vegetable fruits such as tomatoes

Highest risk crops = Raspberries, blackberries, blueberries, cherries, strawberries, nectarines

Lower risk crops = Grapes, pears, peaches

Common factors contributing to high risk:

- Softer fruit (skin)
- Later season

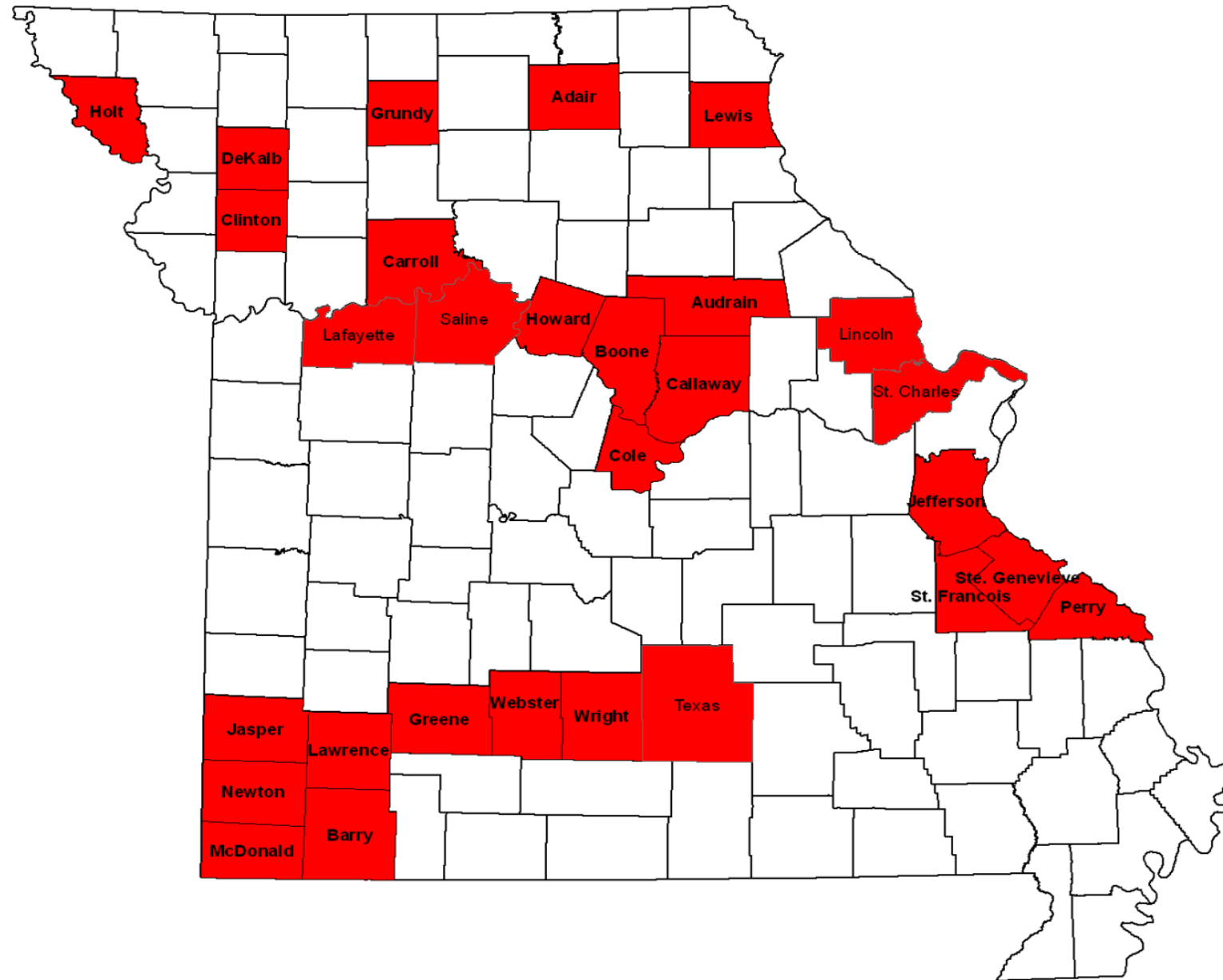


Significance

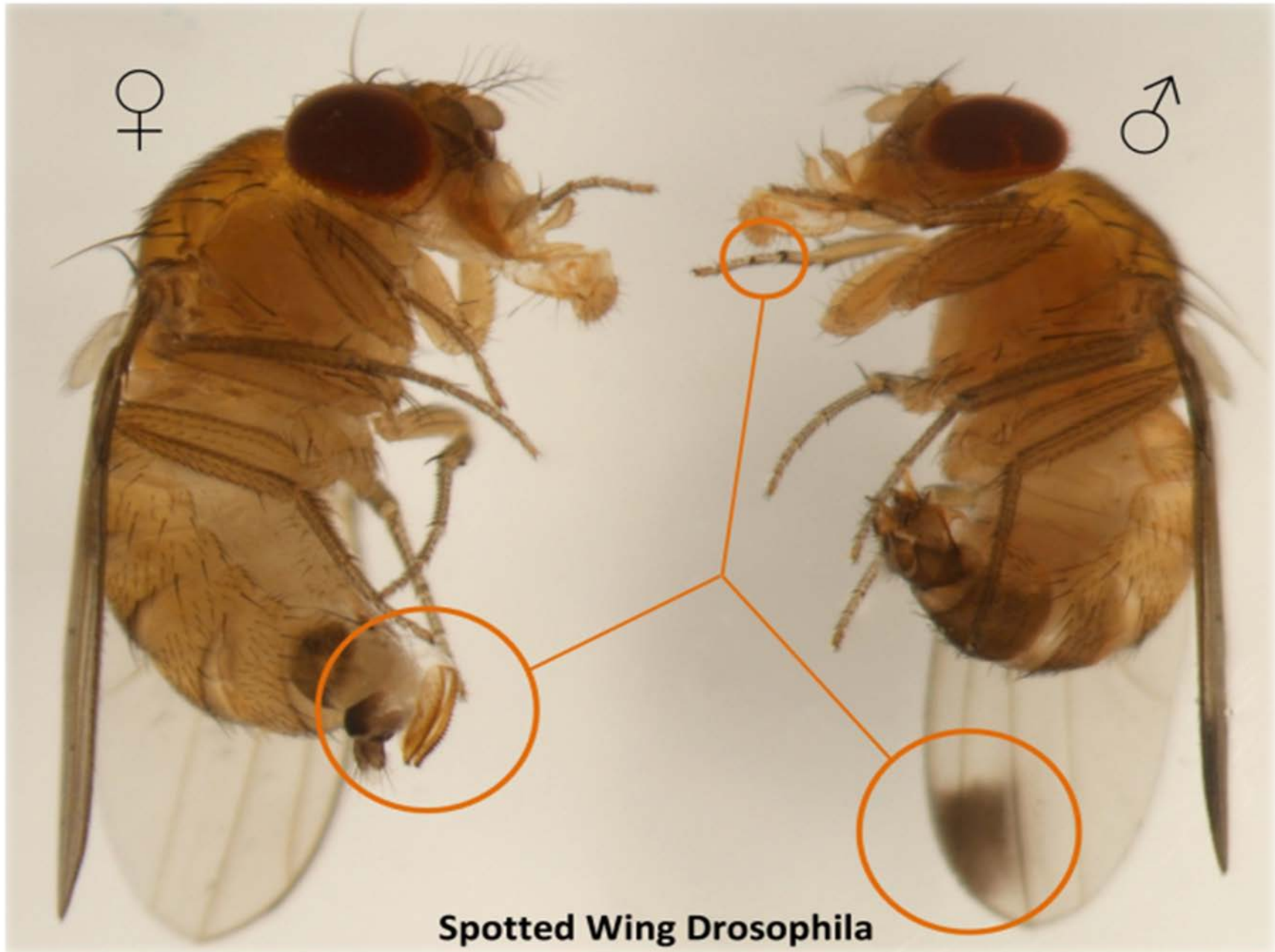


- ✓ Unlike other fruit flies, SWD attacks sound ripening fruit, also attacks some vegetables
- ✓ Once eggs laid in fruit, no longer able to control with pesticides
