Managing Pest of Berry Crops with Emphasis on Spotted Wing Drosophila (and something new)

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Potential Reasons for Regional Differences in Use of Grape?

- Higher temperatures in some regions
- Higher rainfall/humidity in east affecting SWD
- Higher rainfall/humidity in east affecting insecticide residues
- Differences in fruit skin/firmness
- Abundance of wild hosts

Infesting Both Red and White Varieties

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Infesting Both Red and White Varieties

A pair of air tubes on most drosophilid eggs

SWD Oviposition in Grape

Petit verdot

Shrader

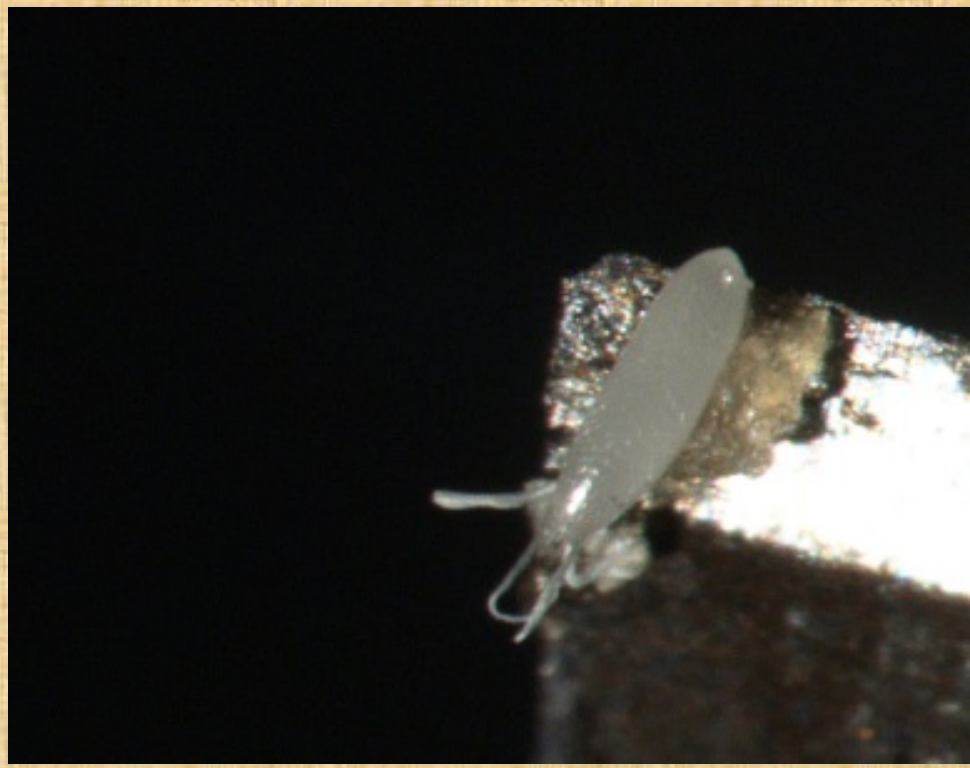
SWD Oviposition in Grape

Viognier

Shrader

Zaprionus indianus Gupta, African fig fly

Zaprionus indianus Gupta, African fig fly



Impact of AFF presence on SWD larval mortality

Substrate	Egg Density on Substrate	Mean Pupal Volume (mm^3)	Mean Developmental Time (days)	Mean Eggs Laid in Lifetime	Larval Mortality (%)	Pupal Mortality (%)
Media	2:2(SWD: AFF)	3.8 ± 0.12 f 3.3 ± 0.08 m	11.1 ± 0.08 f 11.0 ± 0.11 m	156 ± 26.1	23.3	17
	4 SWD Control	4.0 ± 0.11 f 3.5 ± 0.09 m	11.0 ± 0.0 f 10.7 ± 0.11 m	199.4 ± 30.7	31	0
	4:4(SWD: AFF)	4.1± 0.13 f 3.6± 0.1 m	11.2 ± 0.1 f* 11.1 ± 0.13 m*	206.8 ± 31.2	35*	25.6
	8 SWD Control	3.9± 0.1 f 3.6± 0.1 m	10.5 ± 0.13 f 10.2 ± 0.17 m	181.0 ± 34.0	15	24.5

SWD Management
Chemical Control

- Incorporate seasonal max no. of applications!
- Including those before SWD active, or fruit vulnerable

Insecticide	IRAC	Caneberry	Grape
malathion	1	3	2
Brigade	3	2 (32 oz)	16 oz
Danitol	3	--	2
Mustang Max	3	24 oz	24 oz
Pyganic	3	n/a	n/a
Delegate	5	6	5
Entrust	5	6	5
Grandevo	Un	n/a	n/a
Surround	Unk	n/a	n/a

