



DIVISION OF AGRICULTURE
RESEARCH & EXTENSION

University of Arkansas System

Identification and Biology of Invasive Pest Species of Grape

Presenter

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Arkansas Association of Grape Growers Conference
November 15, 2013

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

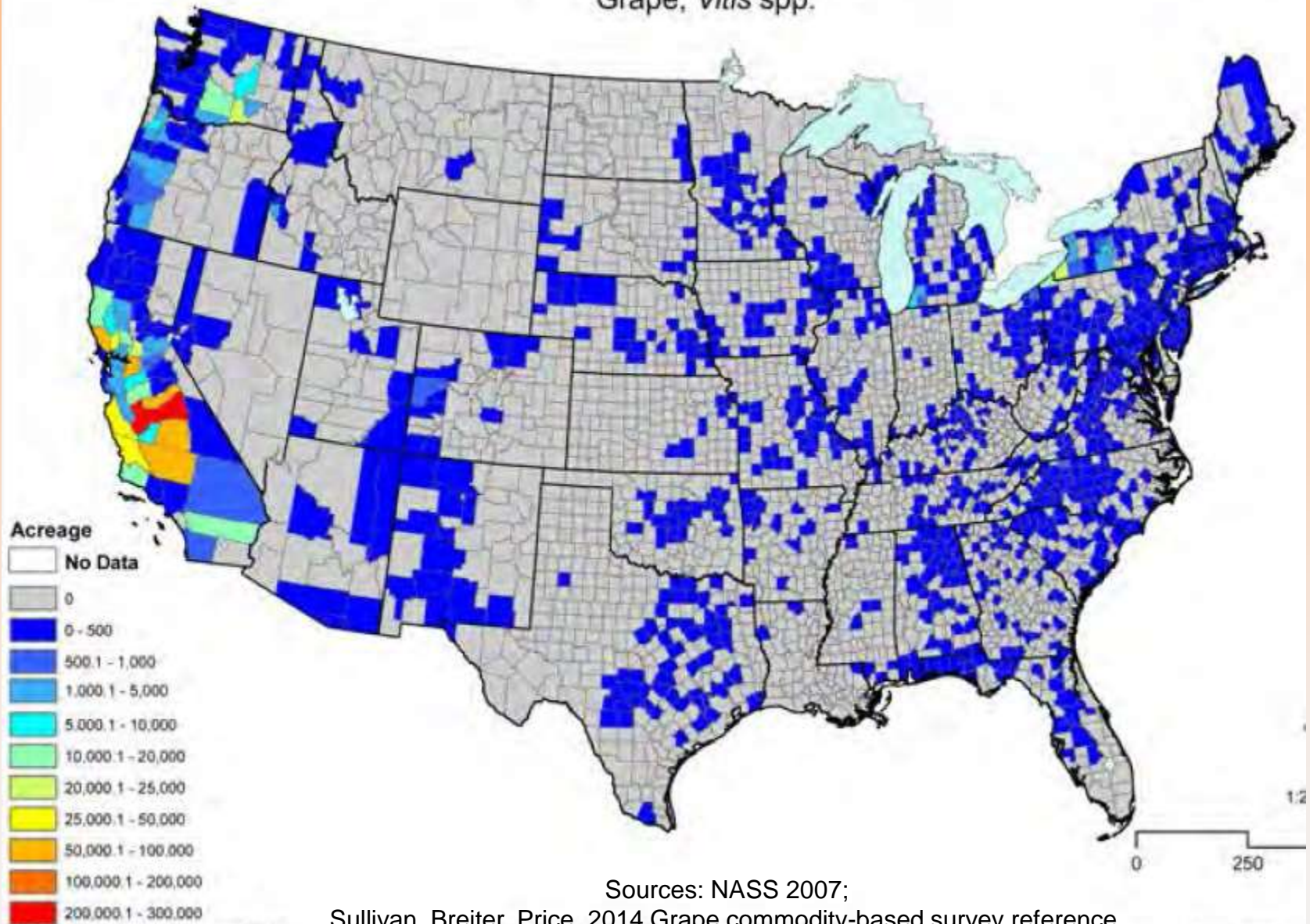
Projects on Invasive Species

- 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

Commodity Acreage Map Grape, *Vitis* spp.



