INVASIVES WORKSHOP

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Presentation Outline

- Invasive pests: What is UC doing about it?
- Moths
  - European Pepper Moth

    Technical Working Group
  - LBAM
  - European Grape Vine Moth

Presentation Outline

- **Psyllids**

  Asian Citrus Psyllid, Olive Psyllid, Tipu Psyllid, Pittosporum Psyllid
- **Spotted Wing Drosophila**
- **Others**
  - **Glassy-winged sharpshooter**
  - **Diaprepes Root Weevil**
- **CDFA Website**

What is UC doing about it?

ANR's Strategic Vision 2025, the division has identified nine initiatives that represent the best opportunities for ANR's considerable infrastructure and talent to seek new resources and new ways of partnering within and outside UC to find solutions for California

What is UC doing about it?

1. Improve Water Quality, Quantity, and Security
2. Enhance Competitive, Sustainable Food Systems
3. Increase Science Literacy in Natural Resources, Agriculture, and Nutrition
4. Sustainable Natural Ecosystems
5. Enhance the Health of Californians and California's Agricultural Economy
6. Healthy Families and Communities
7. Ensure Safe and Secure Food Supplies
8. Managing Endemic and Invasive Pests and Diseases
9. Improve Energy Security and Green Technologies through Innovative Science Linking Engineering, Agricultural, Biological, and Environmental Sciences

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What is UC doing about it?

Managing Endemic and Invasive Pests and Diseases

First Conference on April 25

EIPD Research and Extension Areas

- **Exclusion of pests and pathogens**
- **Emerging Problems with Pests and Diseases**
- **Integrated Management**

What is UC doing about it?

- Generate and disseminate critical information on identification, monitoring and control strategies
- Develop multimedia outreach materials distributed statewide
- Provide updates through electronic media on the most current information.

What is UC doing about it?

- Assume leadership roles to support and advise local (Ag Commissioners), state (CDFA) and federal (USDA-APHIS)
- Generate research data to inform regulatory policy based on science
- Obtain multi-agency funding in support of research and extension efforts
- Collaborate with researchers nationally and internationally

Duponchelia fovealis Zeller






European Pepper Moth

- First indication of a new invasive pest
- Regulatory response
- Technical Working Group
- Minimizing the impact
- Current knowledge
- Current research needs and results

FIRST INDICATION OF A NEW INVASIVE PEST

- Contact from county Ag Commissioner
- CDFA and APHIS survey
- Serious impact on local growers
- Succulents, Kalanchoe and Begonia
- Approximately $250,000 loss
- Restricted shipping
- Increased pesticide use (fogging)