SWD Management
Biological Control

- Starting a new project on biological control
- Will compare crop environments
  - Grape
  - Caneberry
  - Cherry
- Sentinel specimens of SWD and AFF
- Collected parasitoids tentatively identified as:

  Figitidae

  Asobara sp. (Braconidae)


hokie bugfest

Figitidae

Spotted lanternfly, *Lycorma deliculata*

USDA

Spotted lanternfly, *Lycorma deliculata*

Pfeiffer

Spotted lanternfly, *Lycorma deliculata*

- Originally from Asia (China, Japan, Korea, Vietnam, India)
- Expanding its range, 2008 into Korea (Han et al. 2008)
- Introduced into Pennsylvania in Sept 2014; not yet in Virginia (5 townships, 2 boroughs quarantined - Gibbs 2014)
- Two most suitable hosts are tree of heaven, and *Vitis vinifera*
- Also apple, plum, cherry, peach, nectarine, apricot, almond, pine, oak, walnut, poplar
- Can cause wilting of entire trees (Kim et al. 2011)
- Will be important to vineyard, orchard and logging industries.

Spotted lanternfly, *Lycorma deliculata*

- Short range dispersal – flight, hopping, walking
- Long range dispersal – human movement of infested commodities, or egg masses

Spotted lanternfly, *Lycorma deliculata*

- Eggs overwinter on smooth plant tissue or non-plant material. Covered with grey waxy material, lost at hatching

USDA

USDA

Day

Spotted lanternfly, *Lycorma deliculata*

- Nymphs black with white spots in instars 1-3, then red with black spots later in instar 4.

USDA

Spotted lanternfly, *Lycorma deliculata*

- Adults about an inch long, speckling on wings

USDA

Pfeiffer

Spotted lanternfly, *Lycorma deliculata*

- Overwinter as eggs laid on smooth host plant tissue, or non-host material
- Eggs hatch in spring, early summer
- Nymphs feed on a wide variety of plants, on young tissue
- Adults appear in late July, feed mainly on tree of heaven, and grapevines (Lee et al. 2009)
- Feeding results in accumulations of honeydew and sooty mold

Spotted lanternfly, *Lycorma deliculata*

- Adults and nymphs gather in large numbers on host trunks

Spotted lanternfly, *Lycorma deliculata*

- Nymphs cluster for feeding (Choi 2011)
- Look in evening or night on trunk, or by day at base of plant
- Look for eggs on smooth surfaces (bark, brick, stone, dead plant tissue)

Spotted lanternfly, *Lycorma deliculata*

- Overwintering eggs subject to mortality from cold
- Recent range expansion may be related to climate change, warming winters (Lee et al. 2011)
- But details on cold-induced mortality lacking
- Survived polar vortex in Pennsylvania; cold relative to Korea?
- Please let me know of suspected presence!

Brown Marmorated Stink Bug

- *Halyomorpha halys* (Stål)

Brown Marmorated Stink Bug

- Native to China, Japan, Korea
- Introduced around Allentown PA in 1996
- Found in Virginia 2004
- Now found in 39 states
- One gen PA, NJ, 2 generations for us (4-6 in subtropical parts of China)
- In fall, seek shelter in houses
- Why the big stink?

BMSB Host Range

- Highly polyphagous, >300 hosts
- Fruit crops
  - Orchard – apple, pear, peach, hazelnut
  - Small fruits – caneberries, blueberries
  - Wine grapes
- Field crops
  - Soybean
  - Cotton
- Vegetable crops
  - Tomatoes
  - Peppers
- Ornamental crops

