

Berry-Eating Insects & Invasive Pest Update

Diane Alston, Entomologist
Utah State University
Urban & Small Farms Conference
February 17, 2016
Viridian Center, West Jordan, UT



Berry-Feeding Insects

- ⌘ Early Season – bloom to fruitlet
 - ⌘ Thrips
 - ⌘ Lygus bug
- ⌘ Late Season – mature fruit
 - ⌘ Stink bugs
 - ⌘ European earwig
 - ⌘ European paper wasp
 - ⌘ Grasshoppers



European paper wasp eating raspberry

Western Flower Thrips



Thrips larva (left) & adults
~1/20 inch long



Thrips feed on flowers & fruit with punch-and-suck mouthparts



Scouting for thrips in blackberry



Thrips blossom blast
on sweet pea

Distorted fruit with
pronounced seeds



Thrips Insecticides - Bloom

⌘ Commercial

- ⌘ acetamiprid (Assail; 1 d PHI)
- ⌘ Imidacloprid (Admire Pro; 3 d)
- ⌘ diazinon – prebloom only to prevent bee kill (7 d)
- ⌘ spinetoram (Delegate; 1 d)
- ⌘ spinosad (Success, Entrust^{Org}; 1 d)
 - ⌘ allow to dry \geq 3 hr before bee activity

⌘ Home use

- ⌘ acetamiprid (Ortho Max), azadirachtin^{Org}, bifenthrin, carbaryl, insecticidal soap^{Org}, malathion, permethrin, pyrethrin^{Org}, spinosad^{Org}



Wild bee pollinating raspberry flowers

Read and follow label directions carefully!

Lygus Bug

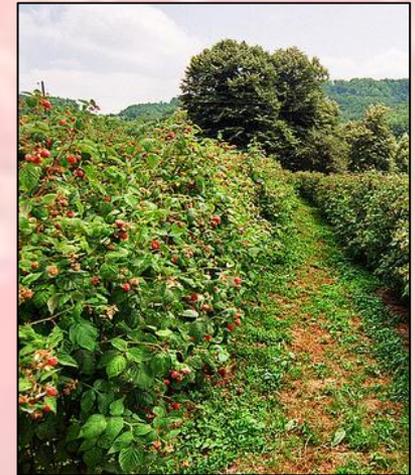
Western Tarnished Plant Bug



Lygus hesperus
~1/4 inch long, yellow V on back
Piercing-sucking mouthparts



Early feeding causes fruit distortion: "cat-facing", due to damaged seeds - piercing



Lygus bug nymphs

Cultural & biological management:

- Alfalfa hay cutting
- Weed suppression & removal
- Flowering trap crop (careful monitoring)
- Natural predators & parasitic wasps
- Bug-vac



Lygus Bug Insecticides - Bloom

⌘ Commercial

- ⌘ *Beauveria bassiana*
(Mycotrol^{some Org})
- ⌘ fenpropathrin (Danitol; 2-3 d
PHI)
- ⌘ malathion (1 d)
- ⌘ thiamethoxam (Actara; 3 d) –
post-bloom only

⌘ Home use

- ⌘ azadirachtin^{Org}, bifenthrin,
carbaryl, esfenvalerate,
kaolin^{Org}, malathion,
permethrin, zeta-cypermethrin



“Cat-faced” strawberry fruits
caused by lygus bug

**Read and follow label
directions carefully!**

Stink Bugs

~1/2 inch
shield-shaped



Green stink bug, *Acrosternum hilare*, adult (left) and nymph



Mating consperse stink bugs, *Euschistus conspersus*



Barrel-shaped eggs,
laid in masses



Deformed, dry berries;
Piercing-sucking mouthparts



Release a foul odor that
contaminates berries;
Use similar cultural
mgmt. practices as for
lygus bug

Stink Bug Insecticides - Before Harvest

- ✘ Knock-down, contact chemicals & repellents
- ✘ Commercial
 - ✘ bifenthrin, esfenvalerate, fenpropathrin, malathion, zeta-cypermethrin
- ✘ Home use
 - ✘ acetamiprid, azadirachtin^{Org}, carbaryl, esfenvalerate, permethrin (raspberry only), insecticidal soap^{Org}, pyrethrin^{Org}
- ✘ Adjust air-blast or vacuum-suction cleaner systems on mechanical harvester to reduce insect contamination in berries

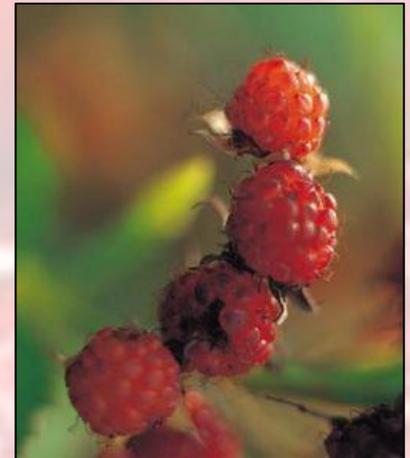
European Earwig



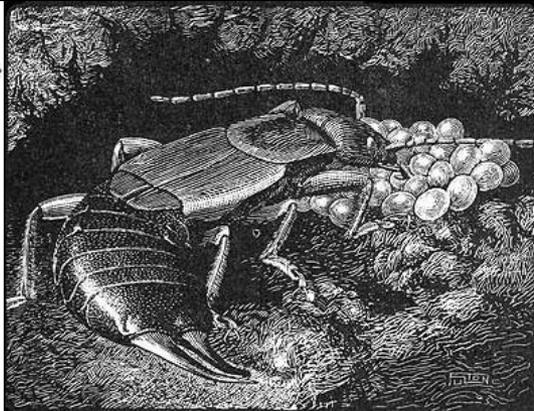
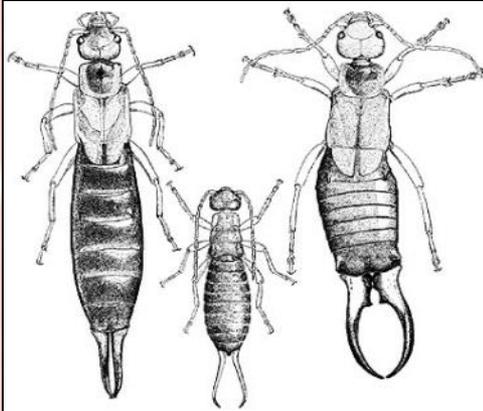
Female European earwig (straight cerci)



Nocturnal – feed on fruits & leaves
with chewing mouthparts



European Earwig



Earwig Management - Before Harvest

- ✘ Same insecticides as for stink bugs
- ✘ Insecticidal soap + pyrethrin^{Org}
 - ✘ reapply every 3-5 days
 - ✘ suppressive
 - ✘ combine with trapping & habitat management
- ✘ Predation by fowl
 - ✘ chicken, turkey, duck



Dense & moist ground covers, such as birdsfoot trefoil, can provide attractive daytime refuge for earwigs (not as much for wheat straw & paper mulch)

Earwigs prefer dense, moist refuge

European Paper Wasp

Polistes dominula



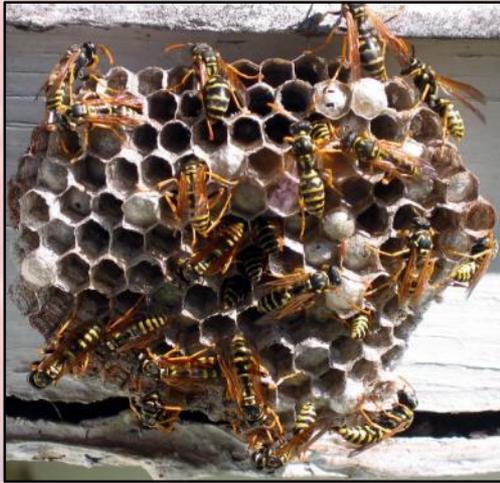
European paper wasp (left) has a more slender waist than a yellow jacket (right)

E. paper wasp likes to feed on ripe fruit, but is also a predator



Deformed wing disease
EPW in Utah since 1990s

European Paper Wasp Management



Spring and early summer: beneficial predator of caterpillars

Treat nests with aerosol wasp sprays & remove nests to eliminate larvae developing in cells

Mid summer to early fall: feed on ripe fruit

Trap: fruit juice/yeast bait in pop bottle

Protect fruit with insecticide sprays (same as earwig & SB)



Yellow jacket traps ineffective



USU Extension
video fact sheet

utahpests.usu.edu
slideshows

Grasshoppers on Berries



Strip the foliage

Some eat fruit: e.g., Differential grasshopper,
Melanoplus differentialis

Late summer to early fall
Hot, dry conditions

Grasshopper Management

- ✘ Floating row cover fabric
- ✘ Cultivate around plants in fall and/or spring to disrupt overwintering eggs in soil
- ✘ Predation by fowl
- ✘ Insecticides
 - ✘ similar products as for earwigs, wasps, and stink bugs
 - ✘ treat a larger area around farm/garden
 - ✘ insecticides and baits
 - *Nosema locustae*, carbaryl



UTAH PESTS fact sheet Utah State University Extension

Community-Wide Grasshopper Control

Main: Murray, Utah Project Leader
Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory 8887-133-08 September 2018

Springtime, while grasshoppers are still nymphs, is the best time for communities or neighborhoods to work together to suppress grasshopper populations. Treating as wide an area as possible is the key to success. When grasshoppers become adults, they can travel great distances and they are more in one area long enough for an insecticide to be effective.

HOW TO IDENTIFY NYMPHS

Grasshoppers go through five nymph stages before becoming adults. Each stage is a few millimeters to several centimeters in length. Grasshoppers that are able to fly have already reached the adult stage. Mobility increases after the 4th instar, so insecticide treatments are not as effective on 5th instar, or adult, stages.

Stage	Size
1st instar	1/4 inch
2nd instar	3/8 inch
3rd instar	1/2 inch
4th instar	3/4 inch
5th instar	1 inch
Adult	1.5 inches

Note: Size is approximate, and depending on species, can vary by 1/8 to 1/2 inch.

Community-Wide Grasshopper Control Fact Sheet

utahpests.usu.edu
Fact sheets

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www.utahpests.usu.edu

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Your source for fruit, vegetable, and landscape pest problems.

School Integrated Pest Management
Teaching responsible pest management for a healthy learning environment.

Cooperative Agriculture Pest Survey
CAPS protects Utah agriculture through statewide monitoring of invasive pests.

In the News

Diverse insect population means fewer pests in cornfields
Sep 11, 2015

Under the sea: the underwater farms growing basil, strawberries and lettuce
Sep 11, 2015

A community of soil bacteria saves plants from root rot
Sep 08, 2015

UTAH PESTS' is a group of Extension entomologists and plant pathologists that helps to solve the thousands of plant pest issues that concern Utah citizens every day. The UPPDL identifies, the IPM Program educates, and the CAPS Program investigates. Open one of the websites to get answers!