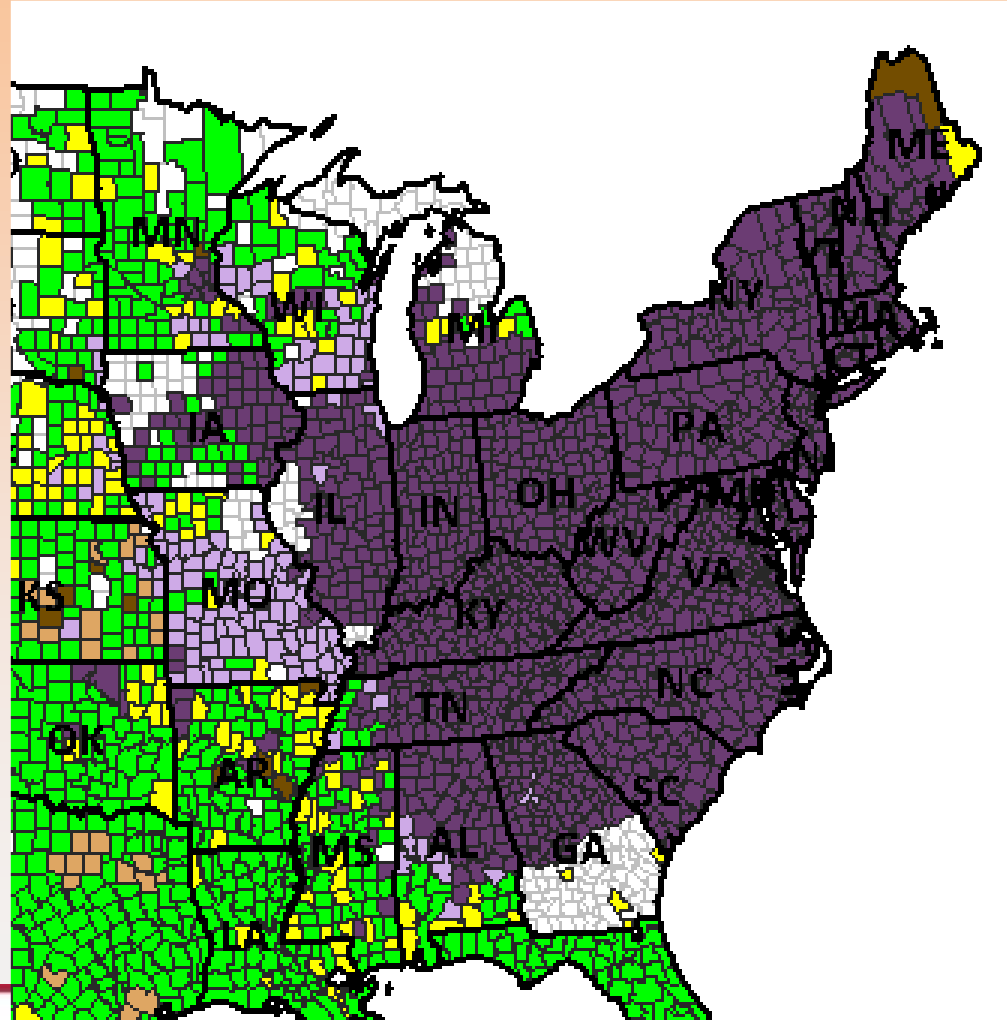
Sources: NASS 2007;
Sullivan, Breiter, Price. 2014 Grape commodity-based survey reference.

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



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



Japanese Beetle Life Cycle



Photo: D.T. Johnson,
U. Arkansas

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

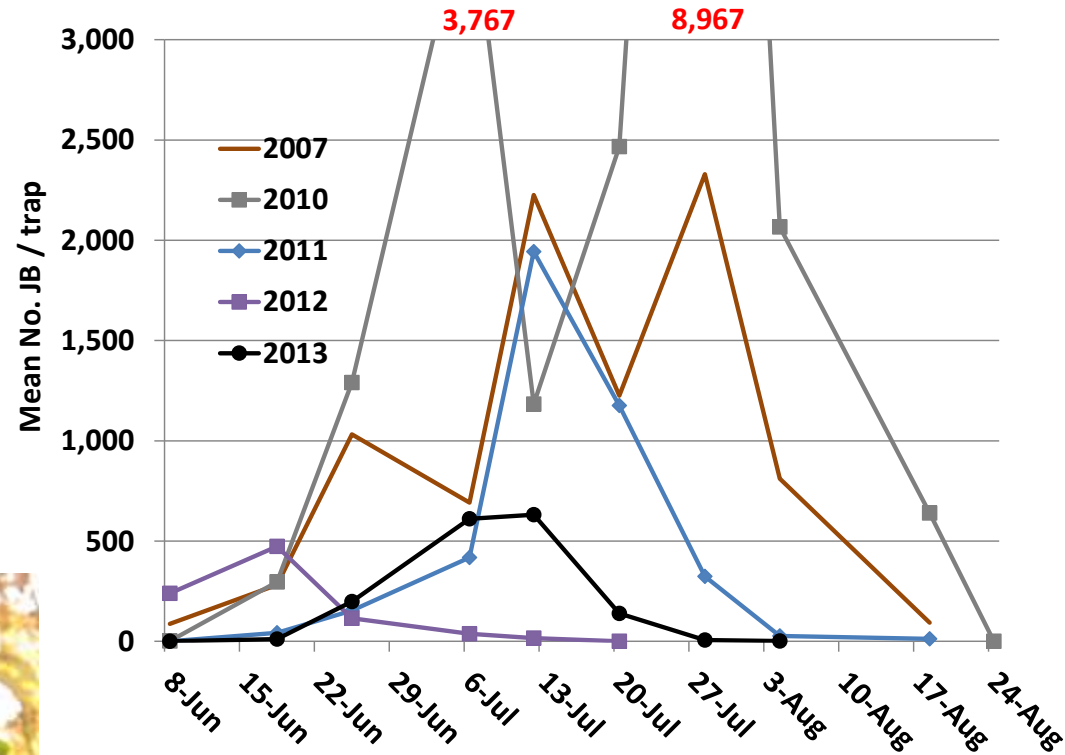
Japanese Beetle:

- Flight,
- Defoliation
- & Control



Photo: D.T. Johnson,
U. Arkansas

Adult Japanese Beetles (JB) by Year - Fayetteville, AR



Effective compounds:

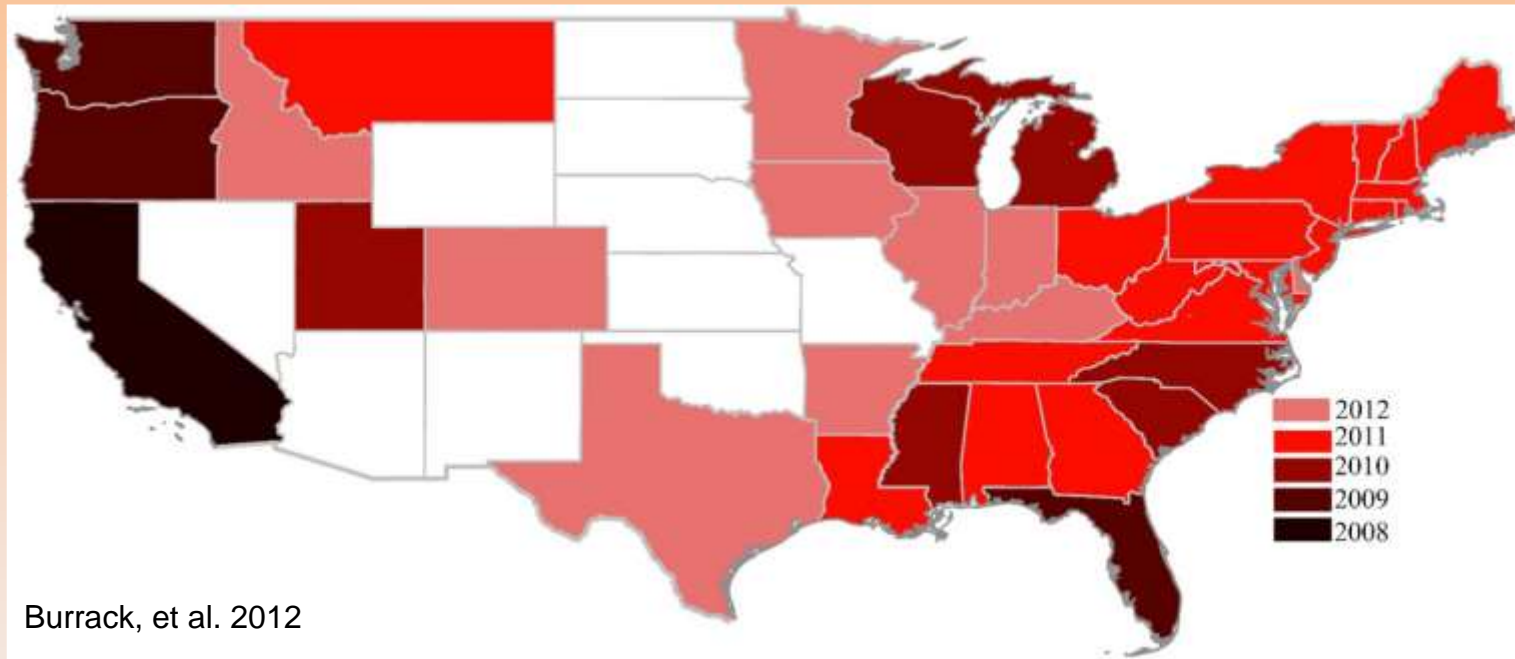
- Assail, Avaunt, Belay, Brigade, Danitol, Imidan, Mustang Max, Sevin, or
- Whitewash vines with Surround kaolin clay

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



(Photo: E. LaGasa)



(Photo: B. Beers,
Wash. State U.)

Spotted Wing Drosophila Workshops



Photo: SH. Kim,
U. Arkansas



Hearldandnews.com



Umn.edu



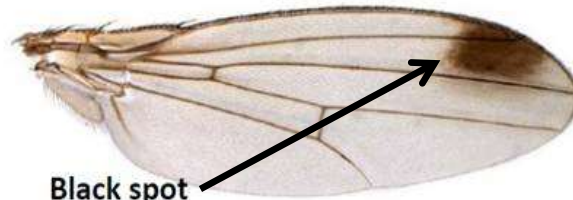
Entomophily.wordpress.com



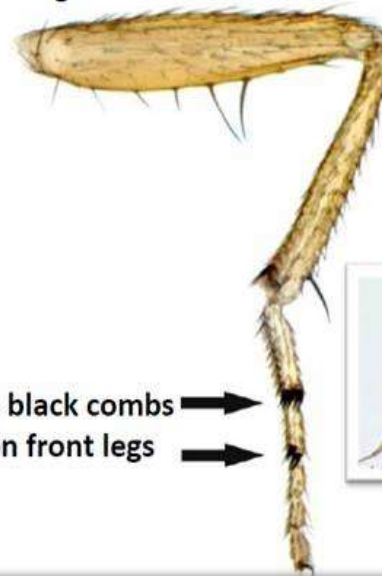
Ucanr.edu

SWD Identification – key characters

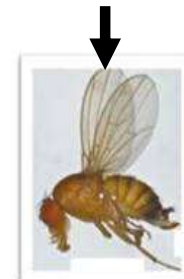
Male



Black spot
on wings



2 black combs
on front legs



Female



She inserts saw-like device
(ovipositor) into fruits and
lays eggs

Photo: Modified from Cornell University

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

Active Ingredient	Trade name	IRAC #	Blueberry	Caneberry	Strawberry	Probable Efficacy
			PHI (days)	PHI (days)	PHI (days)	
Carbaryl	Sevin 80S	1A	7	7	7	Fair/Good
Methomyl	Lannate LV	1A	3	Not labeled	Not labeled	Excellent
Phosmet	Imidan	1B	3	Not labeled	Not labeled	Excellent
Malathion	Malathion	1B	1	1	3	Excellent/Good
Bifenthrin	Brigade	3	1	3	0	Excellent
Esfenvalerate	Asana	3	14	7	Not labeled	Excellent
Fenpropathrin	Danitol	3	3	3	2	Excellent
Zeta-cypermethrin	Mustang Max	3	1	1	Not labeled	Excellent
Pyrethrin	Pyganic*	3	0	0	0	Fair
Spinetoram	Delegate	5	3	1	Not labeled	Excellent
Spinetoram	Radiant	5	Not labeled	Not labeled	1	Excellent
Spinosad	Entrust*	5	3	1	1	Excellent