Brown Marmorated Stink Bug

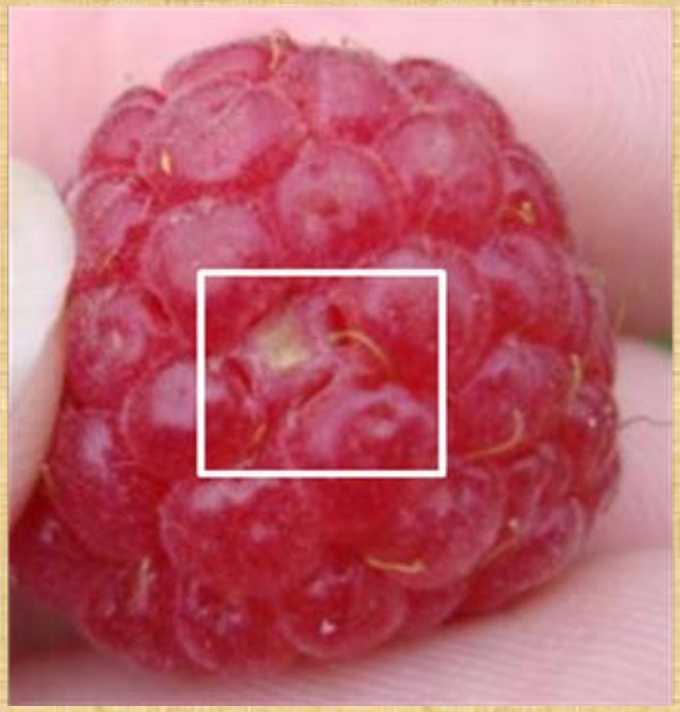
Stink Bug Eggs

Podisus

Halyomorpha

Stink Bug Injury

- Injury to berries



Borers

Primocane vs. Floricane-bearing varieties

- **Borers affecting Caneberries**
  - **Raspberry crown borer *Pennisetia marginata* (Harris) (Sesiidae)**
  - Rednecked cane borer *Agrilus ruficollis* (F.) (Buprestidae)
  - Raspberry cane borer *Oberea bimaculata* (Olivier) (Cerambycidae)

Wash. St. Univ.

Col. St. Univ.

Raspberry Crown Borer

- **Adult is a moth that mimics yellowjackets**

OSU photo

Raspberry Crown Borer

- **Eggs are laid on the undersides of new leaves, with 2-3 eggs per plant.**
- **Eggs incubate 3-10 weeks, beginning to hatch in late July (about the first week of September and continuing until early November in the northern part of its range (Canada))**

WSU photo

Raspberry Crown Borer

- **Biological control: Entomopathogenic nematodes provided some control**
- **Cultural control: infested canes and crowns should be removed and destroyed (After harvest, or during pruning).**
- **Eliminating nearby wild brambles also reduces infestations (extra benefit with advent of SWD).**

Raspberry Crown Borer

- **Sevin XLR (2 qt/A) or (in U.S.) malathion 25WP (2 lb/A) may be applied as a foliar spray**
- **Brigade 10WSB (16 oz) or Sniper 2 (6.4 fl oz) (both bifenthrin) applied in 50 gal/A (Arkansas data; don't need 200 gal/A) (not in Canada)**
- **Altacor applied as foliar spray directed to base of canes**
- **Apply between October and early April**
- **Bifenthrin might be needed for SWD later**
  - **Pay attention to max applications/season**

Raspberry Crown Borer

- **Altacor applied as foliar spray directed to base of canes**
- **3.0-4.5 oz/A**
- **Apply in early fall after eggs hatch, or early spring when larvae first become active**
- **Apply when ½” (or 1 cm) of rainfall is in forecast**

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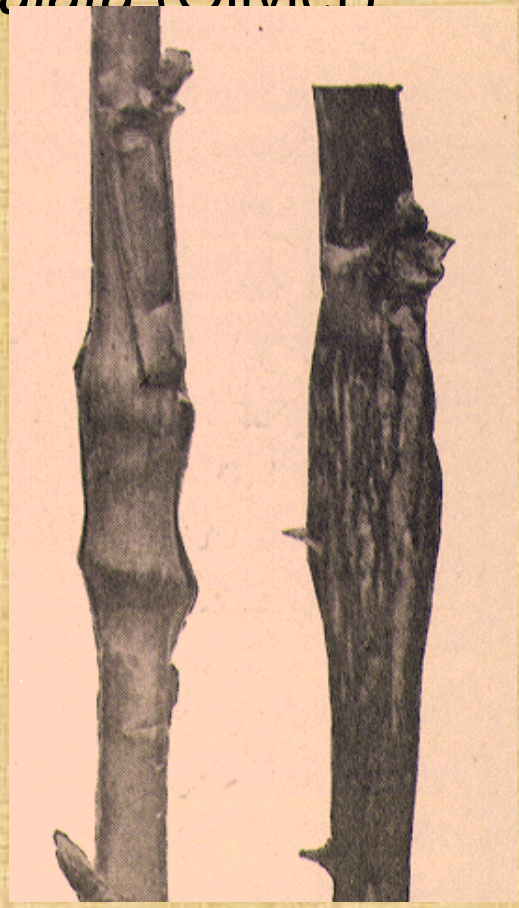


Rednecked Cane Borer

- **A buprestid beetle, dark gray with coppery pronotum**
- **Adults are about 6-7 mm (1/4 inch) long**