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Berry Insect Fact Sheets

Raspberry Crown Borer [*Pennisetia marginata*]

Diane Alston, Entomologist

Quick Facts

- The raspberry crown borer attacks raspberry plants in northern Utah, causing cane-wilt and death.
- Crown borer has a 2-year life cycle; it spends much of it as a grub (larva) tunnelling in the lower cane, crown and roots of raspberry plants.
- To prevent infestation, use only clean planting stock, don't transplant canes between fields, and maintain healthy, non-stressed plants.
- Once a raspberry planting is infested with crown borer, 1) dig and destroy infested crowns and roots, and 2) apply an insecticide as a heavy drench/soak to the lower cane and crown for at least 2 consecutive years; in mid-October to target first year larvae, and in the spring before bud break to target overwintered larvae before they tunnel deeply into crowns.

The raspberry crown borer is a stout-bodied clear-winged moth (Lepidoptera: Sesliidae) that resembles a yellow jacket wasp (Fig. 1). It is native to North America, and was first reported from New England states in the mid-1800s. Today, it is a common cane-boring insect pest of raspberry in northern Utah. Although its host range includes all brambles in the genus *Rubus*, it is only known to cause damage to raspberry in Utah. Larvae tunnel in the lower cane, crown, and upper roots of raspberry causing entire canes to wilt and break off at the crown (Fig. 2). Raspberry crown borer infestations are usually not severe, but populations build up slowly over several years, reducing vigor and yield of plantings by as much as 30% (Raine 1962). In a recent survey of raspberry plantings in northern Utah, crown borer was found in 36% of sites; however, plant infestation levels were low, ~1% (Claudia Nischwitz, unpublished data).

HOST PLANTS

Raspberry (red and black) is the primary host infested in Utah; however, all *Rubus* spp. are potential hosts, including blackberry, loganberry, boysenberry, thimbleberry, and salmonberry.



Fig. 1. Adult female raspberry crown borer. Black and yellow bands on the body mimic a paper wasp to ward off predators. Females have smooth antennae.



Fig. 2. Raspberry plant crowns damaged by raspberry crown borer larval tunneling. Note hollowed-out crowns and sawdust-like frass from larvae.

Raspberry Horntail [*Hartigia cressonii*]

Diane Alston, Entomologist • Brent Black, Fruit Specialist • Marion Murray, IPM Project Leader

Do You Know?

- The raspberry horntail is a cane-boring wasp that can cause crop loss to raspberries in northern Utah.
- Apply insecticides in the spring targeting adults, to prevent egg-laying in the new canes.
- Infested canes often become evident during summer when tips wilt and die back.
- Frequent pruning of infested cane tips during summer can lower horntail populations in a field.
- Several species of parasitic wasps attack horntail larvae within canes and can provide biological control.



Fig. 1. The raspberry horntail larva bears a spine on the tail end.



Fig. 2. Raspberry horntail adult?

The most injurious insects to caneberries are those that bore within the canes resulting in cane dieback, reduced fruit yields, and even cane death. The most common of the borers attacking caneberries in northern Utah is the raspberry horntail [*Hartigia cressonii* (Kirtby)], a type of wasp (Hymenoptera: Cephidae). It was first documented in Utah in the 1980s, and is known to occur in other western states. Horntails spend the winter as mature larvae in the previous year's canes, pupate in the early spring, and emerge as adults to mate and lay eggs in primocanes (first year canes) just after cane growth begins. Early-season egg-laying and protection of the eggs and larvae within canes create challenges for horntail management and potential for high infestation levels in raspberry fields. Recent research to evaluate the susceptibility of raspberry varieties and observations of high parasitism levels of horntail larvae in some fields, provide new insights into raspberry horntail management.

HOST PLANTS

raspberry, other brambles, rose

LIFE HISTORY

There appears to be only one generation per year in northern Utah. Egg-laying extends from early spring to early summer, so larvae of all sizes can be found in canes during the summer.

Mature Larva – Overwintering Stage

- Size, shape, and color: cylindrical, white body about 1 inch (25 mm) long; hardened, brown head; short spine on the tail end (Fig. 1).
- When and where: spends the winter in a silk-lined cavity in the lower cane.

Pupa

- Size and color: tan and about ¾ inch (18 mm) long.
- When and where: pupation occurs within the cane in the early spring.

Rose Stem Girdler [*Agrilus cuprescens*]

Diane Alston, Entomologist

Quick Facts

- Rose stem girdler is a common cane-boring beetle of raspberry and blackberry in central and northern Utah.
- Larval feeding in the cambium under the cane bark causes spiral grooves and gall-like swellings; injured canes may wilt and break off.
- Severe infestations in even-bearing and first-year canes of vigorous summer-bearing cultivars can kill out plant stands.
- Avoid planting raspberries and blackberries near infested roses (wild and cultivated), prune and destroy infested canes, use proper fertility and water management to minimize stress to berry plantings, and apply insecticides during adult beetle activity in May and June.



Fig. 1. The rose stem girdler adult is a small, metallic-copper fatheaded beetle. Note the chewing injury to edges of the raspberry leaf!



Fig. 2. A raspberry cane with damage from tunneling by a rose stem girdler larva. The cane broke at the girdling site.

The rose stem girdler is a small fat-headed, metallic beetle (Coleoptera) in the Family Buprestidae (Fig. 1). It was first introduced into the eastern U.S. from Europe in the early 1900s in infested roses. It was first reported in Utah in American Fork in 1955. Today, it is a common cane-boring pest of raspberry, blackberry, and wild rose in central and northern regions of the state. It has been observed in Rich, Cache, Box Elder, Weber, Davis, Salt Lake, Utah, Wasatch, and Sanpete counties. Larvae tunnel in the canes causing gall-like swellings and cane breakage (Fig. 2). The rose stem girdler can dramatically reduce stands of red raspberry canes, and even kill out a planting.

HOST PLANTS

Raspberry (red and black), blackberry, related brambles (*Rubus* spp.), and wild and cultivated roses (*Rosa* spp.) are host plants.

LIFE HISTORY

The rose stem girdler has a single generation per year in Utah. The winter is spent as a 4th instar (4th molt) larva within the pith of canes (Fig. 3). Pupation occurs in the spring when daytime temperatures average 55°, and adult beetles emerge from infested canes in May to June. Adults rest on plant foliage at night and become active during mid-morning hours as temperatures warm. Eggs

Integrated Pest Management

utahpests.usu.edu/ipm

The screenshot displays the Utah State University Extension website. At the top, the navigation bar includes "EXTENSION UtahStateUniversity" and "UTAH PESTS Home | Utah Plant Pest Diagnostic Lab | Integrated". A search bar is located on the left. The main content area features a large banner for "Subscribe to IPM Pest advisories HERE" with a ladybug on a leaf. Below this, a section titled "BENEFICIAL INSECTS & PESTS" is visible. A sidebar on the left lists various resources: "Plant Pests by Crop", "Fruit IPM", "Vegetable IPM", "Landscape IPM", "Field Crops IPM", "Pest Advisories", "Fact Sheets", "Image Galleries", "Slideshows", "Utah IPM & SA Mini-Grant Program", "Pesticide Information", "Weather Info", "Resources and Links", and "Contact Us". A Facebook icon is at the bottom left. A definition of IPM is provided: "Integrated Pest Management (IPM): 'a comprehensive approach to pest control that uses a combined means to reduce the status of pests to tolerable levels while maintaining a quality environment.'"

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IPM Advisories:

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In the News
Self-Medicating Parasitized Bees
Sep 11, 2015
Biodiversity belowground is just as important as aboveground
Sep 11, 2015
Improving wheat varieties in Kazakhstan
Sep 08, 2015

All you need to sign up for the advisories is an email address

Free subscription

Timely info on pest activity

-insects

-mites

-diseases

-nutrient deficiencies

-environmental stress

Lots of images!

IPM recommendations

Effective pesticides

IPM Advisories (2015 Examples)

EXTENSION
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Landscape IPM Advisory



Weekly Pest Update for 'Woody Ornamentals, Utah State University Extension, April 29, 2015



What's In Bloom
(Salt Lake City area)

<ul style="list-style-type: none"> Blackhaw viburnum: first bloom Crabapple: end bloom Lilac: bloom - end bloom Redbud: end bloom Redtwig dogwood: first bloom 	<ul style="list-style-type: none"> Japanese flowering cherry: bloom Kwanzan cherry: full to end bloom Quince: end bloom Serviceberry: full bloom
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Insect/Disease Information

DECIDUOUS TREES

Lilac-Ash Borer
Hosts: lilac and ash; occasionally privet and mountain-ash

- treat susceptible trunks now until mid-July



Frass from larva feeding in tree (top portion of lilac; dying back (bottom))

Lilac-ash borer adults have just started to emerge and females are laying eggs on the bark of ash trees and lilac. Green and white ash (*Forsythia*) are the most susceptible. Sometimes, mountain-ash (*Sorbus*) and privet are attacked.

Lilac-ash borer does not directly kill trees, but repeated infestations can cause branch dieback and can leave trees susceptible to breakage in storms. Infested trees will have round exit holes on the bark, sawdust-like frass near the holes or at the base of the tree, and rough, swollen, cracked bark, mostly near branch crotches.

This insect overwinters as a larva inside the host plant and pupates in spring, emerging as an adult moth, usually in early to mid May. Emergence and egg-laying continues for about 6 to 8 weeks.

Treatment:
Healthy plants are able to withstand minor infestations, while stressed plants are more susceptible to attack and failure, so give trees optimal water and fertilizer, and prune properly.

Insecticides target the adults. Small trees can be treated by the home gardener, but in order to get thorough coverage on large trees, treatments should be made by a licensed pesticide applicator.

Residential options: Hi-Yield Permethrin, Spectracide Triazicide (lambda-cyhalothrin)

Commercial options: Acelapryn (chlorantraniliprole), permethrin (Astro, Covert, Waylay), or Ornyx (bifenthrin)

Utah State UNIVERSITY extension

Turfgrass IPM Advisory



Seasonal Turfgrass Pest Update, Utah State University Extension, Winter 2014

Turfgrass Management

At this time of year, your thoughts may be turning to the potential effects of winter conditions on your turf. "Winterkill" is the general term describing turf loss that may occur as a result of winter conditions. This issue will discuss the actual causes of winterkill and how they may be prevented.

News/What to Watch For

During winter, most turfgrass diseases and insects are relatively inactive. However, one disease complex, the snow molds, may be at work despite recent low temperatures.

Focus on: Winterkill

When turfgrasses die over the winter months, it may generally be described as "winterkill" (Figs. 1 and 2). The term covers a multitude of actual causes of turfgrass death in the winter, which may include snow mold, low temperatures, ice sheets, desiccation and crown hydration.

Crown Hydration

Crown hydration is of most concern during the warmer days of late winter or early spring when there is the potential for a day or two of warm daytime temperatures followed by a hard freeze. Turfgrass plants may start to take up water as temperatures warm and then re-freeze rapidly. As a result, ice crystals may form in the crown of the plant, rupturing cells and causing death.

Of the commonly-used cool-season turfgrass species, annual bluegrass and creeping bentgrass are most susceptible to crown hydration problems, though annual bluegrass is the more susceptible of the two because it emerges from dormancy earlier.



Figure 1. Winterkill symptoms in turfgrass.