- ✓ Short lifecycle and overlapping generations make spray timing difficult
- ✓ Requires sprays near harvest time
- ✓ Requires multiple sprays which can lead to pesticide resistance

SWS infestations in MO



How to identify SWD

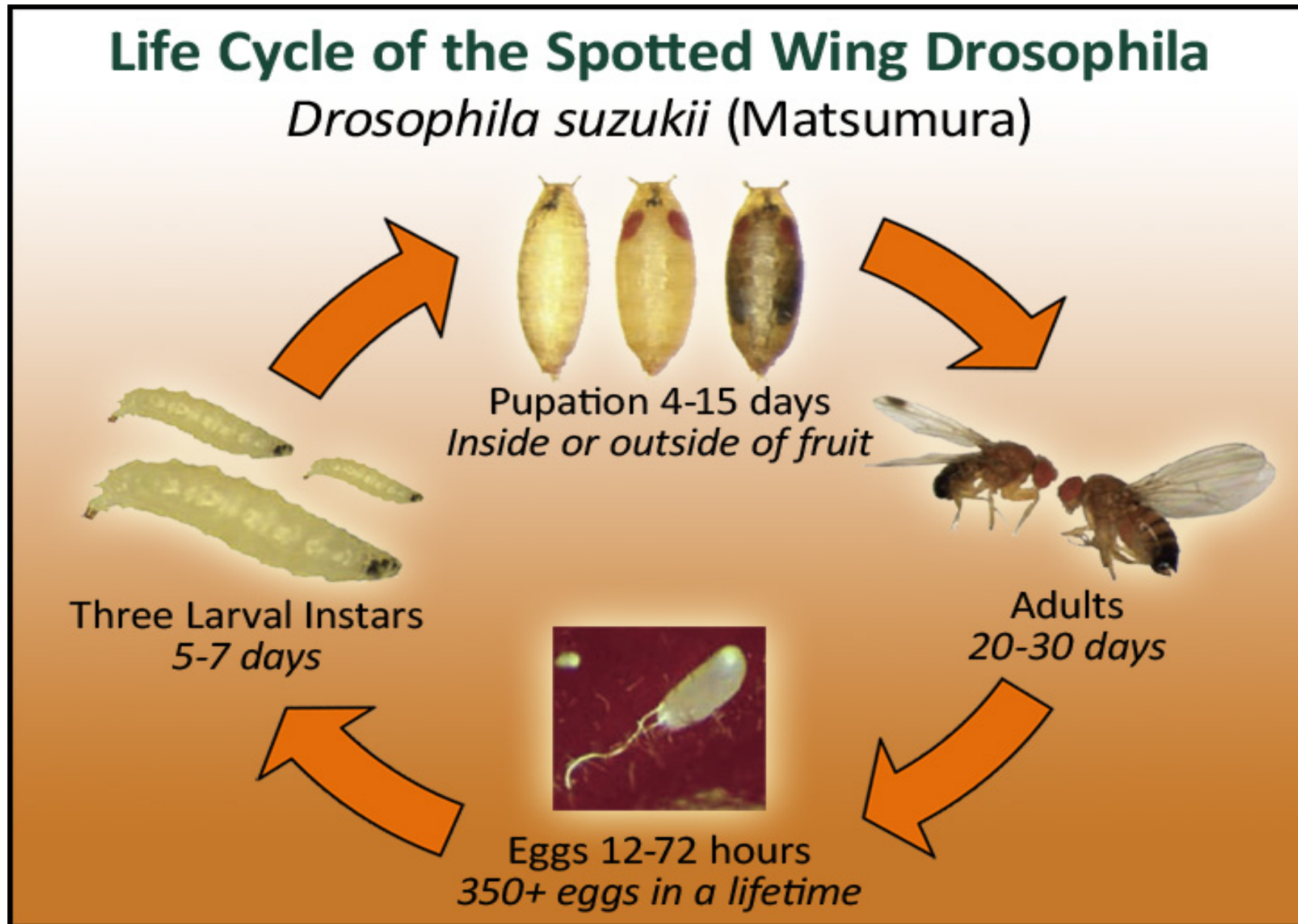


Everything starts with an egg being laid...



Ovipositing female SWD. Source: E. Beers, Washington State Univ.

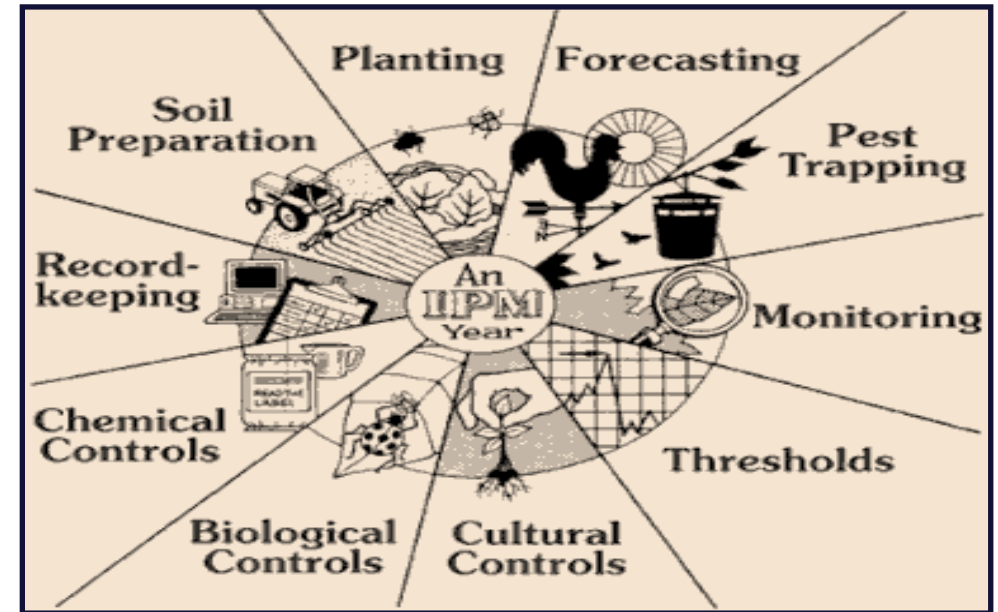
Life Cycle



Source: Washington State Univ.