Rednecked Cane Borer

- **Young larvae are restricted to the cambium, circling the cane 3-4 times in a close spiral, girdling the primocane, and producing gall-like swellings.**

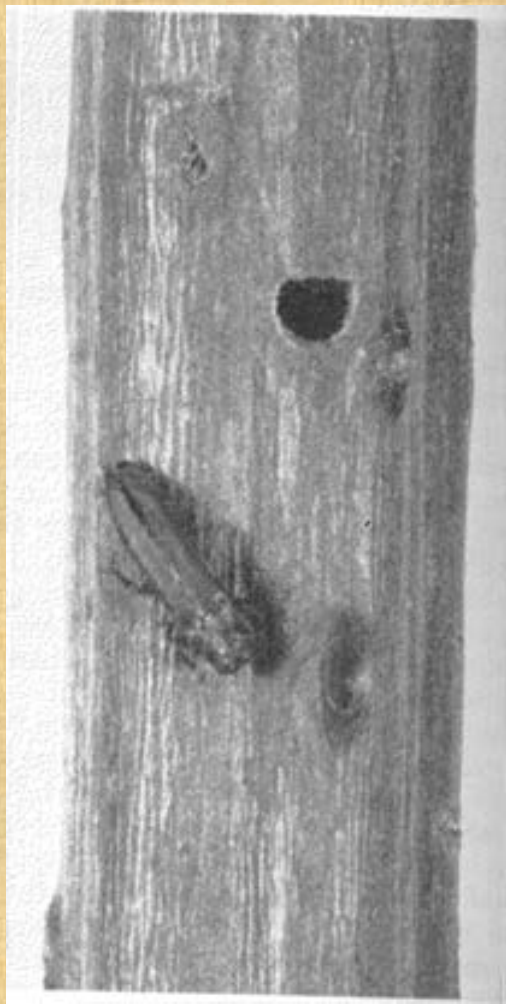
UGA photos

Rednecked Cane Borer

- **Larvae reach a length of 12 mm, and have a pair of horn-like projections on the posterior end. The larvae are white and legless, with a flattened head (the family is often called flatheadeded borers).**
- **Larvae winter in the cane, and in March create a pupal chamber. The pupa is formed in late April. The pupal period lasts 20-40 days.**
- **Cultural control?**

Rednecked Cane Borer

- When the adult leaves the pupal skin, it remains in the tunnel for about 10 days before chewing a D-shaped emergence hole.
- Adults feed on foliage for several days before beginning oviposition.



Rednecked Cane Borer

- **Cultural control: Remove galled canes in dormant season or early spring.**
- **Primocane-bearing varieties?**
- **This is most effective if nearby wild hosts are eliminated, and also more effective in open settings (wild brambles in nearby woods provide a source of wild beetles).**

Rednecked Cane Borer

- Chemical control: After leaf fall, if more than 10% of the primocanes are infested, or if the number of primocanes expected to be pruned off is exceeded, a spray in justified.
- Examine primocanes for adults twice weekly, beginning at the beginning of bloom. Damage is minimized when malathion, Brigade are applied twice at intervals of 7-12 days from the time the first beetles appear (early to mid May). (not available in Canada)
- Wild host removal helpful in itself, also makes chemical control more effective.

Rednecked Cane Borer

- Chemical control: Admire Pro or 2F applied to soil or foliar?
- Bee issues
- “Do not apply prebloom or during bloom or when bees are actively foraging.”

- **Borers affecting Caneberries**
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Raspberry Cane Borer

- **Adults appear in June, and are present until late August. After ovipositing, the female girdles 6 mm above and 6 mm below the egg puncture.**
- **Shoot tips wilt in early summer.**

Raspberry Cane Borer

- **Cultural control: Wilting canes or those with girdling should be destroyed. If pruning occurs within a few days of the onset of wilting, only a small amount of additional shoot need be removed.**
- **Chemical control: Just before blossoms open, malathion 57EC (3.0 pt/A) may be applied;**
- **M-Pede - 2 % solution**

Not all neonics are equal regarding bee toxicity

- Nitro-substituted most toxic to bees
  - Clothianidin, dinotefuran, thiamethoxam, imidacloprid, pitenpyram
- Cyano-substituted less toxic
  - Acetamiprid, thiacloprid

Who is to blame for CCD?

Who is to blame for CCD?

- Plenty of blame to go around …

Who is to blame for CCD?