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Tree Fruit IPM Advisory



Orchard Pest Update, Utah State University Extension, October 5, 2015

JUST THE BASICS: Current Treatments

GENERAL

- Clean up fallen fruit to reduce pest pressure for next year.
- Mow tall weeds around trees/install barrier or wire to reduce rodent problems and deer rubbing.
- Make sure all new plantings get white tree paint or tree wrap (base of tree to scaffold limbs) from December through early April, to prevent sun scald.
- Give trees a good watering before the ground freezes.
- Do not do any pruning now; wait until winter (apples) or early spring (peaches).

APPLE & PEAR

- Apply lime-sulfur when the first leaves start turning color to control blister mites.
- To reduce codling moth for next year, remove bins and debris from the orchard after harvest and remove fruit on the ground or left on the tree.

PEACH/NECTARINE

- Prevent now common light (shot-hole) infections this fall by applying copper to trees when 50% of leaves have fallen.

Insect and Disease Information

 information for residential settings

 information for commercial orchards

APPLE & PEAR

Blister Mites
Hosts: apple, pear



Blister mites cause early fall color change and leaf drop (shown here on apple).

Blister mites and other eriophyid mites can be treated now, and no later than just before leaf drop. They are more of an aesthetic problem, and do not harm the health of the tree. In fact, they serve as a food source for early emerging predatory mites in the spring. In turn, the predatory mites will take care of the harmful spider mites that are active during summer.



Blister mite spots on pear turn black by mid to late season.

If treatment is desired, options include:

- 1.5-2% oil, thoroughly covering the bottoms of the leaves
- Sevin (carbaryl), alone or with 1% oil
- lime-sulfur (only at this time of year; you can mix with oil, but not on drought-stressed trees)

Blister mites belong to a group of mites called eriophyid mites (ar-ee-oh-FYE-ee). They are so small that they are invisible to the naked eye, but their feeding can cause visible symptoms.

continued on next page

Utah Pests News

Quarterly newsletter on all things “insects and plant diseases” in Utah



UTAH PESTS News

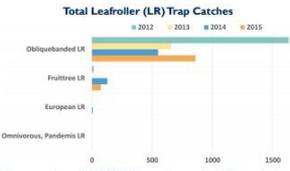
Utah Plant Pest Diagnostic Laboratory and USU Extension Vol. X, Winter 2016

Utah Orchard Leafroller Survey



Leafrollers are a type of moth-caterpillar (Lepidoptera: Tortricidae) that may roll or tie leaves together to form a protective shelter, from which they feed on the leaves and fruits of plants. This group contains many economically important pests that attack fruits, vegetables, and ornamentals. The need for an orchard leafroller survey was prompted by an outbreak of leafroller caterpillars in Utah County tart cherry orchards just before harvest in July 2012.

Total Leafroller (LR) Trap Catches



Species	2012	2013	2014	2015
Obliquebanded LR	~1100	~1200	~500	~1000
Fruittree LR	~100	~100	~100	~100
European LR	~10	~10	~10	~10
Omnivorous, Pandemis LR	~10	~10	~10	~10

The survey showed that OBLR is the most common leafroller species in Utah, followed by FTLR.

We surveyed for five species that commonly occur in western U.S. orchards. The survey included five counties of northern Utah from late spring through early fall in 2014 (21 orchards) and 2015 (20 orchards). We used pheromone traps for moths, and feeding injury inspections and beating tray sampling for larvae. In 2014, 11 of the orchards received minimal management, such as limited insecticides, pruning and irrigation. The remaining orchards were commercially managed.

Our objectives were to determine the species of leafrollers present, types of orchards at greatest risk for infestation, leafroller phenology (timing of moth flight and caterpillar activity), and validate an existing temperature-based (degree-day) model that predicts timing of leafroller treatments.

Obliquebanded leafroller (OBLR) was the primary species caught in the pheromone traps, followed distantly by fruittree leafroller (FTLR), as shown in the graph above. We detected very few European leafroller (ELR) moths, and no omnivorous or pandemis leafrollers. In more limited surveys in 2012 and 2013, OBLR numbers were very high in 2012, the season of the larval outbreak in tart cherries. OBLR moth capture in 2015 increased over those in 2013 and 2014, and although several orchards had high trap captures, the overall catch in 20 orchards was not as high as the total catch in 2012 (6 orchards). Growers were notified when OBLR numbers were high, and populations will be monitored in 2016 to prevent another outbreak.

utahpests.usu.edu

continued on next page

fruit.usu.edu

The image shows two overlapping screenshots of the fruit.usu.edu website. The top screenshot displays the main navigation menu with categories like Home, Utah 4-H, Food & Health, Home & Family, Gardening, Ag, Natural Resources, and Finance. The bottom screenshot shows a sidebar with a search bar and a list of categories including Fruit, Vegetables, High Tunnels, Home Garden, Organic Agriculture, Upcoming Events, and Affiliated organizations. The main content area features several tiles: Commercial Fruit (highlighted with a yellow box), Commercial Vegetables (with a yellow arrow pointing to it), Home Garden, Organics, and Upcoming Events. On the right side, there is a 'Fruit' section with a sub-menu and links to Commercial Tree Fruit, Commercial Berry Crops (highlighted with a yellow box), Pest Management, and Home Garden Information.

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Vegetables
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Home Garden
Organic Agriculture
Upcoming Events
Affiliated organizations

Commercial Tree Fruit

Commercial Berry Crops

Pest Management

Home Garden Information

Raspberry IPM Manual (WSU)

[A-Z Index](#)

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WSU Whatcom County Extension

Integrated Pest Management for Raspberries

A Guide to Sampling and Decision Making for Key Raspberry Pests in Northwest Washington.

WSU Whatcom County
Extension

Integrated Pest
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[Raspberry IPM Manual](#)

[Introduction](#)

[Dormant/Pre-Bloom](#)

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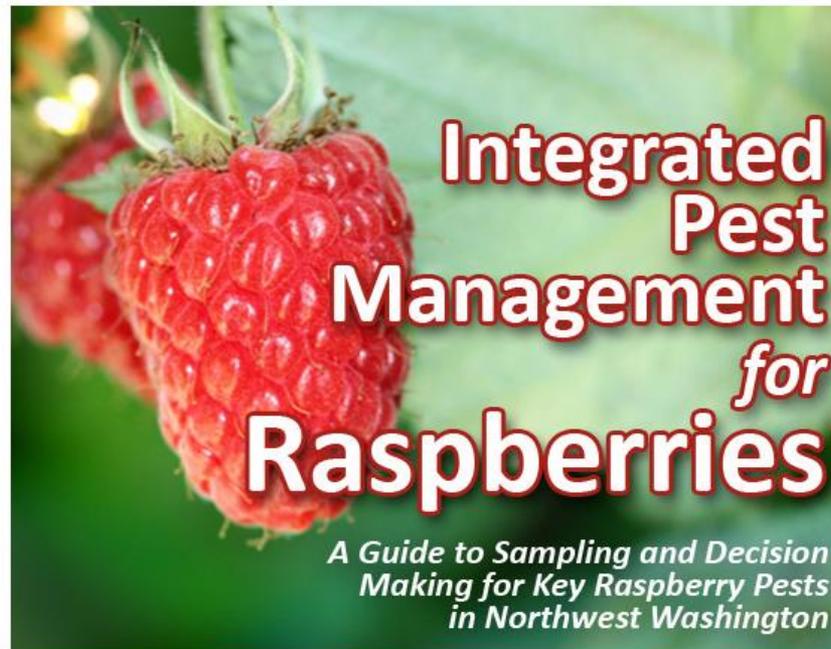
[Weed Management](#)

[Pesticide Selection](#)

[Pesticides and Water](#)

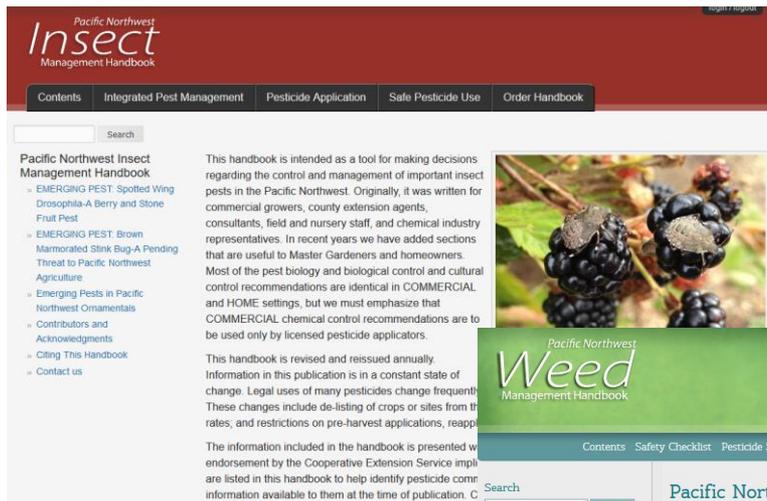
[IPM Field Guide \(pdf\)](#)

[Give Feedback](#)



Pacific Northwest Pest Management Handbooks

Google: PNW Handbook for links



Pacific Northwest Insect Management Handbook

Contents Integrated Pest Management Pesticide Application Safe Pesticide Use Order Handbook

Search

Pacific Northwest Insect Management Handbook

- EMERGING PEST: Spotted Wing Drosophila-A Berry and Stone Fruit Pest
- EMERGING PEST: Brown Marmorated Stink Bug-A Pending Threat to Pacific Northwest Agriculture
- Emerging Pests in Pacific Northwest Ornamentals
- Contributors and Acknowledgments
- Citing This Handbook
- Contact us

This handbook is intended as a tool for making decisions regarding the control and management of important insect pests in the Pacific Northwest. Originally, it was written for commercial growers, county extension agents, consultants, field and nursery staff, and chemical industry representatives. In recent years we have added sections that are useful to Master Gardeners and homeowners. Most of the pest biology and biological control and cultural control recommendations are identical in COMMERCIAL and HOME settings, but we must emphasize that COMMERCIAL chemical control recommendations are to be used only by licensed pesticide applicators.

This handbook is revised and reissued annually. Information in this publication is in a constant state of change. Legal uses of many pesticides change frequently; these changes include de-listing of crops or sites from rates, and restrictions on pre-harvest applications, reapp...

The information included in the handbook is presented with endorsement by the Cooperative Extension Service implies are listed in this handbook to help identify pesticide compatibility information available to them at the time of publication. C



Pacific Northwest Weed Management Handbook

Contents Safety Checklist Pesticide Safety Tables and Calculations Websites of Interest Order Handbook

Search

All PNW Handbooks

Weed Management Handbook

Pacific Northwest Weed Management Handbook

This handbook is designed as a quick and ready reference for weed control practices and herbicides used in various cropping systems or sites in Idaho, Oregon, and Washington.

This handbook will be useful to Extension agents, company field representatives, commercial spray applicators and consultants, herbicide dealers, teachers, and producers.

Recommendations are based on research results from the Agricultural Experiment Stations and Extension Services of Oregon, Idaho, and Washington. A few suggestions are included from research conducted in other states, and from U.S. Department of Agriculture research centers. In all cases, authors make every effort to list only registered herbicides, and to ensure that the information conforms to product labels and company recommendations.