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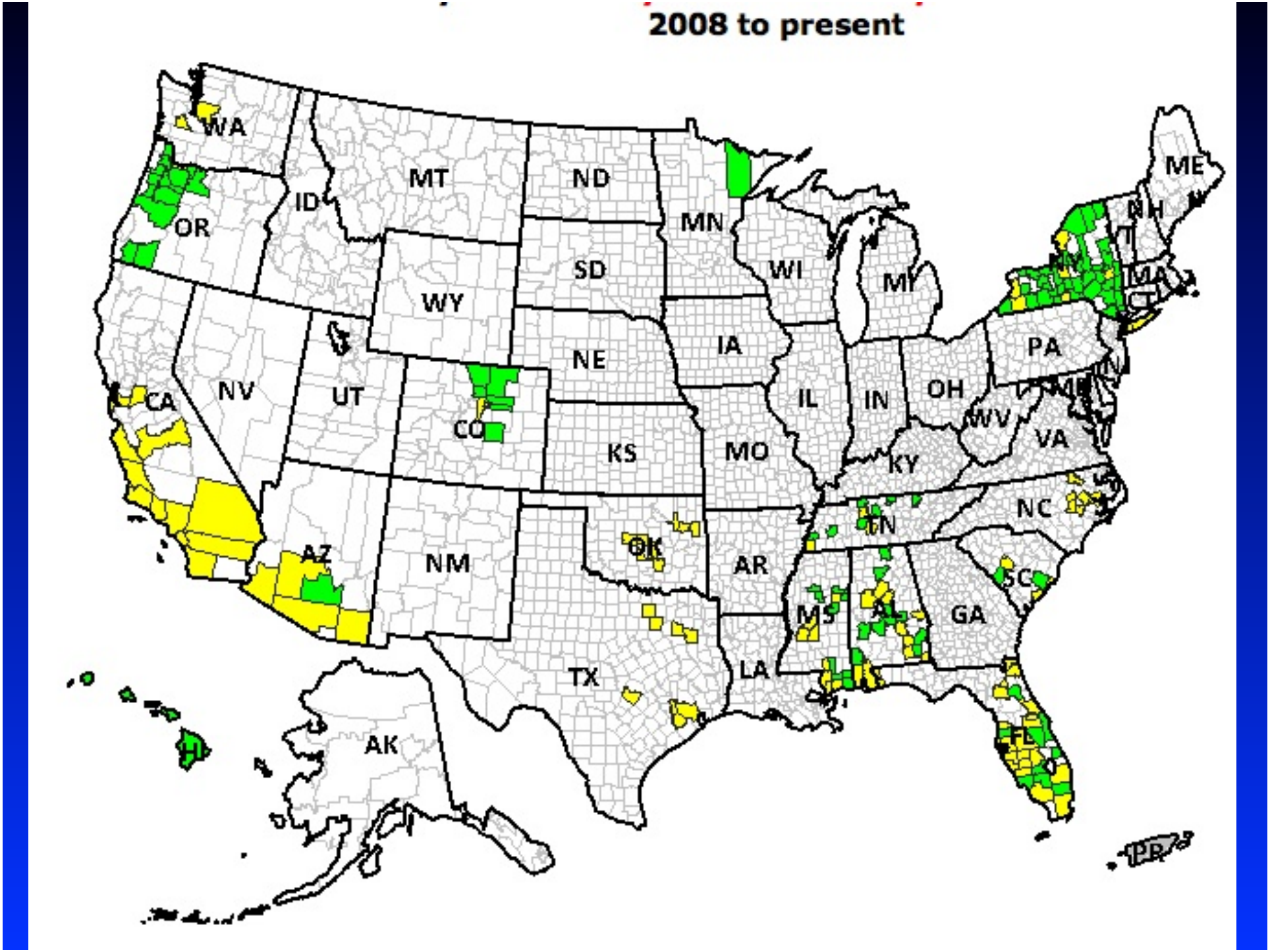
REGULATORY RESPONSE

- Extensive survey using pheromone
- Finds in 15 states
- Formation of a Task Force and a Technical Working Group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REGULATORY RESPONSE

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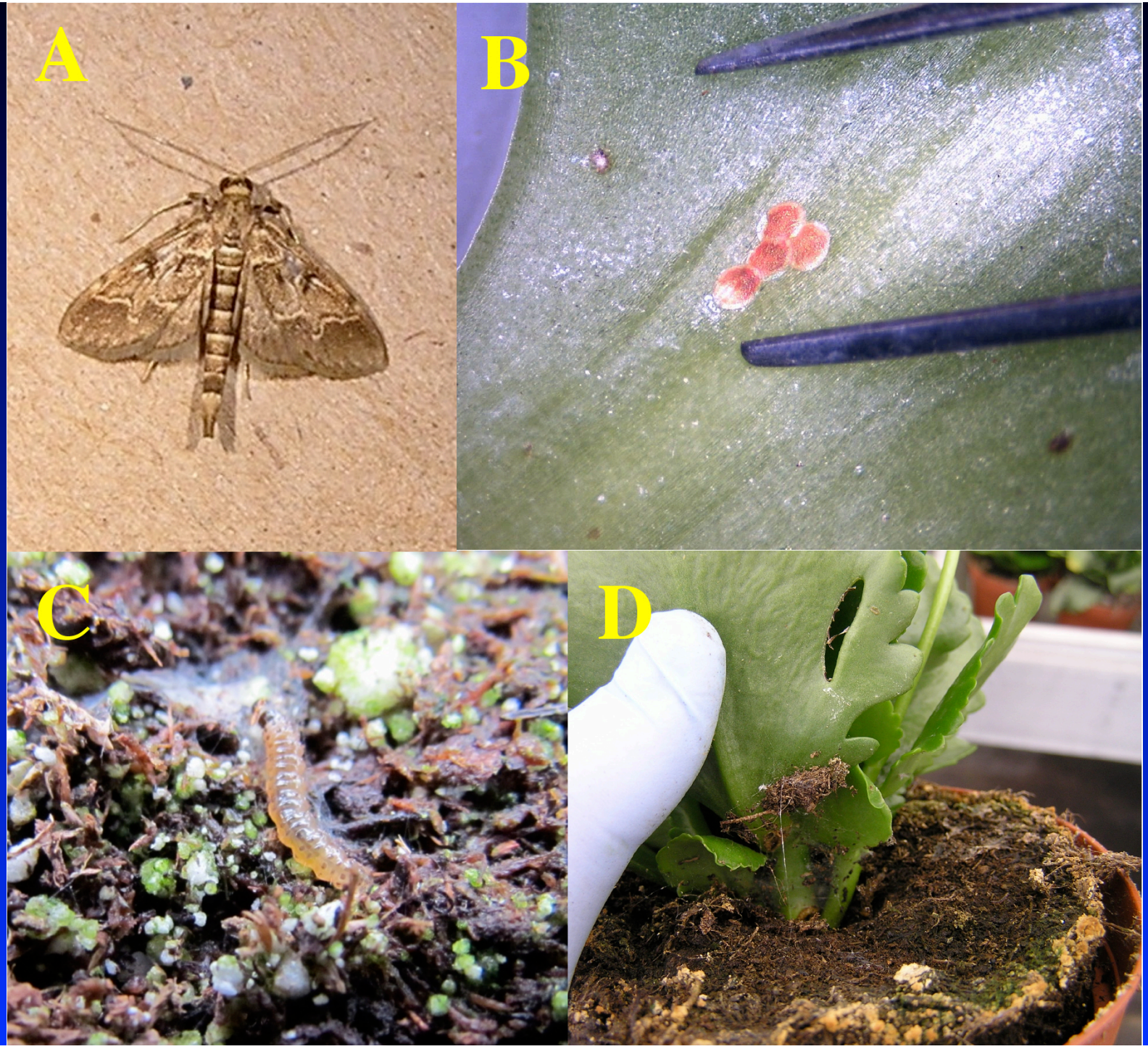
TECHNICAL WORKING GROUP