- Insecticides an easy target – a painful history to remember, DDT and Silent Spring, Furadan and eagles
- Public perception of insecticides – perception vs reality
- Pesticide companies – pushing neonics
- Farmers – choice of neonics (comparing with alternatives), planting fence to fence, killing alternate foods
- Homeowners – herbicides to kill alternate foods (aka weeds); neonics also in home OTC pesticides
- Fruit protection specialists – incorporate into recommendations
- Beekeepers – stressing bees with pollination services, assuring exposure to multiple pathogens
- Government – decreased subsidies for honey production, increasing focus on pollination services

Expanded Pollinator Label Protection

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

See individual crops for specific pollinator protection application restrictions. If none exist under the specific crop, for foliar applications, follow these application directions for crops that are contracted to have pollinator services or for food/feed crops & commercially grown ornamentals that are attractive to pollinators.

FOR CROPS UNDER CONTRACTED POLLINATION SERVICES

Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen unless the following condition has been met:

If an application must be made when managed bees are at the treatment site, the beekeeper providing the pollination services must be notified no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying.

FOR FOOD/FEED CROPS AND COMMERCIALLY GROWN ORNAMENTALS NOT UNDER CONTRACT FOR POLLINATION SERVICES BUT ARE ATTRACTIVE TO POLLINATORS

Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen unless one of the following conditions is met:

- **The application is made to the target site after sunset**
- **The application is made to the target site when temperatures are below 55°F**
- **The application is made in accordance with a government-initiated public health response**
- **The application is made in accordance with an active state-administered apiary registry program where beekeepers are notified no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying**
- **The application is made due to an imminent threat of significant crop loss, and a documented determination consistent with an IPM plan or predetermined economic threshold is met. Every effort should be made to notify beekeepers no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying.**

Expanded Pollinator Label Protection

CROP USE DIRECTIONS

Pollinator Precautions

- Actara is highly toxic to bees exposed to direct treatment on blooming crops/plants or weeds.
  - For **apples,** do not apply Actara after pre-bloom (early pink growth stage) or before post bloom (petal fall growth stage).
  - For **citrus,** do not apply during pre-bloom or during bloom when bees are actively foraging.
  - For **pears,** do not apply Actara after pre-bloom (green cluster stage) or before post bloom (petal fall growth stage).
  - For **stone fruit,** do not apply Actara between the pre-bloom (swollen bud) and post bloom (petal fall) growth stages.
- Do not apply Actara or allow it to drift to blooming crops/plants or weeds if bees are **foraging in/or adjacent to the treatment area.** This is especially critical if there are adjacent orchards that are blooming. (Refer to **Spray Drift Precautions** for additional information).
- **After an Actara application, wait at least 5 days before placing beehives in the treated field.**
- If bees are foraging in the ground cover and it contains any blooming plants or weeds, always remove flowers before making an application. This may be accomplished by mowing, disking, mulching, flailing, or applying a labeled herbicide.
- Consult with your local cooperative extension service or state agency responsible for regulating pesticide use for additional pollinator safety practices.

Expanded Pollinator Label Protection

Sea buckthorn Cultivars, varieties and/or hybrids of these		
Caneberry Subgroup Blackberry Loganberry Raspberry, black and red Wild raspberry Cultivars, varieties and/or hybrids of these	Aphids Leafhoppers	2.0 - 3.0 oz/A
	Japanese Beetle Stinkbugs Tarnished Plant Bug Weevil Adults Whiteflies	3.0 oz/A

Use Restrictions:

- **Maximum Actara Allowed per Growing Season:**
  Bushberry Subgroup: Do not exceed a total of 12.0 oz/Acre (0.188 lb ai/A) of Actara or 0.188 lb ai of thiamethoxam containing products per acre per growing season.
  Caneberry Subgroup: Do not exceed a total of 6.0 oz/Acre (0.094 lb ai/A) of Actara or 0.094 lb ai of thiamethoxam containing products per acre per growing season.
- **Application Timing:** Apply before pests reach damaging levels. Scout fields and treat again if populations rebuild to potentially damaging levels. Apply the higher rate within the listed rate range for heavy infestations.
- **Pre-Harvest Interval (PHI):** 3 days
- **Minimum Interval Between Applications:** 7 days
- **Water Volume:** Use sufficient water volume to ensure thorough coverage of foliage. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.

Refer to Pollinator Precautions section.
Refer to Resistance Management section.

Have we changed our recommendations?

	2014	**2015**
Tight cluster	Actara, Calypso	Calypso
Pink	Actara, Calypso	Calypso
Petal-fall	Actara, Admire, Belay, Assail, Calypso	Assail, Calypso
First cover	Actara, Admire, Belay, Assail, Calypso	Assail, Calypso,
2nd-8th cover	Actara, Admire, Belay, Assail, Calypso	Assail, Admire, Calypso, Actara, Belay

Questions?

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Virginia Fruit Web Site