Revision and Availability This handbook is updated quarterly. Individual sections are revised once each year; revision dates are listed at the start of each section. Most sections are also available as PDF documents on the weed handbook website: <http://pnwhandbooks.org/weed>



Field bindweed (*Convolvulus arvensis*) thrives in the high moisture and fertility conditions of crops such as blueberries, reducing yield and interfering with harvest.
Photo by Ed Peachey, © Oregon State University



Pacific Northwest Plant Disease Management Handbook

Hosts and Their Diseases Diagnosis and Testing Pathogen Articles Pesticide Articles Safety Information Resources Order Handbook

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PNW Plant Disease Management Handbook

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Pacific Northwest Plant Disease Management Handbook

This handbook is intended as a ready reference guide to the control and management tactics for the more important plant diseases in the Pacific Northwest. No attempt has been made to include all of the plant diseases that could possibly occur in the Pacific Northwest. The specific cultural, biological, and chemical recommendations are intended to manage a specific plant disease but may not always be appropriate under all production circumstances. The synthesis of a specific management recommendation should be done by a qualified individual. For this reason, this book should be used by—and has been expressly written for—county Extension agents, consultants, field and nursery people, and chemical industry representatives.

Growers also will find this publication useful but should contact their local county Extension agent or consultant for specific recommendations. Management of plant diseases is based first on an accurate diagnosis since plant problems can be due to environmental, physiologic, entomological or management problems, as well as plant pathogens or a combination of these problems. Organic growers will concentrate on cultural and biological control measures but should realize that many compounds listed under chemical control



Brassica plants with symptoms of black leg (*Phoma lingam*) showing leaf spots peppered with tiny black pycnidia (left) and cankered tissue on the lower main stem (right).
Photo by Cynthia M. Ocamb, © Oregon State University.

ATTRA Biorationals Database



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Biorationals: Ecological Pest Management Database



by **Rex Dufour**
NCAT Agriculture Specialist

Refer to the [instructions](#) below for search usage.

Select a Pest Type

Select a Pest Name

Active Ingredient or
Beneficial Organism

OR

Pesticide Trade Name

Submit Search

 [Reset Search](#)

Listing of OMRI Products

The screenshot displays the OMRI website's search interface. At the top, the OMRI logo is visible on the left, and navigation links for 'OMRI Lists', 'Get Listed', 'Who We Are', 'What We Do', and 'Community' are in the center. On the right, there are links for 'Log In' and 'Help', along with a prompt to 'Log in for more features'. The main content area is titled 'Search' and includes a search bar with the text 'OMRI Website Content' and an 'open' button. To the right of the search bar is a 'Keyword search' section with a search input field and a magnifying glass icon. Below the search bar, there are filter options: 'Products and Materials' with checkboxes for 'Generic Material' (checked), 'Livestock Vitamins Minerals', and 'OMRI Listed Product' (checked). Underneath, 'Advanced Filters' are shown, including 'Crops' (CF, CP, CT, LF, LH, LP, LT), 'Livestock', 'Processing' (PA, PS, PC, PN, PP), and 'Ruling Body' (Canada, USA, with USA checked). The results section shows '964 Total Results' and a list of products with their respective ruling bodies (CP) and country flags (USA or Canada). The products listed are: 440 Superior Spray Oil (USA), Able® 50 WDG Biological Insecticide (USA), Acetic Acid - nonsynthetic, pesticide (USA), Acetic Acid - synthetic (USA), ACOIDAL Fungicide-Miticide Micronized Wettable Sulphur WDG (Water Dispersable Granule) (USA), and Actinovate AG Biological Fungicide (USA).

OMRI

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Search

Filters [View the search legend](#) **Keyword search**

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Generic Material Livestock Vitamins Minerals OMRI Listed Product

Advanced Filters Deselect content to narrow your search clear selections

Crops CF CP CT LF LH LP LT

Livestock PA PS PC PN PP

Processing Ruling Body

964 Total Results 1 2 3 4 5 6 7 8 9 ... next last

- ▶ 440 Superior Spray Oil CP USA
- ▶ Able® 50 WDG Biological Insecticide CP USA
- ▶ Acetic Acid - nonsynthetic, pesticide CP USA
- ▶ Acetic Acid - synthetic CP USA
- ▶ ACOIDAL Fungicide-Miticide Micronized Wettable Sulphur WDG (Water Dispersable Granule) CP USA
- ▶ Actinovate AG Biological Fungicide CP USA

Suppliers of IPM Products

Great Lakes IPM

- ✕ wide variety of IPM products

Peaceful Valley Farm and Garden Supply

- ✕ monitoring tools, beneficial insects, biological control agents, floating row covers, and organically approved pesticides

Gemplers

- ✕ monitoring tools, hand lenses, safety equipment

BioQuip Products

- ✕ hand lenses and insect collecting, counting, and preserving supplies; books on insects

Suppliers of Beneficial Organisms

Arbico Organics

- ✘ organic supplies for home, garden, and agriculture use

Biocontrol Network

- ✘ beneficial insects, mites, nematodes and others

Rincon-Vitova Insectaries Inc.

- ✘ beneficial insects, mites, and nematodes

Green Methods

Koppert

Utah Plant Pest Diagnostic Lab - utahpests.usu.edu/upddl

The screenshot shows the homepage of the Utah Plant Pest Diagnostic Lab. At the top, there is a navigation bar with the Utah State University logo and the text "EXTENSION Utah State University". To the right, it says "UTAH PESTS Utah Plant Pest Diagnostic Lab" with a logo. Below this is a secondary navigation bar with links: "UTAH PESTS Home", "Utah Plant Pest Diagnostic Lab", "Integrated Pest Management", "School IPM", and "Cooperative Agricultural Pest Survey".

The main content area features several key elements:

- Search:** A Google search box.
- Home Menu:** A vertical list of links including Home, Fact Sheets, Frequently Asked Questions, Image Galleries, \$7.00 Diagnosis, Recent Pests, Alfalfa Hay Testing, Tick Survey, and Contact Us.
- Current Pest Issues:** A section with links for Top 20 Insects, Top 20 Arachnids, Bed Bug Travel Tips, and Hobo Spiders.
- Handbook Promotion:** A large banner for the "Utah Urban Pest Identification Handbook" with the text "IDENTIFY AND MANAGE PESTS WITH THE Utah Urban Pest Identification Handbook". It includes an image of the handbook cover titled "Common Pests of Schools & Structures in Utah" and contact information: "To order a hard copy, email us at ryan.davis@usu.edu".
- Sample Submission:** A section titled "Submit a Sample" with an image of a sample.
- Fact Sheets:** A section titled "Fact Sheets" with an image of ticks on a ruler.
- Events:** A list of upcoming events: "Jan 29, 2016 4-H Teen Winter Retreat" and "Feb 01, 2016 Teen Council Meeting", with a link for "More Events...".

At the bottom, there is a Facebook icon and a footer with the text: "Utah State University is an affirmative action/equal opportunity institution. © 2016 Utah State University Utah Plant Pest Diagnostic Lab". Navigation links "ext home", "site map", and "ext directory" are also present.

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Manure Analysis Proficiency Program

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USUAL
Soil • Manure • Plant • Feed • Water

USUAL is here to help you solve many of your **gardening, lawn, plant, and animal feed** problems. We are the only soil testing lab in Utah **open to the general public**. We work closely with your County Extension Agent to best serve you. [more >>](#)

Facilities
USUAL is here to help you solve your plant and animal problems with modern facilities and [equipment](#). Our modest fees place the right answers within reach.

Methods
Our [FAQ \(Frequently Asked Questions\)](#) may answer many of your questions. The answers cover what we do, how to sample, how much sample we need, etc. If not, feel free to [contact us](#) or your [County Agent](#).

USUAL is located in the Skaggs Laboratory at 1541 N on 800 E in North Logan:

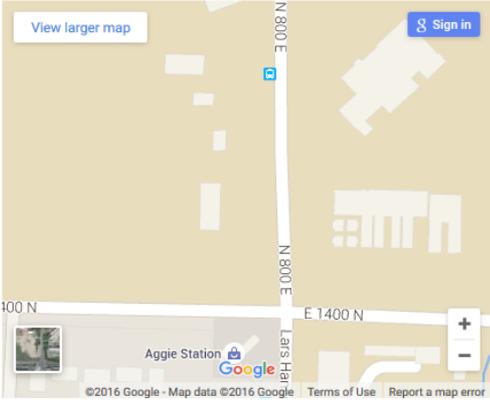
Please mail samples to:
USUAL
9400 Old Main Hill
Logan UT 84322

Feel free to drop samples off in person at:
1541 N 800 E in North Logan.

Please Note: USUAL has implemented it's first price change since 2003. Please find new pricing schedule using the link to the left or at: [Prices](#).

Submission forms have also been updated and new forms are also found using the link to the left or at: [Forms](#).

Please call with any questions.
435-797-2217



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Current Status of Brown Marmorated Stink Bug and Spotted Wing Drosophila