IPM defined

- Optimization of pest control in an ecologically and economically sound manner
- Emphasis on coordinated use of multiple pest management tactics to ensure adequate crop production
- Maintenance of pest damage below injurious levels, while minimizing hazards to humans, animals, plants and the environment in general



Source: <http://www.ipminstitute.org>

For the 2014 season, an IPM program to manage SWD in susceptible crops throughout harvest is recommended.

IPM of SWD: FOLLOW THE *PAMS* APPROACH

Prevention, Avoidance, Monitoring and Suppression

**Prevention:
Cultural
management**

PREVENTION

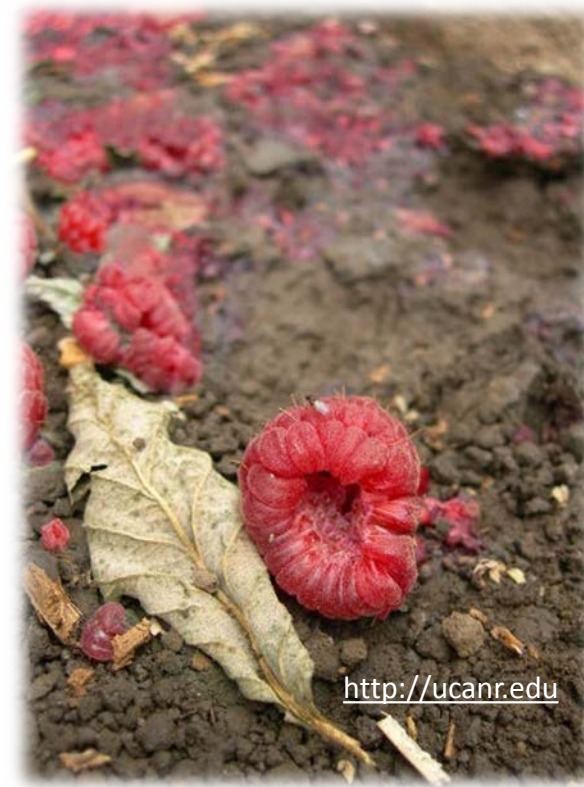
Canopy management



- For brambles, thin the plant row to 3-4 strong canes per square foot, eliminating weaker shoots and **opening the canopy**
- Consider a trellising system that similarly opens the canopy
- **This may make plantings less attractive to SWD and will improve insecticide spray coverage**

PREVENTION

Sanitation



- Removing over-ripe fruit from production areas can minimize SWD egg laying and larval development
- Growers in other regions of the country have sent pickers through fields with one container to collect good fruit and another container to collect over-ripe fruit
- **In the case of strawberries, sanitation also helps reduce incidence of fungal diseases such as Rhizopus rot and Botrytis grey mold**

PREVENTION

Exclusion



- For small plantings, or for high tunnels, one option is using a fine mesh screen with openings less than 0.039 inches (0.98 millimeters) wide (18 mesh or finer)
- Mesh screens will exclude pollinating insects, so it is best to cover your plants once fruit is set, or introduce pollinators if the crop is in bloom
- High tunnels: Removable screens with Velcro allow for attachment at fruit set and early development.
- **If SWD is found by trapping inside the high tunnel, an insecticide application may provide SWD suppression for the rest of the season if exclusion is implemented**

IPM of SWD: FOLLOW THE *PAMS* APPROACH

Prevention, Avoidance, Monitoring and Suppression

E.g., Trap cropping, mass trapping

**Almost no
options**

IPM of SWD: FOLLOW THE *PAMS* APPROACH

Prevention, Avoidance, Monitoring and Suppression

Goals:

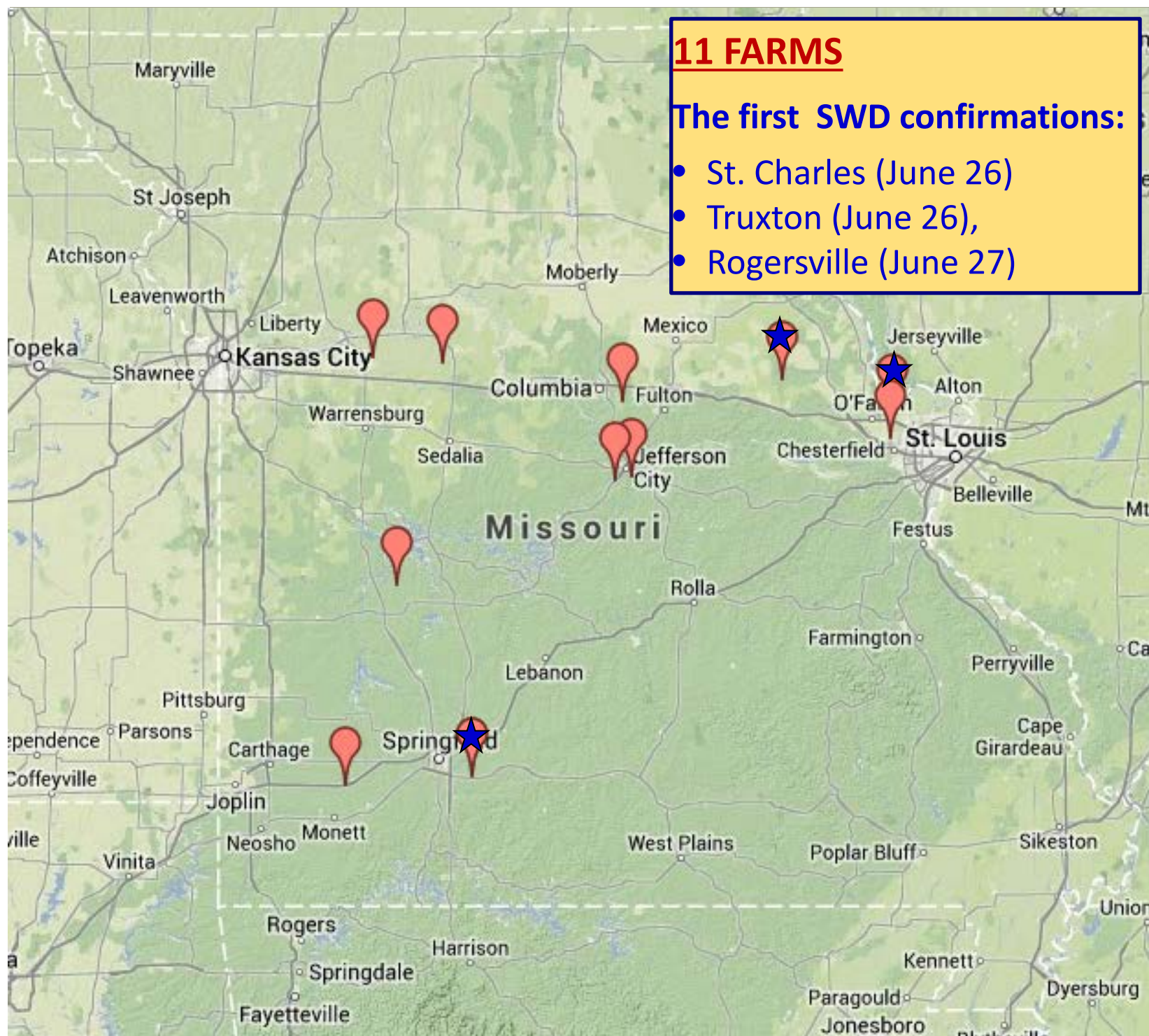
- *Simply determine SWD presence or absence*
- *Helps time insecticide sprays (if needed)*
- *Confirm efficacy of control measures*