Trap design and field placement

- Best trap is a 18 oz red Solo cup with lid and 20 holes each 3/16" diameter on side above fermenting and drowning mixtures
- 3 weeks before ripening, put at least 4 traps in ripening fruit planting at height of fruit

Bait Recipes

- **Fermenting mixture:** 12 oz water + 1 Tbsp apple cider vinegar + 4 Tbsp sugar + 1 Tbsp yeast + 2 Tbsp whole wheat flour
 - Pour 3 oz of fermenting mixture in each small 6 oz cup covered with cloth lid and hang inside big trap
- **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

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)

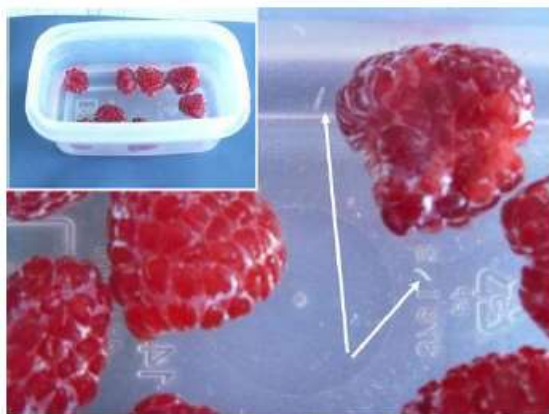


Photo: omafra.gov.on.ca

Larvae sampling

Collect 30 ripening strawberries or 70 cane or blueberries you would eat and either:

1. Use handlens 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)

Life Cycle of Spotted Wing Drosophila

Life Cycle of the Spotted Wing Drosophila *Drosophila suzukii* (Matsumura)

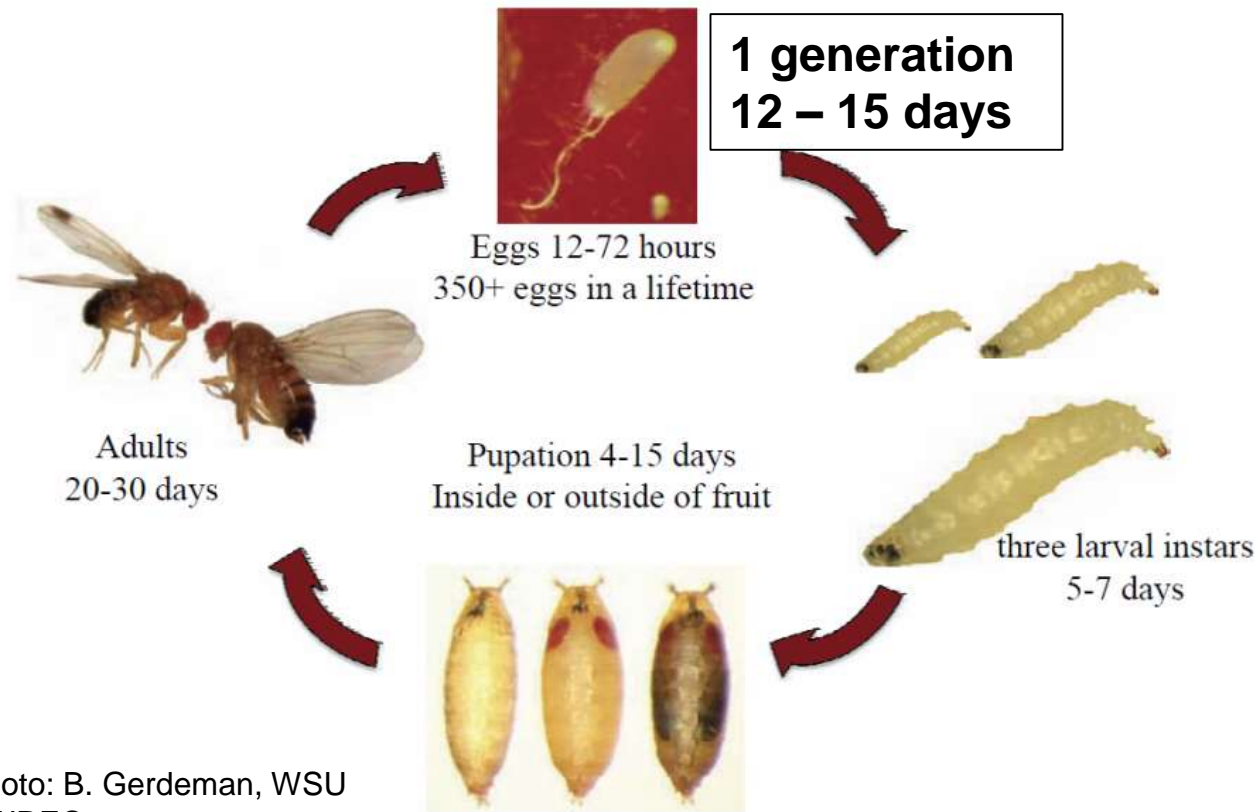


Photo: B. Gerdeman, WSU
NWREC

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: A. Eaton,
U New Hampshire



Photo: D.T. Johnson,
U. Arkansas

Photo: D.T. Johnson

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%)