**Lori Spears
Utah State Horticulture Association
January 22, 2016**

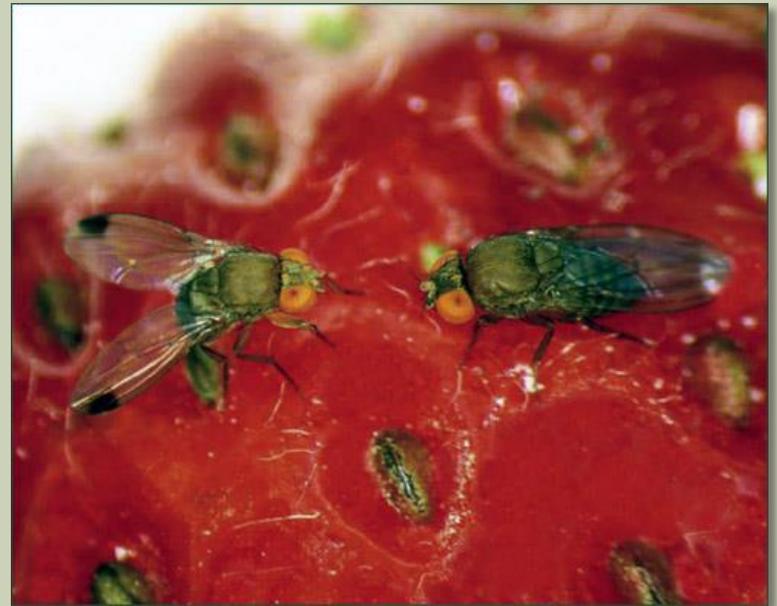


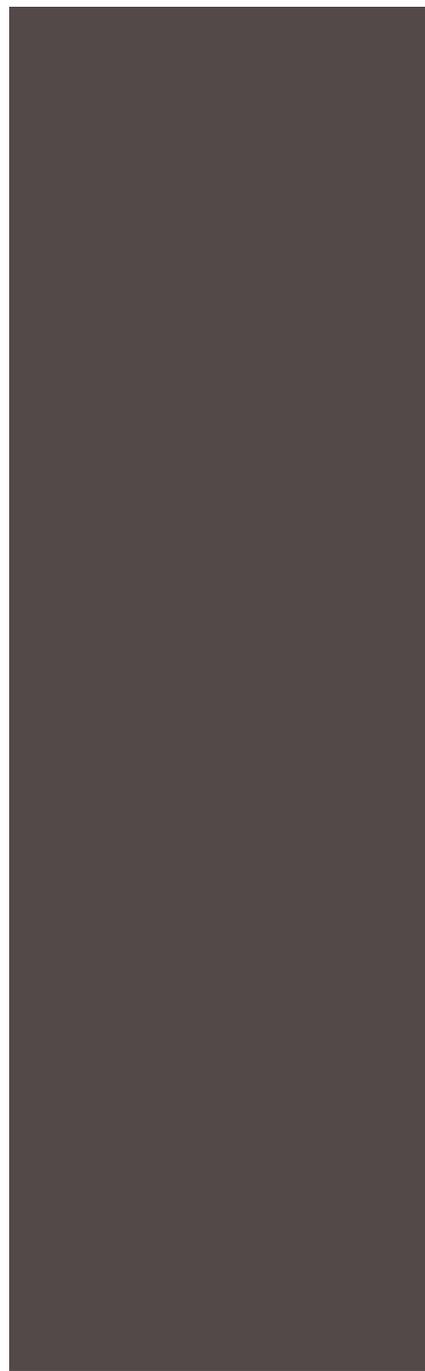
Spotted Wing Drosophila

Spotted Wing Drosophila

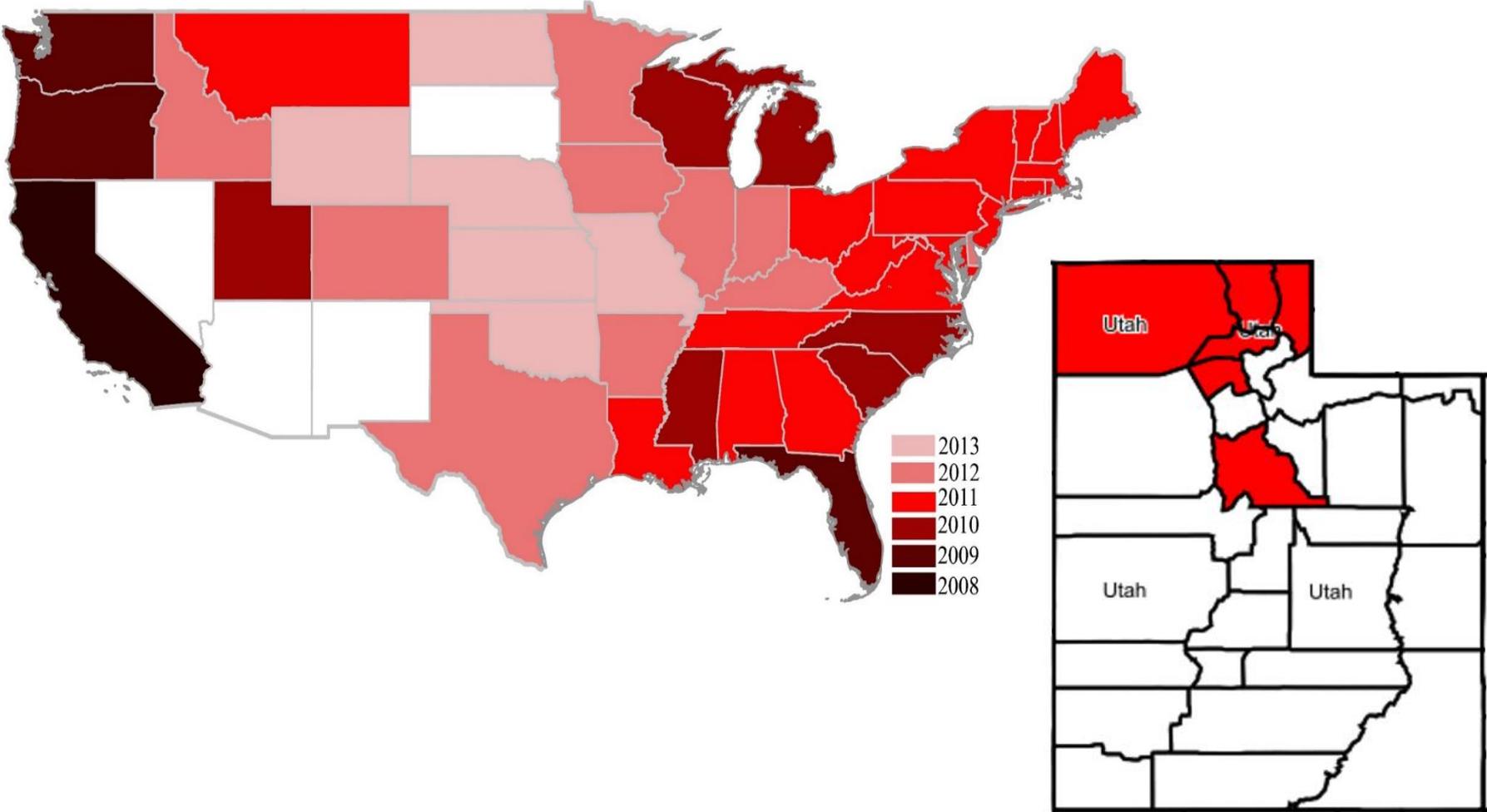
(*Drosophila suzukii*)

- Native to southeast Asia
 - First detected in CA in 2008
 - Introduced to Utah in 2010
- Most *Drosophila* spp. attack overripe and rotting fruit
- SWD preferentially infests ripening and ripe fruit





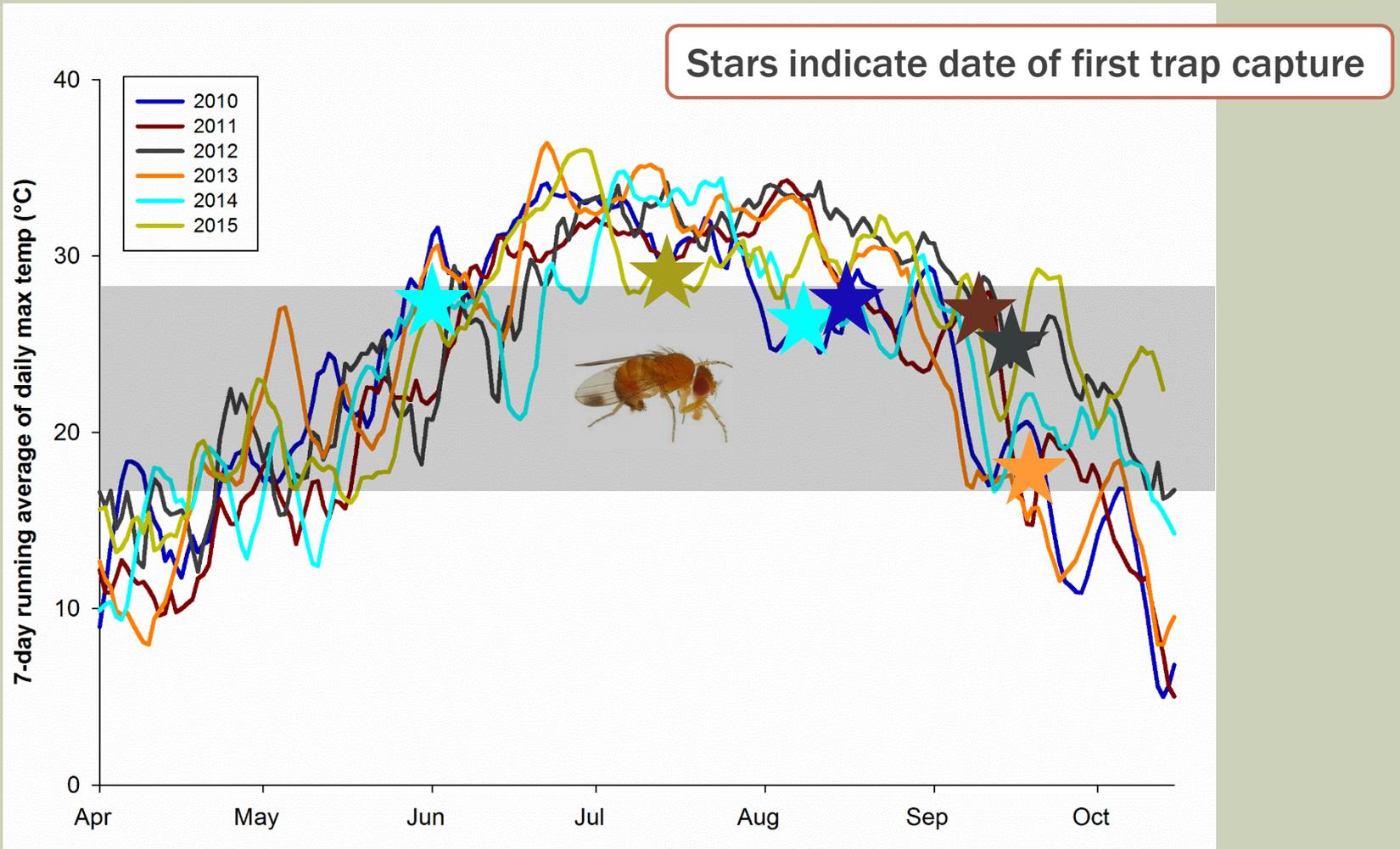
Current Distribution



All Years

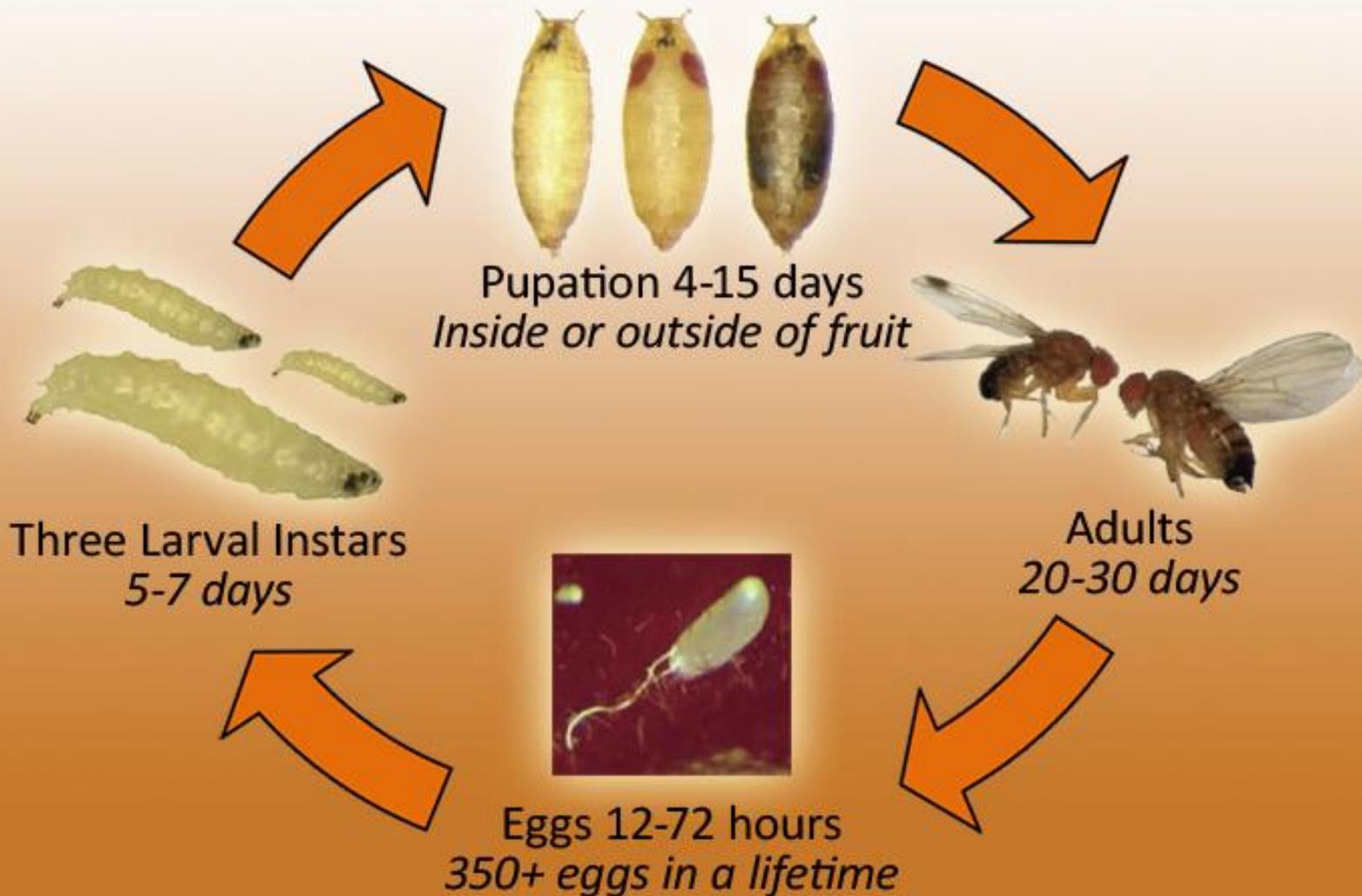
Year	Total # of SWD	1 st trap capture	County
2010	73	Aug 18	Davis
2011	61	Sep 8	Davis
2012	16	Sep 17	Davis
2013	23	Sep 25	Davis
2014	3582	Jun 2 / Aug 12	6 counties
2015	6917**	Jul 20	6 counties