MONITORING

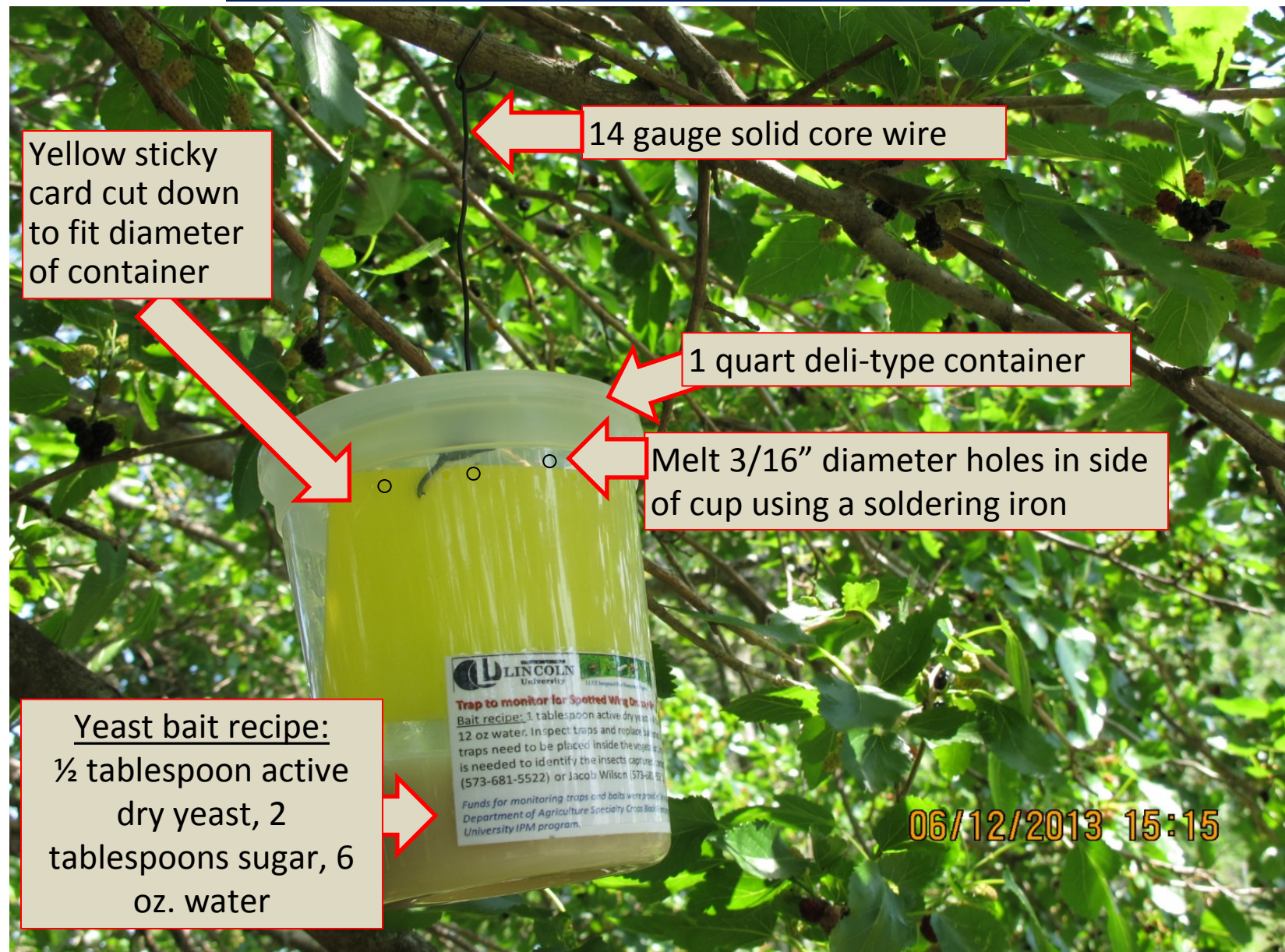


Invasive Insect Pests
Threatening Specialty Crops
in Missouri: Monitoring,
Organic Management, and
Farmer's Education
(2013-2014)

12-25-B-1471



How to make a trap to monitor for SWD



Some Guidelines

- Check at least weekly (more often is better)
- Change bait weekly
- Do NOT dump old bait in the field
- As fruit ripens, visually scout areas with ripe and overripe fruit for adults
- Will traps bring flies to my farm that are not already there?

No, the radius that the traps attract from is thought to be quite small





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IPM of SWD: FOLLOW THE *PAMS* APPROACH

Prevention, Avoidance, Monitoring and Suppression

Insecticides


Insecticidal options

- Pesticides in three activity groups – **pyrethroids** (IRAC activity group 3), **spinosyns** (activity group 5), and **organophosphates** (activity group 1B) have shown fairly good efficacy against SWD adults
- Applying sprays without knowing whether SWD is present is not recommended, **as populations of beneficial predatory insects and pollinators may be needlessly decimated**



Insecticidal options


Pyrethroids and pyrethrins (IRAC activity group 3A)

Trade name (Active Ingredient)	Pre-harvest interval (days)				Effectiveness	Length of Residual Activity
	Raspberries	Blackberries	Strawberries	Cherries		
Brigade (bifenthrin)	3	3	0	X	Excellent	7 days
Danitol (fenpropathrin)	3*	3*	2*	3*	Excellent	7 days
Baythroid (beta-cyfluthrin)	X	X	X	7*	Excellent	7 days
Mustang Max (zeta-cypermethrin)	1*	1*	X	14*	Excellent	7 days
PyGanic (pyrethrins) ** 	0	0	0	0	Good***	0-2 days