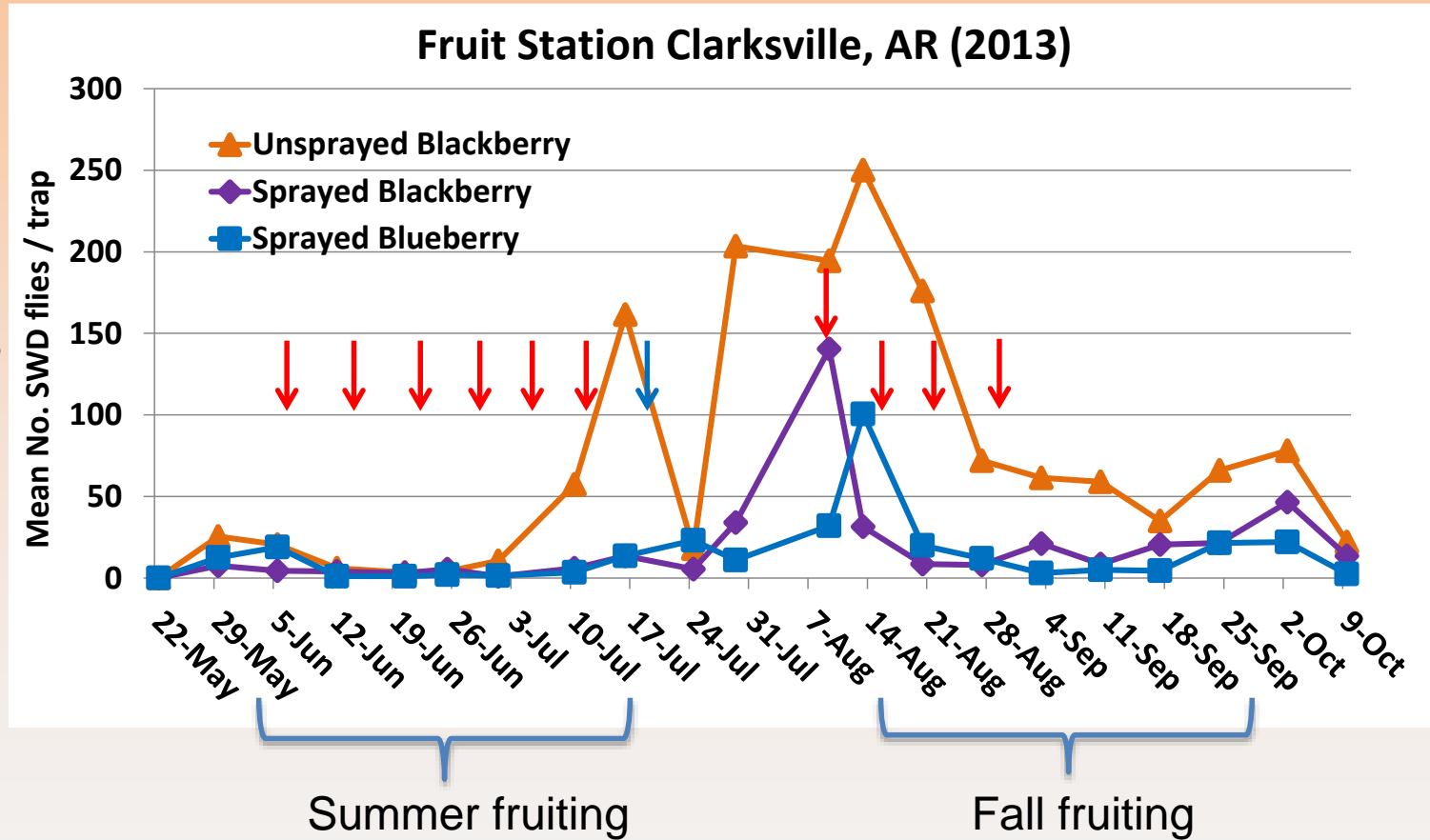
Insecticide Efficacy (IRAC #) Against SWD