SWD adults start appearing in traps after peak summer temperatures have decreased

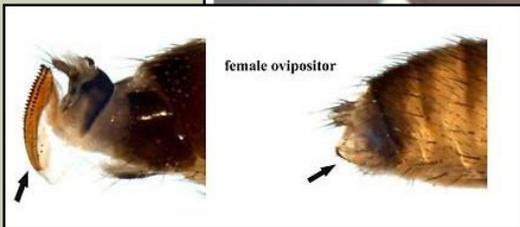
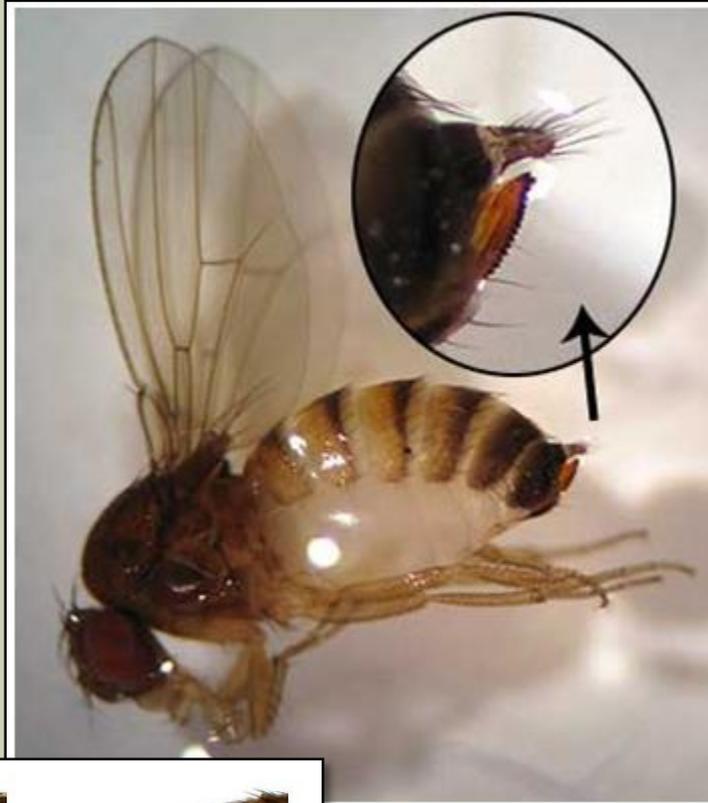


Life Cycle of the Spotted Wing Drosophila

Drosophila suzukii (Matsumura)



Identification



SWD Monitoring

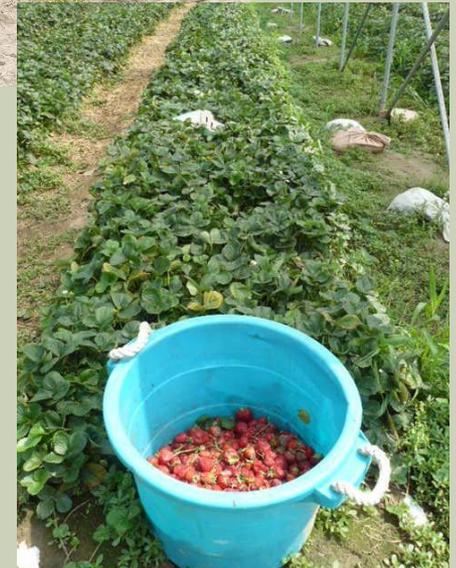
(Adult Activity)

- Pheromone-baited trap (Scentry or Trece)
 - Add 1-2 drops of unscented dish soap
 - Place trap in shaded fruit zone
 - Check trap and change bait weekly
- 2 T yeast, 8 T sugar, 24 oz. water (makes 4 traps)



SWD Management (Cultural Control)

- Harvest early
- Eliminate fallen and suspicious fruit
- Maintain open canopy
- Repair leaking irrigation lines and minimize overhead irrigation
- Consider removing alternative fruit hosts





African Fig Fly

African Fig Fly

(Zaprionus indianus)

- Native to Africa, the Middle East, and Eurasia
 - Found in Central America
 - First detected in Florida in 2005
 - Detected in Utah in 2015
- Can be distinguished by their “prominent racing stripes”
- Lays eggs in overripe or previously damaged fruit





**Brown Marmorated
Stink Bug**

Brown Marmorated Stink Bug

(Halyomorpha halys)

- A highly invasive crop pest
 - Native to eastern Asia
 - First detected in PA in 1998
 - Detected in Utah in 2012
- Has a very broad host range
- Nuisance in urban landscapes
- Strong fliers and excellent hitchhikers



BMSB Feeding

- Feeding stylet
 - Physical damage
 - Secondary infections
- Feed on vegetative and reproductive structures
 - even woody tissue



Specialty Crops at Risk to BMSB Damage

<p>HIGH RISK</p> 	<p>apple, Asian pear, beans (green, pole, snap), bee-bee tree, edamame, eggplant, European pear, grape¹, hazelnut, Japanese pagoda tree, nectarine, okra, peach², Peking tree lilac, pepper, redbud, sweet corn, Swiss chard, tomato</p>		
<p>MODERATE RISK</p> 	<p>apricot, asparagus, blueberries^{1,3}, broccoli, cauliflower, cherry², collard, cucumber, flowering dogwood, horseradish, lima bean, littleleaf linden, serviceberry, tomatillo</p>		
<p>LOW RISK</p> 	<p>blackgum, carrot, cranberries, garlic, ginkgo, greens, Japanese maple, kohlrabi, kousa dogwood, leeks, lettuce, many gymnosperms, onion, potato, spinach, sweet potato, turnip</p>		
<p>UNKNOWN</p> 	<p>almond, citrus, hops, kiwi, olive, pistachio, plum, strawberries, walnut</p>	<p>HOSTS Non-Specialty Crop BMSB Hosts Contributing to Specialty Crops Risk</p>	<p>field corn, soybean</p>

1—Potential risk of taint/contamination. 2—Additional risk potential due to bark feeding. 3—Considered moderate-high risk.



Funded by USDA-NIFA SCRI Coordinated Agricultural Project, grant #2011-51181-30937. Image credits—sweet corn: Joe Zlomek; eggplant: Howard F. Schwartz, Colorado State University, Bugwood.org; apple, carrots: morguefile.com/creative/bekahboo42; flowering dogwood: Richard Floyd, Creative Ideas LLC, Bugwood.org; blueberries, cauliflower: Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org; ginkgo: Jan Samanek, State Phytosanitary Administration, Bugwood.org; cranberries: Cjboffoli (CC-BY-3.0). Printed May 2015.



About BMSB

The brown marmorated stink bug, *Halyomorpha halys* (Stål), is a voracious eater that damages fruit, vegetable, and ornamental crops in North America. With funding from USDA's Specialty Crop Research Initiative, our team of more than 50 researchers is uncovering the pest's secrets to find management solutions that will protect our food, our environment, and our farms.

Learn more at StopBMSB.org.



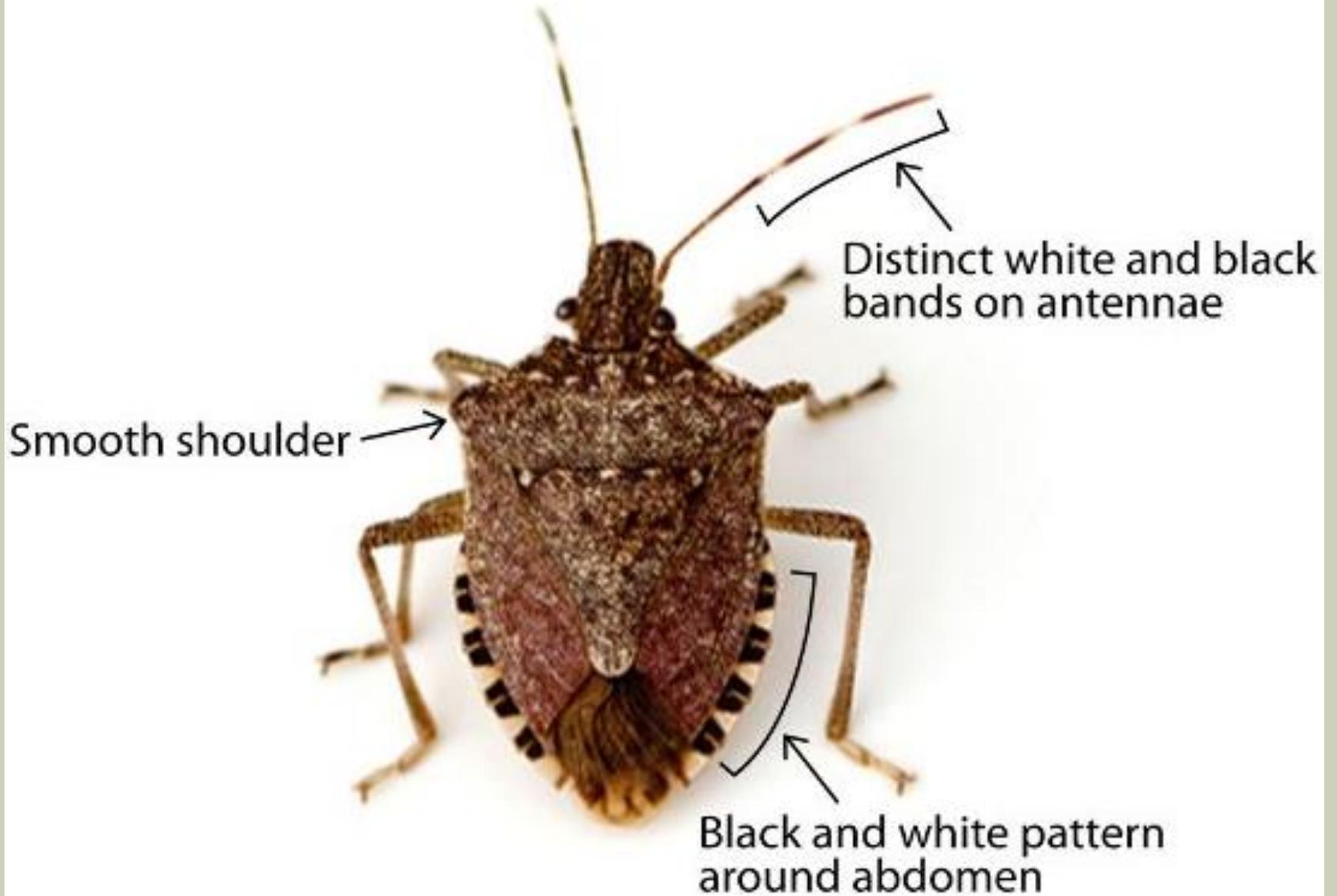
Damage on fruit caused by BMSB feeding can occur throughout the entire growing season

