Identification and Biology of Invasive Pest Species of Grape

Presenter
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Arkansas Association of Grape Growers Conference
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Invasive Pests

• Japanese beetle (1997)
• Spotted wing drosophila (2012)
• Brown marmorated stink bug (2013)
• Light brown apple moth (In California)
• European grape berry moth
• False codling moth
Projects on Invasive Species

• Japanese beetle (AR Agriculture Department)
• Spotted Wing Drosophila Project in Arkansas (AR Agriculture Department and Extension IPM)

1. Three SWD Workshops to educate county agents and fruit growers
2. Growers help monitor for SWD in Arkansas
3. Note Arkansas counties with confirmed SWD
4. Seasonal trapping and fruit counts for SWD in high tunnels and in open berry fields
5. Grower SWD survey in progress
Projects on Invasive Species

• Exotic Fruit Pest Survey (USAD/APHIS, AR State Plant Board - pending)

  Survey for the following pests listed as Commodity Priority Pests or on the Prioritized Pest List (*):

  1. Light brown apple moth
  2. European grape vine moth
  3. False codling moth
Japanese Beetle in USA
(Invasive Pest from Asia)

• 1916: appears in New Jersey
• 1997: trapped in Arkansas
• 2001: defoliating grapes in Lowell

Japanese Beetle image courtesy USDA

http://pest.ceris.purdue.edu/map.php?code=INBPAZA#
Identification of Japanese Beetle

- 3/8 to 1/2 inch long
- Metallic green in front of brown wings
- White spots along each side of the abdomen
- **Hosts**: grape, apple, brambles, ornamentals

Photo: SH. Kim, U. Arkansas
Japanese Beetle Life Cycle

Potter et al. 2006: http://www2.ca.uky.edu/entomology/entfacts/ef451.asp
Japanese Beetle Trap

Dual lure of sex pheromone and floral odors

Photo: D.T. Johnson, U. Arkansas
Japanese Beetle:
- Flight,
- Defoliation
- & Control

Effective compounds:
- Assail, Avaunt, Belay, Brigade, Danitol, Imidan, Mustang Max, Sevin, or
- Whitewash vines with Surround kaolin clay

Photo: D.T. Johnson, U. Arkansas
Japanese Beetle Fact Sheet Online

Common Questions About Japanese Beetles in Arkansas

http://www.uaex.edu/Other_Areas/publications/PDF/FSA-7062.pdf
Spotted Wing Drosophila in USA (Invasive from Asia)

- 2008: found in California
- 2012: found in Arkansas
- 2013: first fruit damage in AR

Male:
- Black spot on the end of the first wing vein
- Two sets of combs on the front legs
- Antenna with many hairs (branched)
- Large red eyes

Female:
- No black spot on wing
- Sclerotized, double serrated ovipositor (>12 teeth per side)
- Antenna with many hairs (branched)
- Large red eyes

Photo: Modified from Cornell University
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<th>IRAC #</th>
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<th>Caneberry PHI (days)</th>
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Earliest SWD fruit infestation in Arkansas was 20 May 2013.

*If SWD flies are in trap and fruit is ripening, spray weekly, but reapply after rain (rotate insecticides with different IRAC # to delay SWD resistance)*

**Larvae sampling**

Collect 30 ripening strawberries or 70 cane or blueberries you would eat and either:
1. Use hand lens to see fly larvae in fruits or
2. Mix 1 qt water + 1/4 cup salt, pour over fruit sample, wait 30 min. and check for floating white larvae or
3. Place fruits in jar covered with cloth and rear out flies for identification (takes 2 weeks)

**Fermenting mixture**
- 12 oz water + 1 Tbsp apple cider vinegar + 4 Tbsp sugar + 1 Tbsp yeast + 2 Tbsp whole wheat flour

**Drowning mixture**
- Mix 20 oz red wine + 13 oz apple cider vinegar + 3 drops unscented dish soap. Pour 8 oz in big trap.
- Weekly, strain out flies, add new baits to trap and discard old bait in garbage.