- **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

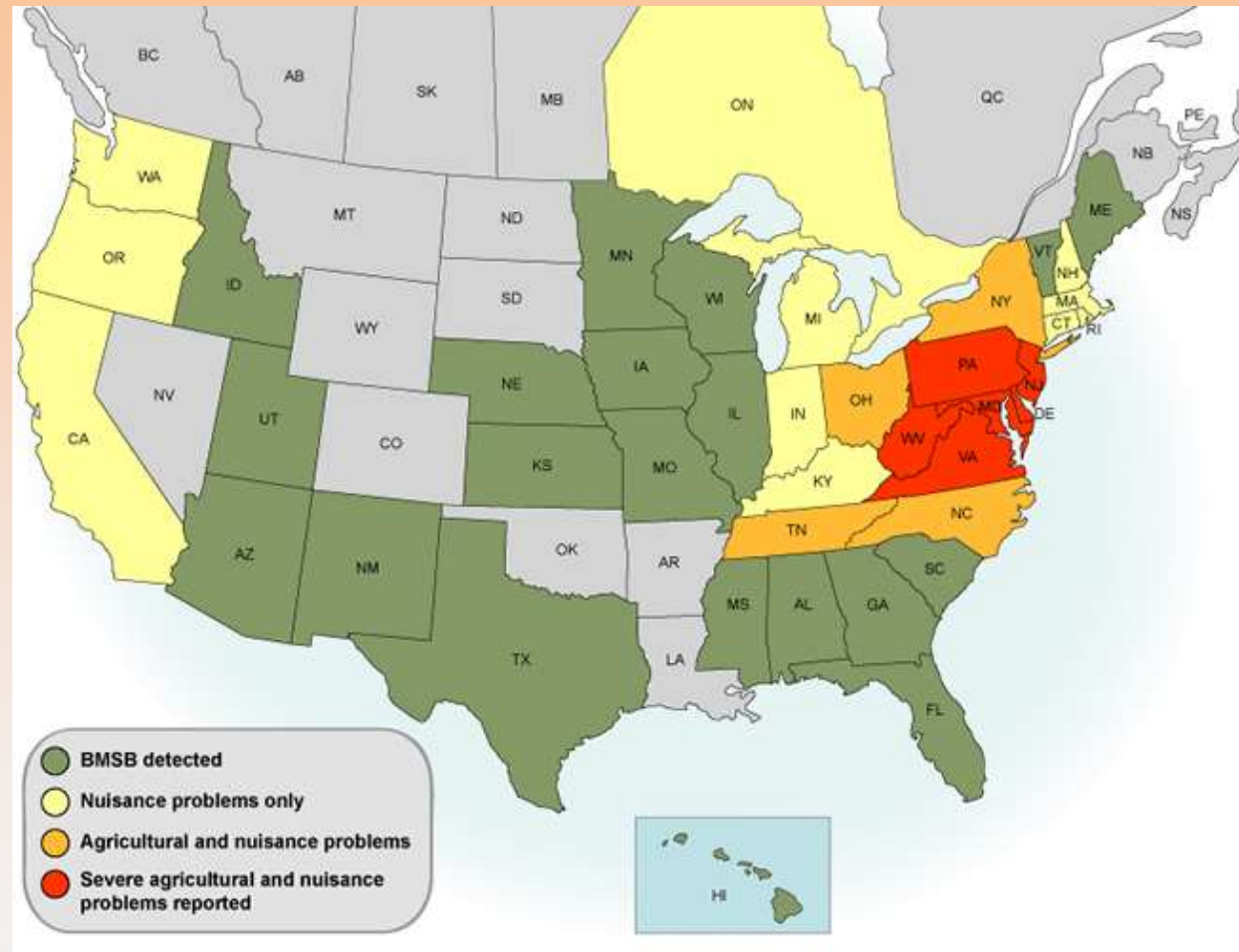


Cultural Control

- **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



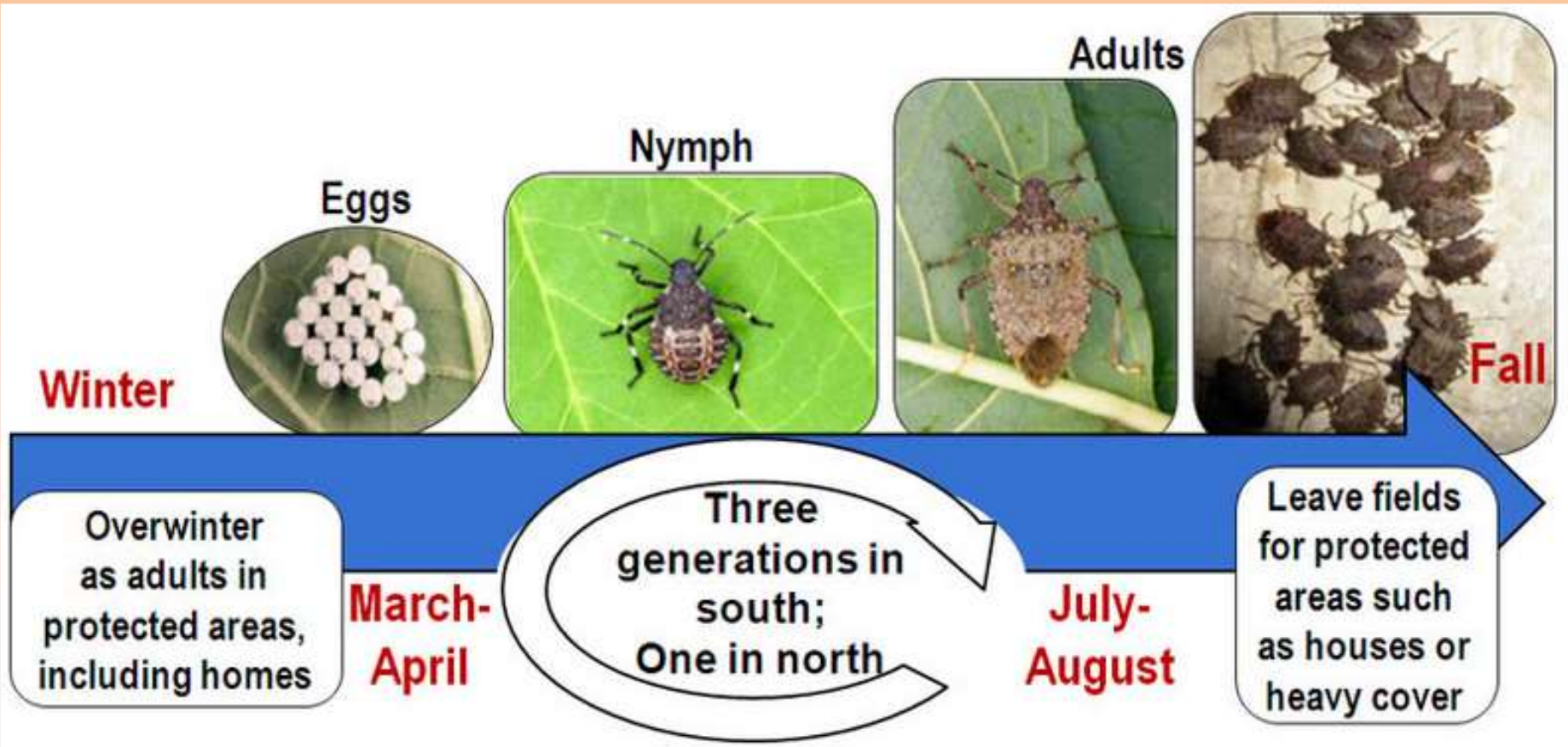
Identification of Brown Marmorated Stink Bug