- Early season feeding causes **misshapen** fruit
- Late season feeding causes depressions on the fruit surface and “**corking**” just below the fruit surface
- Internal damage can be present even when external damage is not detectable





Brown Marmorated Stink Bug (*Halyomorpha halys*)





Smooth

Banded

Brown Marmorated



Toothed

Banded

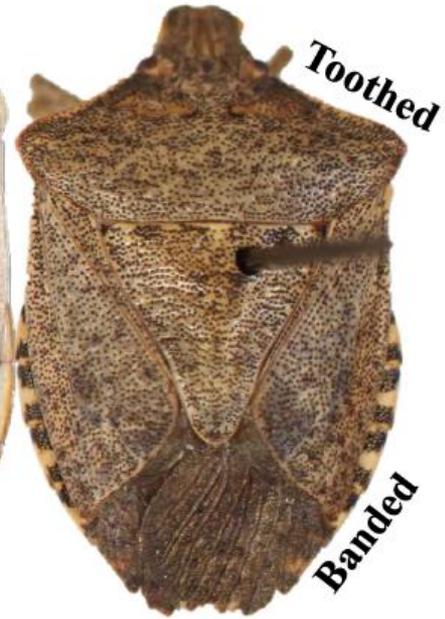
***Brochymena* sp.**



Smooth

Solid margin and
central spot

***Chlorochroa* sp.**



Toothed

Banded

Conspere

Life History and Biology

- Eggs laid under leaves in clusters
- 1st instars feed on egg mass
- 2nd instars disperse from host plant
- Developmental period from egg to adult lasts ~50 days



28 eggs



“red ring”



1st instars



2nd instars

Life History and Biology

Nymphs (5 stages)

Winged adults



2

3

4

5



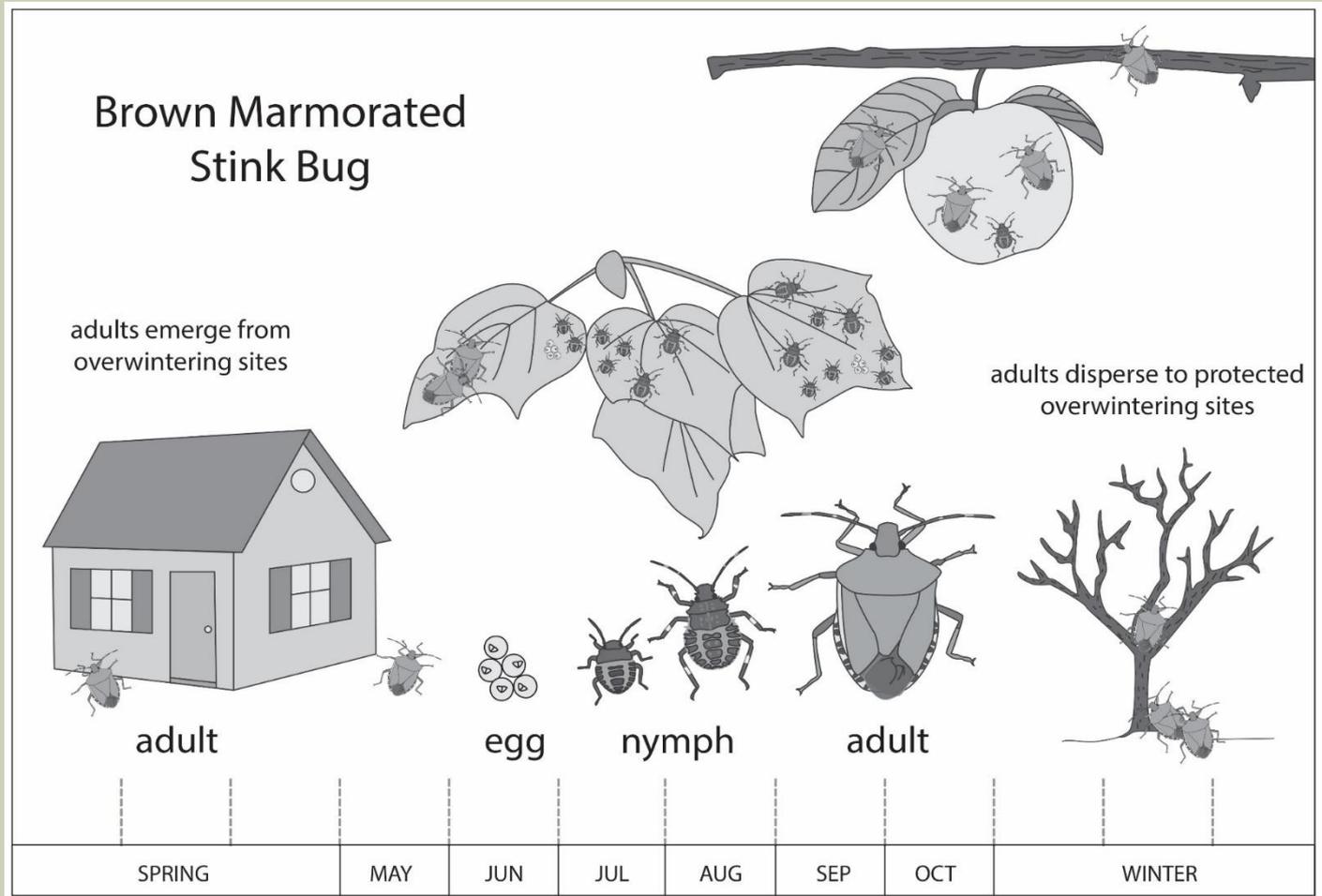
male



female

All except stage 1 are damaging

Spring emergence of adult bugs from overwintering sites is usually very extended



Detection Approaches

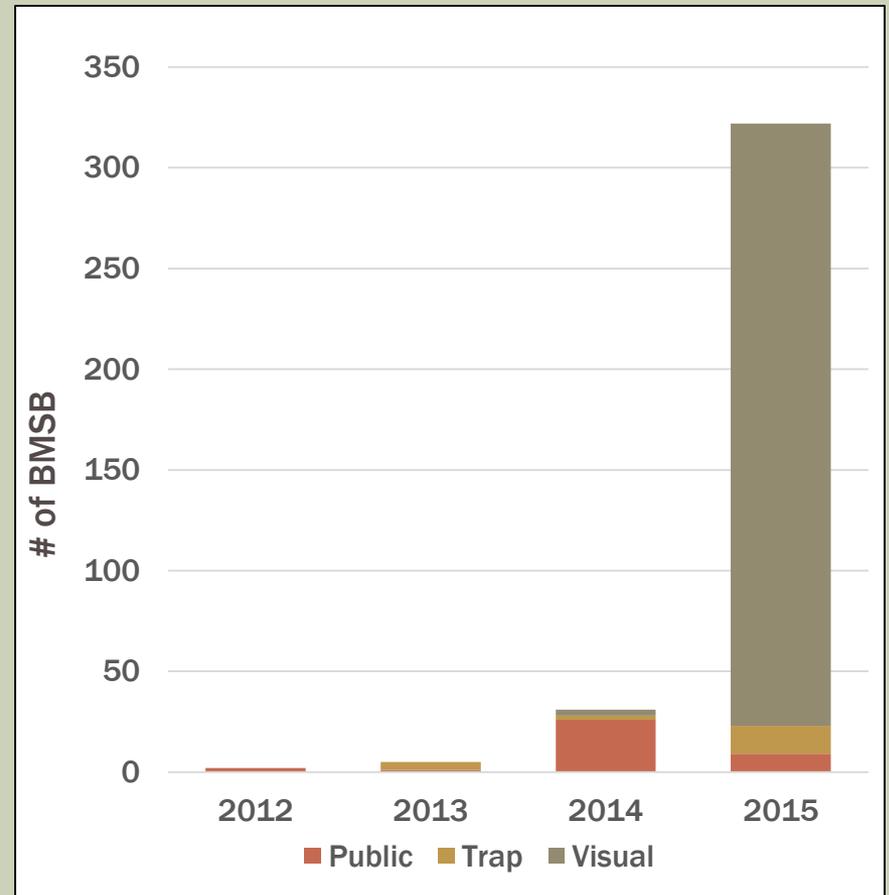
- Surveys
 - Passive (traps)
 - Active (beating trays)
- Reports
 - Citizens
 - Workshops / media
 - Overwintering bugs
 - Growers
 - Our highest concern
 - Please report!



caps@usu.edu

BMSB is here and most likely will be an important and serious threat to Utah's agriculture

- 2 new county detections
 - Salt Lake
 - Utah
 - Davis
 - Weber
- Massing adults and breeding populations