For SWD fly confirmation, mail vial of flies to:
Ms. Barbara Lewis
AGRI 319 Department of Entomology
Univ. of Arkansas
Fayetteville, AR 72701
Life Cycle of Spotted Wing Drosophila

1 generation
12 – 15 days

Eggs 12-72 hours
350+ eggs in a lifetime

Adults
20-30 days

Pupation 4-15 days
Inside or outside of fruit

three larval instars
5-7 days

Photo: B. Gerdeman, WSU NWREC
SWD Monitoring in Arkansas

Growers helped to monitor for SWD with yeast/ACV bait traps. Confirmed flies as SWD and generated Arkansas county map showing confirmed SWD samples.

* Late summer started using 8 oz. of new bait mixture plus fermenting bait in cup trap with 20 holes each 3/16” dia. (researchers recommend red trap):
  - 20 oz. red wine
  - 13 oz. apple cider vinegar
  - 3 drops unscented soap (flies do not gum up)

Photo: D.T. Johnson, U. Arkansas
Photo: A. Eaton, U New Hampshire
Seasonal Changes In Confirmed Numbers of SWD in Arkansas

- 8 counties: Mid-May to mid-June
- 13 counties: Mid-May to mid-July
- 14 counties: Mid-May to mid-October
SWD Attacked Fruit in Arkansas

- 48% infested blackberries
- 33% infested raspberries
- Confirmed in blueberry, strawberry and peach
- No SWD in undamaged grapes, but did see other *Drosophila* species in damaged grapes and muscadine
- Other states found SWD in < 24% of grapes: Chardonnay (low), Frontenac, Marechal Foch, Merlot, Petit Verdot (24%), Pinot (3%)
Insecticide Efficacy (IRAC #) Against SWD

- **Best**: Lannate (1A), Mustang Max (3)
- **Excellent**: Brigade (3), Danitol (3), Delegate (5), Entrust (5), Imidan (1B) and Exirel – not registered as yet)
- **Excellent to Good**: Malathion (1)
- **Fair to Good**: Assail (4A), Actara (4A), Sevin (1A)
- **Fair**: Pyganic (3), Provado (4A), Rimon (15)
- **Insecticide resistance management program**: rotate IRAC # (MOA)
Trapping SWD in Unsprayed and Sprayed Field of Berries

Clarksville sprays:
6/6  Mustang Max
6/14  Mustang Max
6/21  Malathion
6/28  Mustang Max
7/5  Mustang Max
7/12  Delegate
7/19  Blueb. - Delegate
8/9  Delegate
8/16  Malathion (no blueb. fruit)
8/30  Delegate
9/6  Malathion

Fruit Station Clarksville, AR (2013)

- Unsprayed Blackberry
- Sprayed Blackberry
- Sprayed Blueberry

Summer fruiting: 22-May, 29-May, 5-Jun, 12-Jun, 19-Jun, 26-Jun, 3-Jul, 10-Jul, 17-Jul, 24-Jul, 31-Jul, 7-Aug
Fall fruiting: 14-Aug, 21-Aug, 28-Aug, 4-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-Oct

Mean No. SWD flies / trap
Cultural Control

- **Sanitation**: remove overripe and bury or solarize culls and grape residue
- **Remove wild hosts**: wild blackberry, honeysuckle, pokeweed, persimmon, rose hips, mock strawberry, nightshade
- **Intercept and/or Exclude**: baited traps around perimeter and screen
- **Post-harvest removal**: 1) some processing floats out larvae; 2) remove soft, damaged fruit; 3) refrigerate for 168 hrs. (0% live larvae)
Brown Marmorated Stink Bug

- 1996: New Jersey
- 2013: see in Arkansas
- No damage in AR, yet
Identification of Brown Marmorated Stink Bug

• $\frac{1}{2}$ to $\frac{3}{4}$ inch long
• White bands on antennae and legs
• Abdomen with alternating white and dark markings