- $\frac{1}{2}$ 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



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

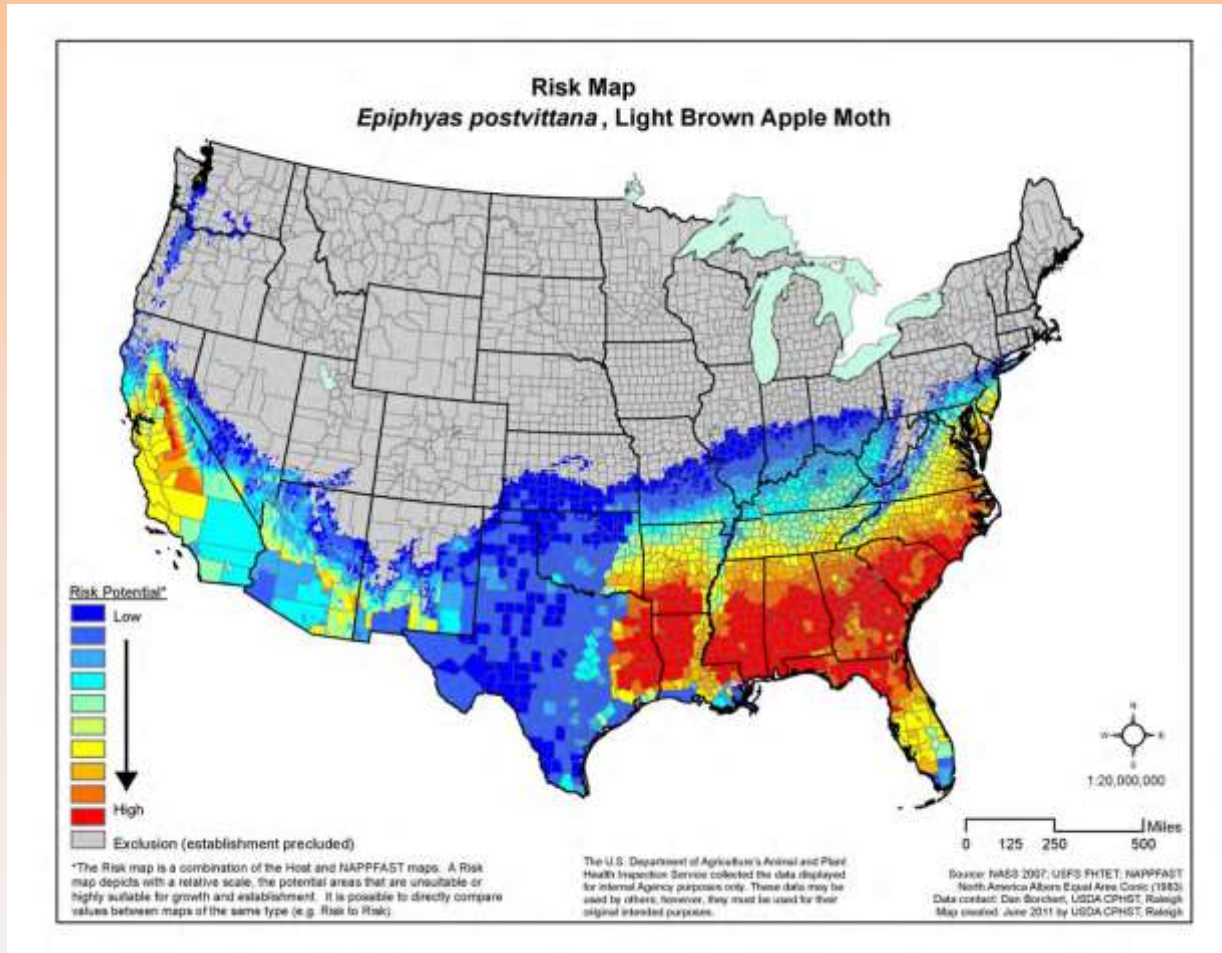


CA Department of Food & Agri.

- 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

Source: Sullivan, Breiter, Price. 2014 Grape commodity-based Survey Reference.

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)