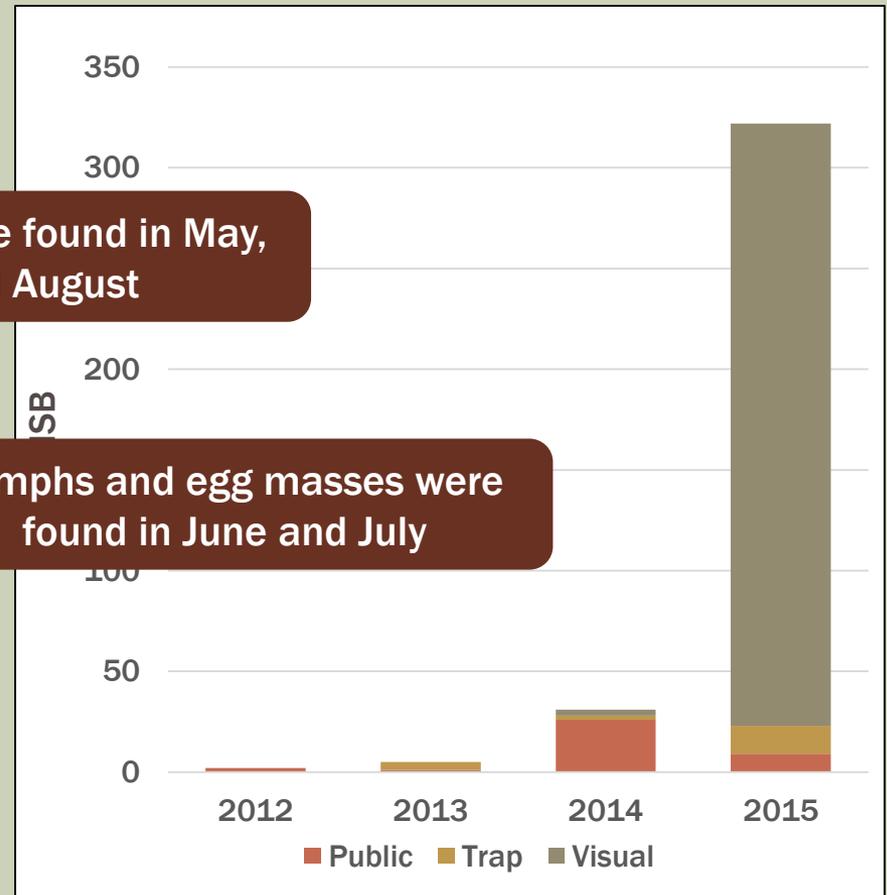


BMSB is here and most likely will be an important and serious threat to Utah's agriculture

- 2 new county detections
 - Salt Lake
 - Utah
 - Davis
 - Weber
- Massing adults and breeding populations

Most adults were found in May, June, and August

Nymphs and egg masses were found in June and July



It is unclear how BMSB captures relate to density or damage potential



Honeysuckle



Downy Japanese Maple



Siberian Peashrub



Butterfly Bush



Catalpa

IPM Tools for Managing BMSB

(Chemical Control)

- Effective products include methomyl, pyrethroids, and some of the neonicotinoid products
 - Intensive spray programs are still seeing high damage
 - Pesticides are hard on biological control
- Barriers to effective chemical control
 - Mouthparts enable them to “by-pass” insecticide residues
 - Only tarsi (feet) are in contact with surface residues
 - Hard-bodied

IPM Tools for Managing BMSB

(Biological Control)

- **Parasitoid from China**
 - > 50% egg parasitism in China
 - Low levels of parasitism in the U.S. (~4%)
 - Found in Maryland, Virginia and Washington
- **Fungal pathogens**
- **Other natural enemies**



Online Resources

www.utahpests.usu.edu/caps/



Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-144-11 May 2011

Brown Marmorated Stink Bug [*Halyomorpha halys* (Stål)]

Erin Petrizzo, Research and Extension Assistant • Diane G. Alston, Entomologist

Do You Know?

- Brown marmorated stink bug was introduced into the U.S. from eastern Asia in the late 1990s, and has since spread to the East, upper Midwest, and Northwest regions.
- It feeds on a broad range of plants including vegetables, field crops, ornamentals, weed, and native species.
- Adult- and nymph-feeding causes light-colored stippling and lesions on leaves, necrotic lesions and scars on fruits, and deformed pods on legumes.
- Adults can be a major nuisance pest by overwintering inside buildings.
- This insect has not yet been reported in Utah. Please report suspected specimens or crop to USU Extension or the Utah Department of Agriculture and Food.

Commercial growers were caught by surprise during the 2009 growing season when they began to see crop damage inflicted by BMSB. Since then an increasing number of farms and gardens have experienced extensive crop damage (high levels of crop damage were experienced in 2010, especially in the Mid-Atlantic



Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-175-15 August 2015

Invasive Insect Look-Alikes Mistaken Insect Identity

Lori R. Spears, CAPS Coordinator • Ryan S. Davis, Arthropod Diagnostician • Ricardo A. Ramirez, Entomologist

Proper identification is the cornerstone of integrated pest management, but it is a skill that can be difficult to master. Mistakes in identification are common, as many insects look and act alike, and/or can cause similar injury. Misidentifications could potentially lead to adverse agricultural and ecological consequences. For this reason, suspected pest species should be quickly identified. A number of guides and websites are available to assist with insect identifications (e.g., bugguide.net) is complete with color photographs and links to identification keys. In addition, several state and federal agencies are specialized in insect identifications and have diagnostic labs to help assess suspected insect injury (for contacts in Utah, see page 6 of this fact sheet). Here, we provide a quick identification reference guide for two invasive insects that have been found in Utah (i.e., the brown marmorated stink bug and Japanese beetle) and two that have not been found in the state (i.e., the emerald ash borer and Asian longhorned beetle), but are on our radar as they have been found elsewhere in the U.S. We focus on these four insects because they are often mistaken in Utah as native insects. We also briefly describe some similar species that can be mistaken for these insects. **Note that this publication, for spacing reasons, does not cover ALL species that resemble a particular invasive insect.** We highlight the most common look-alike species.



Fig. 1. Proper species identification is key to effective IPM.

UPDDL, 5305 Old Main Hill, Logan UT 84322, utahpests.usu.edu

Page 1

Brown marmorated stink bug (Order Hemiptera: Pentatomidae) (BMSB) (Fig. 1) was accidentally introduced into the eastern U.S. from Asia in the 1990s. In 2001 it was officially identified in Pennsylvania and has since spread along the eastern seaboard westward into the Great Lakes region. In 2002 it found in Portland, Oregon, and has since spread localized areas in Washington and California. It yet been found in Utah, but it is likely only a matter of time before it will occur in most states due to its adaptation to a wide range of climates. Since 2008 BMSB has gained notoriety as a major nuisance to large aggregations of the bugs invading buildings, fall to winter, attracted to the protective wa-



Fig. 1. Adults are shield-shaped, brown, and 5/16 inch in

Keep in mind that insect look-alike species are sometimes other pests, but they can also be beneficial insects. For example, the spined soldier bug (*Podisus maculiventris*) is a beneficial, predatory stink bug (Fig. 2), but can be mistaken for the destructive and invasive brown marmorated stink bug (*Halyomorpha halys*). Similarly, the six-spotted tiger beetle (*Cicindela sexguttata*) is a predatory ground beetle (Fig. 3) that can be misidentified by some as the invasive Japanese beetle (*Popillia japonica*). We describe the brown marmorated stink bug and the Japanese beetle (and more of their look-alikes) in more detail in the next section.



Fig. 2. The spined soldier bug is a predatory stink bug.



Fig. 3. The six-spotted tiger beetle is a beneficial, predatory beetle, but can be mistaken for the invasive Japanese beetle.



Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-161-12 January 2012

Monitoring for Spotted Wing Drosophila in Utah (*Drosophila suzukii*)

Cory A. Stanley, Extension Entomologist

Do You Know?

- Spotted wing drosophila (SWD) is a non-native vinegar fly that was first detected in Utah in 2010.
- SWD attacks a broad range of fruits, including tree fruits, berries, vegetables, and ornamentals.
- SWD can infest unripe, ripe, over-ripe, and soft fruits.
- Detection and monitoring are crucial management of SWD.
- Because the fly is not widespread in Utah, the identification of suspect SWD flies is verified by the Utah Plant Pest Diagnostic Laboratory (UPDDL).

WHEN TO MONITOR

Spotted wing drosophila can attack fruit as soon as it begins to ripen, so that is when monitoring should begin. For example, place a trap in a cherry tree when the fruits begin to turn pink (Fig. 3). Continue trapping for at least



Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-140-10 September 2010

Spotted Wing Drosophila

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WHAT YOU SHOULD KNOW

- Spotted Wing Drosophila (SWD) is a new Utah pest (first found August, 2010) that can infest unripe (pre-harvest), ripe, over-ripe, and spotted fruits.
- SWD attacks a broad range of fruits, including tree fruits, berry fruits, and vegetable fruits.
- SWD can be easily controlled using standard insecticides, and by expanding the spray program to pre- and post-harvest full stages.
- Suspect SWD flies should be sent to the Utah Plant Pest Diagnostic Lab (UPDDL) for identification.

BACKGROUND

Spotted Wing Drosophila (*Drosophila suzukii*) is a new fruit pest recently discovered in Davis County, Utah (August, 2010). Because this pest is widespread in the western and southeastern United States, it is considered "non-indicatable," meaning no import or export restrictions, or quarantines will be implemented. SWD is similar to other vinegar flies (genus *Drosophila*), except they can infest unripe fruit. SWD can be easily controlled using insecticides common in fruit integrated pest management plans. If SWD is caught in monitoring traps, insecticide applications must be used during the unripe fruit stage to prevent damage.

This fact sheet describes SWD biology and current monitoring and control strategies for growers and homeowners. Any suspect SWD should be sent to the UPDDL for identification. Many flies have spots on their wings. Small flies with only 1 spot per wing (Fig. 1) should be considered suspect.

BIOLOGY

Scientific Name: *Drosophila suzukii* (Drosophilidae)

Range in U.S.: Davis County, Utah; California; Oregon; Washington; Florida; Louisiana; North Carolina; and South Carolina.

Hosts: Detected in a raspberry and blackberry field in Kayville, Utah (trap survey). Hosts include: tree fruits (apple, peach, cherry, mulberry, nectarine, peach, persimmons, plum, plum); small fruits (blackberry, blueberry, grapes, raspberry, strawberry); vegetable fruits (melon, tomato). Any soft-skinned fruit may be susceptible to SWD.

Damaging Stage: Larvae and adults. Larvae feed inside fruit causing abscesses; secondary fungal and pest infection may occur. Adults cause superficial scarring by sawing into fruit to lay eggs.

Overwintering Stage: Unknown if SWD will survive winter in northern Utah; survival in southern Utah is likely. Adults and pupae may overwinter.

Egg: Small, white, inserted into fruit. Two thin filaments used for breathing are visible protruding out of fruit. Over 300 eggs may be laid by a single female (Fig. 2).

Immature: Small (0.067-3.5mm or 0.003-0.1 in.) cream-colored maggot with black mouthparts (Fig. 3).

Adult: Typical vinegar fly appearance: 2-5 mm (0.1 in.) long; red eyes, pale brown body, featherlike antennae. Males have one circular black spot per wing (Fig. 1); females have no spots on wings and a sawlike ovipositor (Fig. 2). They are most active at 68°F; egg laying decreases above 84°F.

Pupae: Small (2-3 mm or 0.1 in.) brown, cylindrical casicles with two extensions on one end (Fig. 4). Found in fruit or just below leaf litter in soil.

Generations per year: Unknown for Utah. Three to eight gen/yr have been observed in Oregon, and 10-13 gen/yr in California.



Fig. 1. Adult male spotted wing drosophila (*Drosophila suzukii*). Photo by G. Arcand.

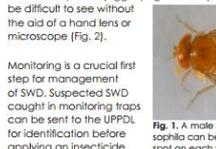


Fig. 1. A male spotted wing drosophila can be 1 spot on each wing.



Fig. 2. Left: Female spotted wing drosophila; not of spots on the wings and presence of the serrated Right: Close-up of the serrated ovipositor.



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