Data for Pyrethroids and pyrethrins (IRAC activity group 3A)

Insecticidal options

Spinosyns (IRAC activity group 5)

	Pre-harvest interval (days)					
Trade name (Active Ingredient)	Raspberries	Blackberries	Strawberries	Cherries	Effectiveness	Length of Residual Activity
Delegate (spinetoram)	1*	1*	X	7*	Excellent	5-7 days
Radiant (spinetoram)	X	X	1	X	Excellent	5-7 days
Spintor (spinosad)	1	1	1	7	Excellent	5-7 days
Success (spinosad)	1*	1*	1	7*	Excellent	5-7 days
Entrust (spinosad) ** 	1*	1*	1	7*	Excellent	3-5 days

Data for Spinosyns (IRAC activity group 5)

Insecticidal options

Organophosphates (IRAC activity group 1B)

	Pre-harvest interval (days)					
Trade name (Active Ingredient)	Raspberries	Blackberries	Strawberries	Cherries	Effectiveness	Length of Residual Activity
Malathion (malathion)	1	1	3	3	Excellent	>7 days
Diazinon (diazinon)	X	X	5	21	Excellent	>7 days

Data for Organophosphates (IRAC activity group 1B)

2014 Midwest Small Fruit and Grape Spray Guide

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Insecticidal options

Pest/Problem	Material	Rate/Acre	Comments
Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila	Baythroid XL (1EC)	2.4-3.2 fl oz	See Special Insect Pest Problems on page 63.
	Delegate 25WG	3-5 oz	
	Entrust 2SC	4-8 fl oz	
	Entrust 80 WP	1.25-2.5 oz	
	Malathion 8F	1.88 pt	
	Mustang Max 0.8EC	4.0 fl oz	

Table 3. Effectiveness of Pesticides for Control of Grape Insects and Mites

	Climbing cutworm	Eight spotted forester	Grape berry moth	Grape cane girdler, Grape cane gallmaker	Grape flea beetle	Grape phylloxera (foliar)	Grape root borer	Japanese beetle	Leafhoppers	Multicolored Asian lady beetle	Redbanded leafroller	Rose chafer	Spider mites	Spotted wing Drosophila, Fruitflies
Insecticides														
Actara		-	-	-	-		-	-	++	-	-	-	-	-
Admire	-	-	-	-	-	++	-	+	+++	++	-	+	-	+
Altacor	-	-	+++		-	-	-	-	-	-	+++	-	-	-
Applaud	-	-	-	-	-	-	-	-	++	-	-	-	-	-
Assail	-	-	-	-	-	++	-	++	+++	-	-	+++	-	+
Baythroid, Renounce (RUP)	-	-	+++	++	++	++	-	+++	++	++	-	+++	-	+++
Belay	-	-	+	-	-	-	-	+	+++	+++	-	-	-	-
Belt	-	-	+++	-	-	-	-	-	-	-	+++	-	-	-

Insecticidal options

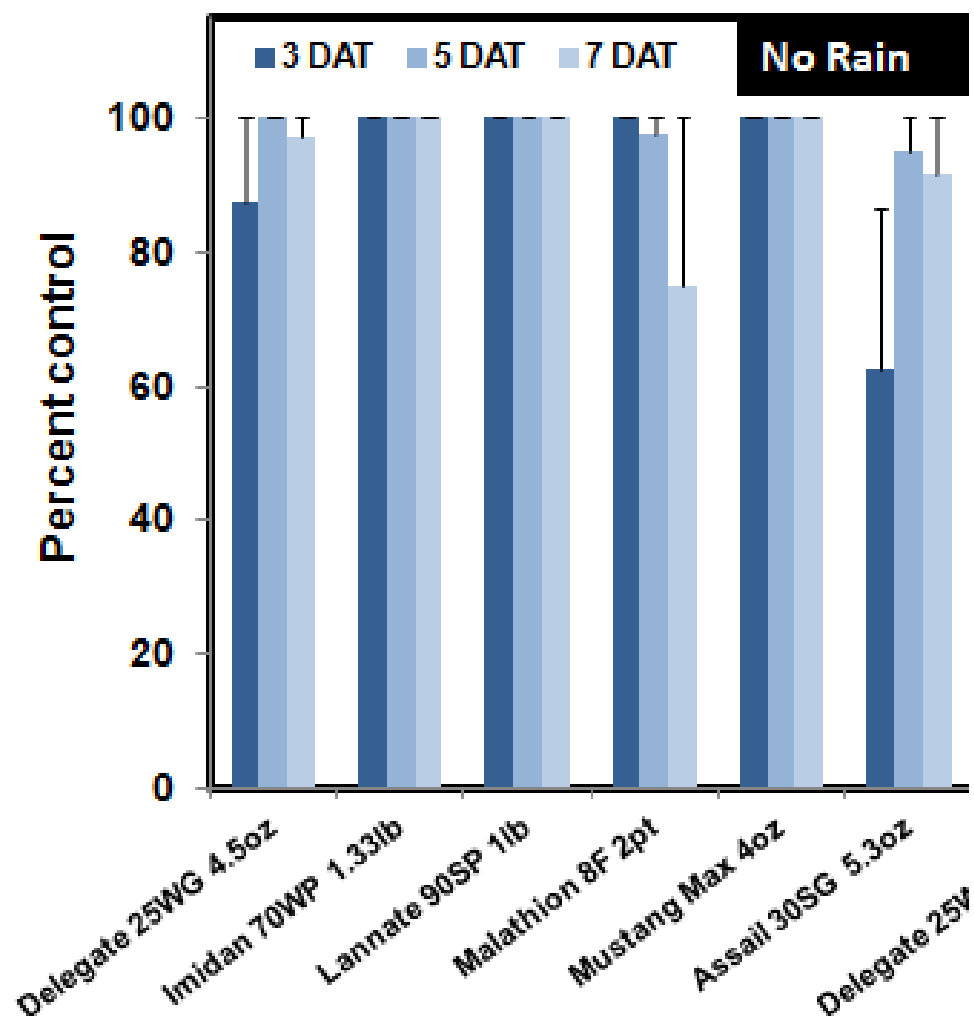
Blueberry

Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila	Brigade WSB (10WP)	8-16 oz	See Special Insect Pest Problems on page 63.
	Danitol 2.4EC	10.7-16 fl oz	
	Delegate 25WG	3-6 oz	
	Entrust 2SC	4-6 fl oz	
	Entrust 80WP	1.25-2 oz	
	Imidan 70W	1.33 lb	
	Lannate LV	1.5-3 pt	
	Lannate SP	0.5-1 lb	
	Malathion 8F	2.5 pt	
	Mustang Max 0.8EC	4.0 fl. oz	

Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila	Brigade WSB (10WP)	5.3-16 oz	<i>Raspberry & Blackberry</i> See Special Insect Pest Problems on page 63.
	Danitol 2.4EC	10.7-16 fl oz	
	Delegate 25WG	3-6 oz	
	Entrust 2SC	4-6 fl oz	
	Entrust 80WP	1.25-2 oz	
	Malathion 8F	2.5 pt	
	Mustang Max 0.8EC	4.0 fl. oz	

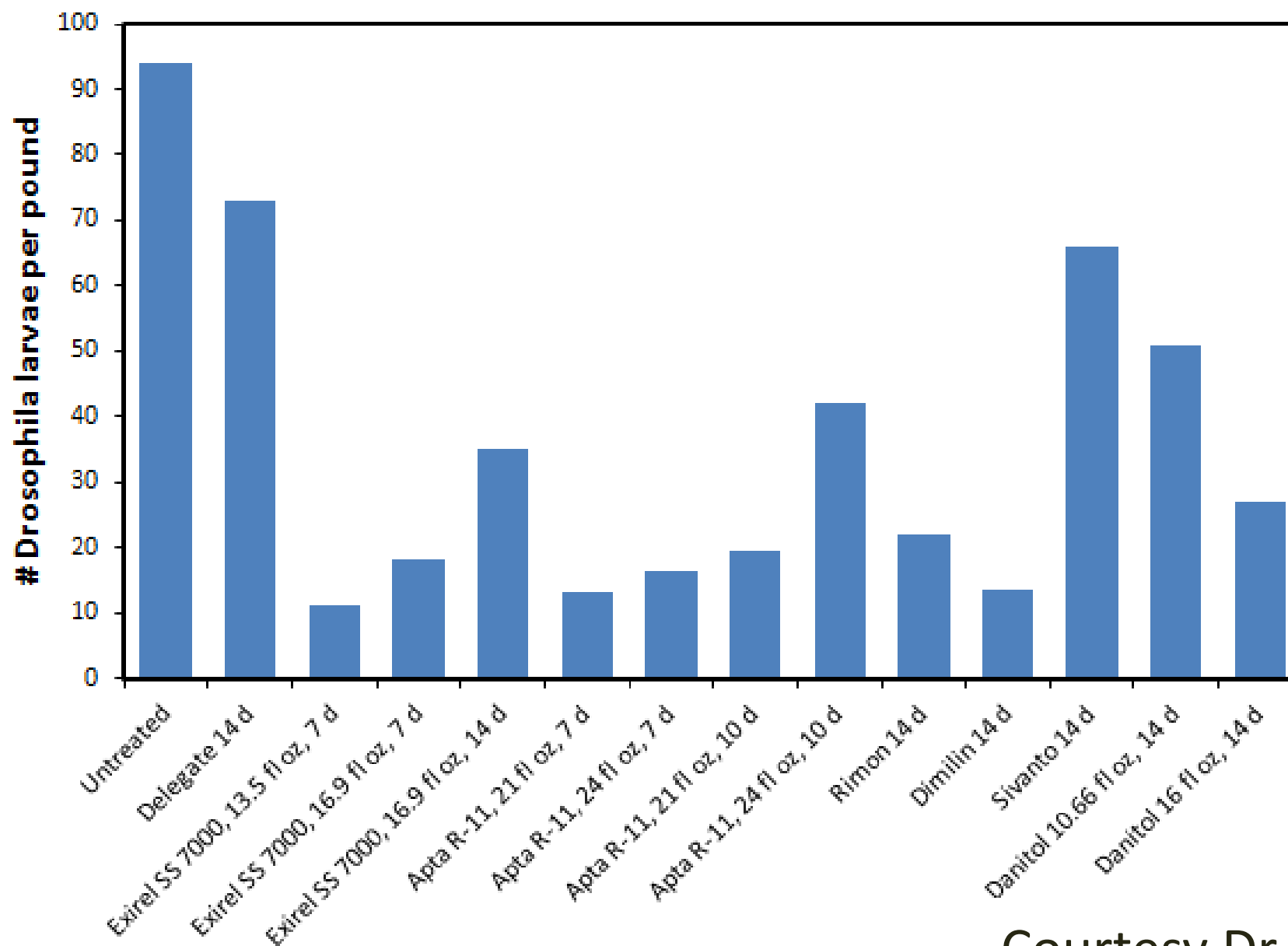


If there's rain, spray again





2013 SWD blueberry field trial



Courtesy Dr. R. Isaacs

To Kill the Following Listed Insects:

Aphids Including:

Apple Aphids
 Alfalfa Aphids
 Artichoke Aphids
 Bean Aphids
 Black Maringed Aphids
 Black Bean Aphids
 Black Peach Aphids
 Blue Alfalfa Aphids
 Cabbage Aphids
 Cotton / Melon Aphids
 Cowpea Aphids
 European Asparagus Aphids
 Filbert Aphids
 Foxglove Aphids
 Green Peach Aphids
 Lettuce Aphids
 Lettuce Root Aphids
 Melon Aphids
 Pea Aphids
 Potato Aphids
 Rose Aphids
 Spotted Alfalfa Aphids
 Willow Carrot Aphids

Amyworms, Caterpillars and Loopers Including:

Alfalfa Caterpillars
 Artichoke Plume Moths

Bagworms
 Beet Armyworms
 Black Cutworms
 Budworms
 Cabbage Loopers
 Cankerworms
 Carpenterworms
 Citrus Cutworms
 Corn Earworms
 Cross-striped Cabbageworms
 Cutworms
 Diamondback moths
 Eastern Tent Caterpillars
 Fall Armyworms
 Fall Cankerworms
 Fall Webworms
 Filbert Worms
 Fireworms
 Forest Tent Caterpillars
 Garden Webworms
 Grapefruit Worms
 Grape Leaf Skeletonizers
 Green Fruit Worms
 Hickory Shuckworms
 Hornworms
 Imported Cabbageworms
 Lawn Armyworms

Lesser Webworm Loopers
 Melonworms
 Navel Orangeworms
 Oriental Fruit Moths
 Pecan Nut Case bearers
 Rindworms
 Sod Webworms
 Southern Armyworms
 Soybean Loopers
 Saltmarsh Caterpillars
 Tent Caterpillars
 Tobacco Budworms
 Tomato Hornworms
 Tomato Fruitworms
 Tomato Pinworms
 Yellow striped Armyworms
 Walnut Caterpillars
 Webworms
 Western Yellow-Striped Armyworms
 Western Grapeleaf Skeletonizers
Beetles and Weevils Including:
 Alfalfa Weevils
 Asparagus Beetles
 Bean Beetles
 Bean Leaf Beetles
 Black Vine Weevils
 blister Beetles
 Boll Weevils
 Carrot Weevils
 Chestnut Weevils
 Clover Weevils
 Colorado Potato Beetles
 12-Spotted Cucumber Beetles
 Cucumber Beetles
 Darkling Beetles (lesser meal worms)
 Egyptian Alfalfa Weevils
 Elm Leaf Beetles
 Flea Beetles
 Fuller Rose Beetles
 Grape Bud Beetles
 Japanese Beetles
 June Beetles
 Mexican Bean Beetles
 Navel Orangeworms (NOW)
 Pecan Weevils
 Pink Bollworms
 Potato Flea Beetles
 Rice Weevils
 Rose Chafers
 Saw-Toothed Grain Beetles
 Strawberry Beetles