<http://phpps.cdfa.ca.gov/PE/InteriorExclusion/PDF/LBAMApprovedTreatments.pdf>

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

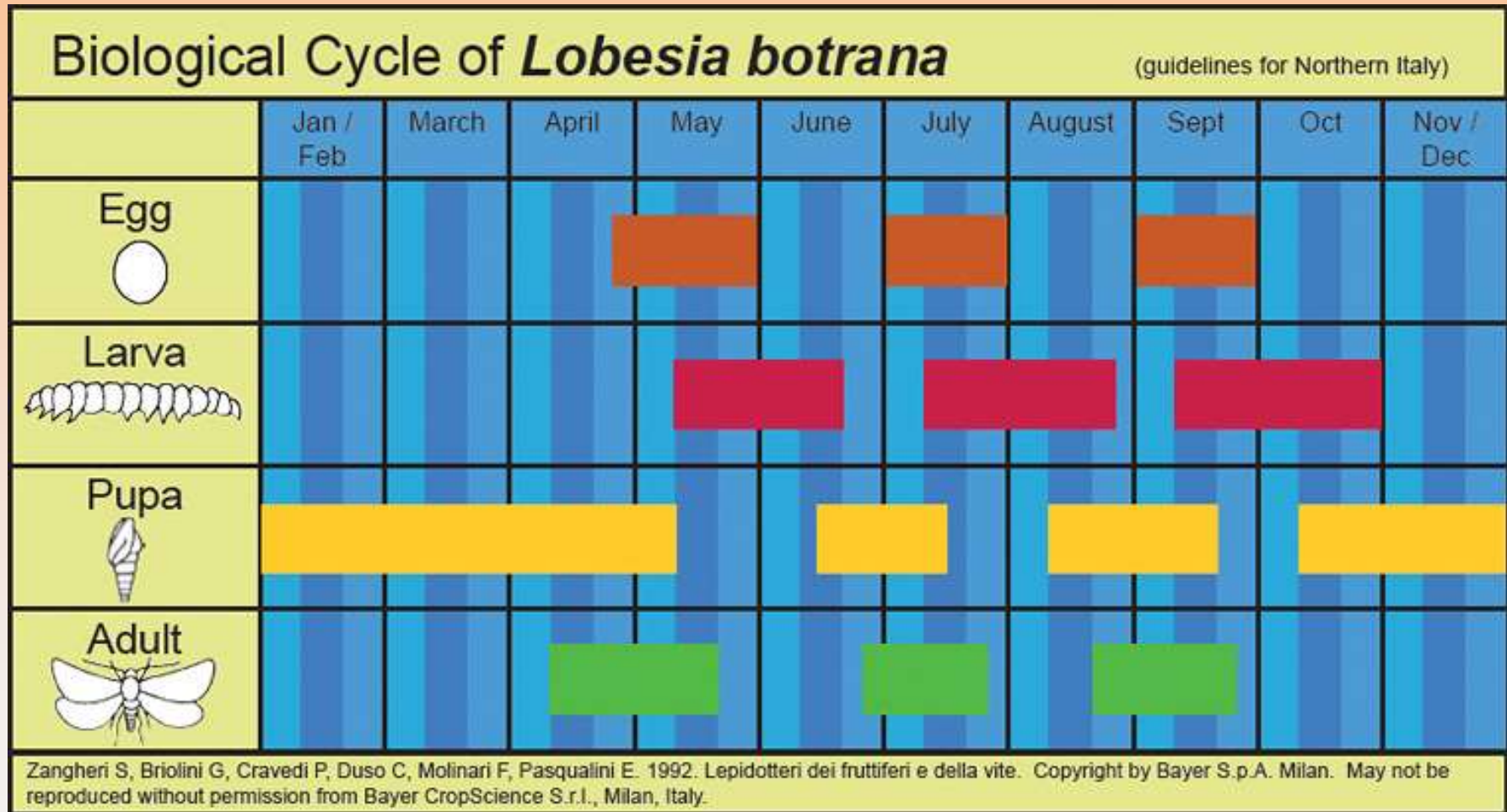


Photo: V. Neimorovets



Photo: R. Coutin

Life Cycle of European Grape Berry Moth



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



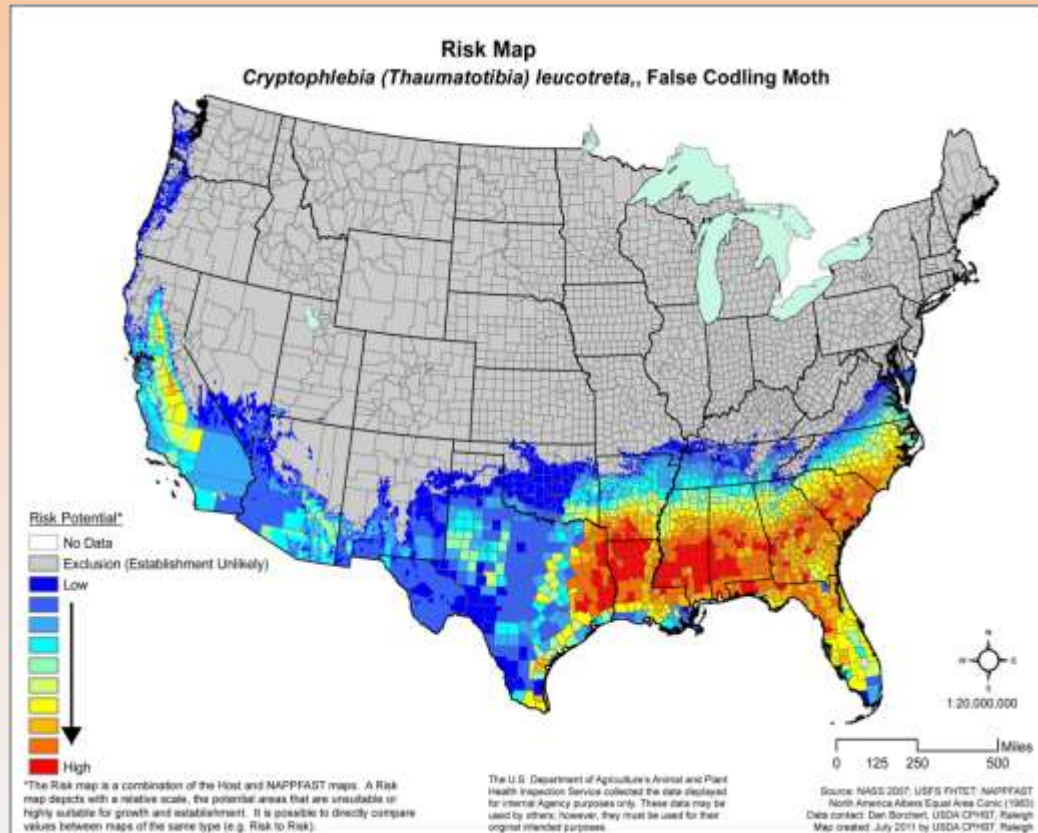
Photo: Zalom, Varela, Cooper (2013)



Photo: R. Coutin

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 – $\frac{3}{4}$ " long
- Adults: $\frac{2}{3}$ ", brownish-gray



Photo: M. van der Straten



Figure 1. FCM Adult

Illustration courtesy of <http://www.padil.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