Photo by W. Hershberger
Life Cycle of Brown Marmorated Stink Bug

- **Winter**: Overwinter as adults in protected areas, including homes
- **March-April**: Three generations in south; one in north
- **July-August**: Leave fields for protected areas such as houses or heavy cover
- **Fall**: Adults

BMSB Fact Sheet by DuPont Pioneer
Hosts of Brown Marmorated Stink Bug

- Grapes, blueberries, raspberries, blackberries, apples, peaches, cherry, and pears
- Sweet corn 97%
- Soybeans
- Peppers 39%
- Tomato 34%
- Okra 19%
- Eggplant 5%
- Green bean 2%

Photo: D. Pfeiffer
Corn photos: D. Wright; Tomato photo: E. Day
Insecticide Control of Brown Marmorated Stink Bug

- Pyrethroids are only thing that works
Light Brown Apple Moth

- From Australia
- Currently only in California - trying to eradicate: sprays + mating disruption
- **Hosts**: ribwort plantain, curly dock, white clover, apples, grape, peach
- Nursery pest, some damage to grape berry when feeding on leaves

Light Brown Apple Moth Risk Map

Map: USDA-APHIS-PPQ-CPHST
Identification of Light Brown Apple Moth

- 1/2-3/4” long yellow green larva
- Pupate in rolled leaves
- Adult forewing is mottled brown a 1/4-1/2” long

Photos: T. Gilligan & M. Epstein
Life Cycle of Light Brown Apple Moth

- 4 generations in California from March to November
- Lay 35 eggs in a mass on upper leaf surface near midrib
- Hatch in 8 days
- Larvae feed for 25 days – web several leaves – feed on flowers, leaves, and fruit surface
- Up to 30% berry damage - introduces *Botrytis* gray mold
- Pupae in webbed leaves (1 to 3 weeks)

Photos: T. Gilligan & M. Epstein
Light Brown Apple Moth Control

• For eggs and larvae on crops apply mixture of 1% paraffinic spray oil (Superior oil or JMS Stylet oil) + insecticide:
  – Sevin
  – Imidan
  – Entrust
  – Intrepid
  – Confirm
  – Bt (Dipel)

European Grape Berry Moth

- This is the *grape berry moth* of Europe
- Risk: could establish throughout United States
- Destruction of fruit and allows infection by *Botrytis cinera* causing gray rot

Zalom, Varela, Cooper. 2013
Identification of European Grape Berry Moth

• Front wing with dark middle band
• 1/2” wingspan
• Larva is 1/2“ long, yellowish brown to olive green

Photo: V. Neimorovets

Photo: R. Coutin
Life Cycle of European Grape Berry Moth

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http://www.ipm.ucdavis.edu/EXOTIC/eurograpevinemoth_lifecycle.html
Life Cycle European Grape Berry Moth

- 3 generations
- Flight soon after bud-break
- Eggs laid singly on clusters – develop in 13 days
- 1st larvae tie several flower buds together with a silken web and feed for 15-25 days
- Larvae chew round holes in the berries eating the pulp and seeds
- Pupate on edge of leaves or trunk
False Codling Moth

- From sub-Saharan Africa – pest of citrus and cotton
- Intercepted over 1500 times at 34 U.S. ports of entry

Map: USDA-APHIS-PPQ-CPHST
Identification of False codling Moth

- Eggs: whitish, flat and oval
- Caterpillars: young are whitish and spotted and mature are pinkish – ¾” long
- Adults: 2/3“, brownish-gray

Photo: M. van der Straten

Figure 1. FCM Adult
Illustration courtesy of http://www.padi.gov.au
(Simon Hinkley & Ken Walker)
Life Cycle of False Codling Moth

- 6 generations a year – each 45-100 days
- Individual eggs laid singly on fruit or foliage
- Caterpillars bore into fruit, introduce bacteria and other microorganisms; sunken around entry hole; and granules of frass often at penetration hole

Photos: S. Johnson
Questions