Twig Girdlers
 All other beetles and weevils

Leafrollers:

Blueberry Leafrollers
 Filbert Leafrollers
 Fruit Tree Leafrollers
 Grape Leafrollers
 Oblique Banded Leafrollers
 Omnivorous Leafrollers
 Orange Tortrix
 Western Avocado Leafrollers

Borers such as:

European Corn Borers
 Pacific Flatheaded Borers
 Peach Tree Borers
 Peach Twig Borers
 Squash Vine Borers
 Shot-hole Borers
 Branch and Twig Borers

Flies:

Australian Sod Flies
 Caribbean Fruit Flies
 Crane Flies
 Fruit Flies
 Fungus Gnats
 Hessian Flies
 Mediterranean Fruit Flies
 Melon Flies
 Mushroom Flies
 Oriental Fruit Flies
 Olive Fruit Flies

Sawflies

Shore Flies

Vinegar Flies

Walnut Husk Flies

Leafhoppers & Sharpshooters:

Aster Leafhoppers
 Beet Leafhoppers
 Glassy-winged Sharpshooters
 Grape Leafhoppers
 Potato Leafhoppers
 Variegated Leafhoppers
 Three-Cornered Alfalfa hoppers

Leafminers:

Citrus Leafminers
 Holly Leafminers
 Serpentine Leafminers
 Vegetable Leafminers

Midges (plant pests):

Millipedes
 Onion Maggots
 Plant Bugs
 Proba Bugs
 Scale Insects
 Silverfish
 Skippers
 Soft Scales
 Spider Mites
 Sowbugs
 Spiders (except Black Widow and Brown Recluse Spiders)
 Springtails

Squash Bugs

Stink Bugs

Tarnished Plant Bugs

Spittle Bugs

Wireworms

European Chafers

Northern Masked Chafers

Southern Masked Chafers

Western Boxelder Bugs

Moths:

Artichoke Plume Moths
 Codling Moths
 Diamondback Moths
 European Pine Tip Moths
 Grape Berry Moths
 Gypsy Moths (adult & larvae)
 Indian Meal Moths
 Mediterranean Flour Moths
 Pine Tip Moths
 Tussock Moths

Whiteflies:

Greenhouse Whiteflies
 Silverleaf Whiteflies
 Sweetpotato Whiteflies

Other:

Ants (except Pharaoh, Harvester, Carpenter and Fire Ants)
 Apple Maggots
 Billbugs
 Brown Marmorated Stinkbugs

Cabbage Maggots

Clover Mites

Cutworms

Crickets

Dichondra Flea Beetles

Earwigs

Firebrats

False Chinch Bugs

Garden Symphylan

Garden Tortrix

Glassy Winged Sharpshooters

Grasshoppers

Harlequin Bugs

Grape Phylloxera

Katydid

Leaf-footed Plant Bug

Lace Bugs

Leaf tiers

Lice

Lygus

Lace bug

Mealybugs (all)

Psyllids:

Pear Psylla

Thrips:

Avocado thrips
 Citrus Thrips
 Flower Thrips
 Greenhouse Thrips
 Thrips Palmi
 Northern Masked Chafers
 Southern Masked Chafers
 Western Flower Thrips

Useful resources

Michigan State University

http://www.ipm.msu.edu/invasive_species/spotted_wing_drosophila

Oregon State University

<http://spottedwing.org>

Cornell University

<http://www.fruit.cornell.edu/spottedwing/>

PennState University

<http://extension.psu.edu/plants/vegetable-fruit>

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These **ORGANIC PRODUCTION GUIDES** outline general practices for growing **vegetable** and **fruit** crops using organic integrated pest management techniques. Producers working in **dairy** settings will find the organic dairy cattle guide describes ways to manage external arthropod pests.

The guides provide an overall approach for organic production with a focus on biological, mechanical, and cultural controls. Sections on cover crops, resistant varieties, crop rotation, field selection, soil quality and nutrient management all highlight their interrelated qualities and precede specifics on pest management options.

Help improve these guides. If you have additional information or suggestions, please email them to organicguides@gmail.com.

[Organic Guide for Dairy](#)[Organic Guides for Fruit](#)[Organic Guides for Vegetables](#)

2013
Production Guide for
Organic Strawberries



NYS IPM Publication No. 226



Cornell University
Cooperative Extension



Integrated Pest Management



New York State
Department of
Agriculture & Markets

2013
Production Guide for
Organic Blueberries



NYS IPM Publication No. 225



Cornell University
Cooperative Extension



Integrated Pest Management



New York State
Department of
Agriculture & Markets

2013
Production Guide for
Organic Grapes



NYS IPM Publication No. 224



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Integrated Pest Management



New York State
Department of
Agriculture & Markets

GUIDE SHEET Lincoln University Cooperative Extension • Integrated Pest Management Program

Management of Spotted Wing Drosophila

with Emphasis on High Tunnel-grown, Fall-bearing Primocane Raspberries

For more information:
Contact Dr. Jaime Piñero
State Extension Specialist - Integrated
Pest Management, Lincoln University
Cooperative Extension (LUCE)
PineroJ@LincolnLU.edu
and Patrick Byers, MU Extension

The Spotted Wing Drosophila (SWD) *Drosophila suzukii* has very quickly become a devastating pest of berry crops in Missouri. Adults were first detected in monitoring traps in late June 2013. By early August, infestations of blackberry fruits had already been reported. By mid-August, SWD were reported infesting crops statewide. In addition to small fruit crops, this invasive insect pest also attacks some stone fruits (cherry, nectarine, peach), high tunnel tomatoes and wild hosts (including pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle and wild grape). Raspberries, blackberries, blueberries, elderberries and grapes are at the greatest risk.



Female Spotted Wing Drosophila.

SWD flies look similar to the small vinegar flies that are typically found around or on fermenting fruits and vegetables. However, unlike those native vinegar flies, SWD females have a serrated egg-laying device called an ovipositor, which is used to cut a slit into the skin of intact fruit to lay their eggs. This makes SWD a more significant pest than other vinegar flies. The affected crops also ripen later in the summer when the fly population increases, further increasing the risk.

Exclusion: In high tunnels, screening might protect individual plants or crops. In Japan, extremely fine mesh with openings less than 0.98 millimeter (0.039 inches) wide (18 mesh or finer) was able to protect blueberries. If screening is used, passive venting can be problematic; thus, some means of increasing air flow, such as using ventilation fans, will be required. Mesh screens will also exclude pollinating insects, and pollinator introduction will be needed if the crop is in bloom. Raspberries blossom and set fruit over a long period of time, especially with the primocane crop in a high tunnel, so it might not be practical to screen the crop without introducing pollinators into the tunnel. One option would be to use removable screens with Velcro®, allowing for attachment at fruit set and during early development. If SWD are found by trapping inside the high tunnel, an insecticide application might provide SWD suppression for the rest of the season if exclusion is implemented.

This article discusses IPM options to minimize larval infestations by SWD to high tunnel raspberries in the fall. It is very important that farmers also learn how to identify and monitor for SWD and how to detect larval infestations. An identification and monitoring guide is available at: <http://www.lincolnu.edu/web/programs-and-projects/ipm>. Because SWD most likely have come to stay, successful SWD control will require planning and implementation of a program that integrates multiple components.

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Detecting Larval Infestations and Insecticidal Options for Spotted Wing Drosophila, a Significant Pest of Small Fruit Crops in Missouri

By Dr. Jaime C. Piñero
State Integrated Pest Management Specialist
Lincoln University in Missouri
(Article submitted to Missouri Vegetable Growers Association)

The Spotted Wing Drosophila (SWD) is a very serious new invasive pest. It attacks small fruit crops and some stone fruits (cherries, nectarines, peaches). It also attacks high tunnel tomatoes and wild hosts (including pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle and wild grape). Raspberries, blackberries, blueberries and grapes are at the greatest risk. SWD flies look similar to the small vinegar flies that are typically found around or on fermenting fruits and vegetables. However, unlike those native vinegar flies, a SWD female has a serrated egg-laying device (called an ovipositor). The ovipositor cuts a slit into the skin of intact fruit when the female lays its eggs. This makes the SWD a more harmful pest. An identification and monitoring guide was developed by the Lincoln University (LU) Integrated Pest Management (IPM) program. It is available at <http://www.lincolnu.edu/web/programs-and-projects/ipm>.

This article discusses how to detect larval infestations. It also details how to manage the SWD using the key IPM components listed below. A SWD control program starts with monitoring. If the SWD is detected, chemical control is needed so that fruit can remain marketable. Some chemicals already used by commercial growers to control similar pests should effectively control SWD.

1. Monitor fields with traps; check them regularly.
2. Check trapped flies to determine the presence and number of SWD.
3. If SWD are found and fruit are ripening or ripe, apply effective insecticides that are registered for that crop; this will protect the fruit until harvest is completed.
4. Continue monitoring to evaluate your management program; this time check traps twice per week. Respond quickly if needed.
5. Use cultural controls where possible by removing old, infested or damaged fruit from the field; this will reduce SWD food supplies.
6. Stay informed. These recommendations are subject to change based upon new information.

Use of effective insecticides that are well timed and have good coverage can control SWD through harvest. However, there is a potential for rapid population increase by SWD, especially during fall red raspberry season. Therefore, active management, by monitoring flies and fruit infestation, is critical.

Always follow the specific label restrictions for raspberry/blackberry crops. The level of control achieved will depend on the SWD population, timeliness of application, coverage of fruit and product effectiveness.

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Monitoring for Spotted Wing Drosophila

An Insect Pest of Berries and Other Fruits in Missouri

The Spotted Wing Drosophila (SWD) is a small vinegar or "fruit" fly that is about 2-3mm in length. For the past two years, it has been a problem in several areas of the U.S., including the Midwest.

For more information:
Contact Dr. Jaime Piñero
State Extension Specialist -
Integrated Pest Management
PineroJ@LincolnLU.edu



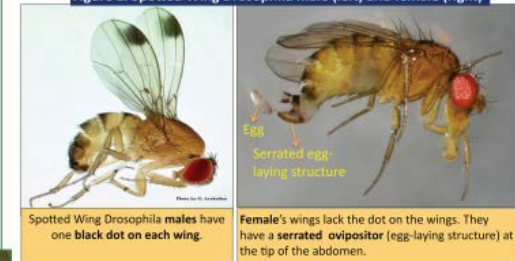
Actual view (under dissecting microscope) of male SWD (see black dots) captured in sticky card.



900 Chestnut Street, Allen Hall
Jefferson City, MO 65101
(573) 681-5543

LUCE/SP18-A-2013
Rev. 7/16/2013

Figure 1. Spotted Wing Drosophila male (left) and female (right)

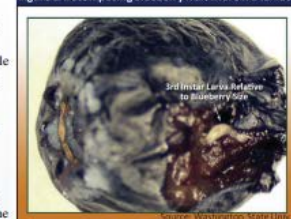


Spotted Wing Drosophila males have one black dot on each wing.

Female's wings lack the dot on the wings. They have a serrated ovipositor (egg-laying structure) at the tip of the abdomen.

The Spotted Wing Drosophila (SWD) (pronounced Dros-o-fill-ah) has caused economic damage to berries, grapes and soft-fleshed fruits, such as peaches. The SWD is also able to attack some vegetables, including tomatoes and peppers. Unlike most other vinegar flies that lay eggs on damaged or fermenting fruits, SWD females can cut into healthy fruit. They do this by using their serrated (saw-toothed) ovipositor (organ for depositing eggs) to inject eggs under the skin of the fruit (see Figure 1). The adult SWD lives for about two weeks; during this time, each female can lay more than 300 eggs. The larvae hatch and feed inside the fruits, causing them to rot (see Figure 2). This insect reproduces so quickly that a few adults can become thousands of flies in just a few months.

Figure 2. Decomposing blueberry fruit with SWD larvae



3rd Instar Larva Relative to Blueberry size.

It is very important that farmers learn how to monitor for this invasive pest. A simple trap can help you determine whether the SWD is present. The most effective and economical

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Contact Information for SWD

KANSAS



Dr. Raymond A. Cloyd

Extension Specialist, Horticultural Entomology / IPM

Phone: 785-532-4750

rcloyd@ksu.edu

IOWA:



Dr. Donald Lewis

Extension Entomologist

Phone: 515-294-1101

drlewis@iastate.edu

Dr. Laura Jesse

Plant and Insect Diagnostic Clinic

Phone: 515-294-0581

ljesse@iastate.edu

MISSOURI



Univ. Missouri Extension

Regional Specialists

<http://extension.missouri.edu>

Dr. Jaime Pinero

Lincoln University

State IPM Specialist

Phone: 573-681-5522

pineroj@lincolnu.edu

Dr. Bruce Barrett

Univ. of Missouri

Extension Entomologist

Phone: 573-882-3446

barrettb@missouri.edu

NEBRASKA



Dr. Bob Wright

Extension Entomologist

Phone: 402-472-2128

rwright2@unl.edu

Mr. Vaughn Hammond

Extension Educator

Phone: 402-873-3166

vaughn.hammond@unl.edu

SOUTH DAKOTA



Dr. Buyung Hadi

Urban Entomology Specialist

Phone: 605-688-5157

buyung.hadi@sdstate.edu



Thank You!

Questions?