- Rob Ahern
- James Bethke
- Julieta Brambila
- Surendra Dara
- Dan Gilrein
- Amanda Hodges
- Galen Frantz
- Jan Hall
- James Hayden
- Graeme Murphy
- Lance Osborne
- Cristi Palmer
- David Riley
- Lin Schmale
- Diane Schuble
- Hugh Smith
- Stephanie Stocks
- Steve Tjosvold

TECHNICAL WORKING GROUP

Sub-groups

- **Survey and Diagnostics – Jim H. and Julieta B.**
- **Biology and Ecology – Steve T. and Jim B.**
- **Education – Dan G. and Stephanie S.**
- **Management – Surendra D. and Hugh S.**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CURRENT KNOWLEDGE

CURRENT KNOWLEDGE


A
B
C
D

Research Priorities

CONTROL

- List of available pesticides
  - Search for effective pesticides and rotations
- Economic Injury Levels
- Mating disruption
- Cultural controls
- Effect of soil types

Research Priorities

LIFE HISTORY

Biology studies

Seasonal Phenology in local areas

Expected Distribution/Weather mapping

Degree Day Models/Phenology Control Models

Effect of detritus

Is there a Diapause?

Research Priorities

DETECTION

Effective Monitoring/Detection

Pheromone Trapping studies

Black Lighting

BIOLOGICAL CONTROL

Biological Control Alternatives

HOST PREFERENCES

RECENT RESULTS

Rearing

- Rose, Cow Pea, and Kalanchoe leaves
- Potting media
- Manduca Diet

Biological Control

- *Atheata* readily eat first instar neonates

RECENT RESULTS

Host Plants in Rearing Cages

- *Kalanchoe blossfeldiana*, Tomato, Peppers, Verbena, Poinsettia

Other plants

- Begonia, Echeveria, Gerbera

RECENT RESULTS

Longevity 10.2 d (N=70)

Fecundity 210.5 eggs/female (N=60)

Efficacy (leaf dip assays 2nd instar EPM)

Enstar 6%, Scimitar 57.5%, Duragard 72.9%, Pedestal 32%, Ecotec 49%, Pyganic 24%, Surfactants – Dyne-amic, BreakThru, Latron, NoFoam B - approximately 20%,
Javelin 92%, Proclaim 5SG 4.8oz 100%, Orthene 100%

Control in Europe

France

10 years ago

20-30% losses to cyclamen and hibiscus

Initially *Steinernema carpocapsae* 500 000/m≤ by foliar spray then Bt every 15 days

Prophylaxis is very important

Control in Europe

Denmark

Ornamental pest for more than 10 years

Claim Bt is the only effective solution

3 Bt sprays every ten days when populations build

10 water traps/1000 m^2

Conclusions

Is already a serious pest of some ornamentals in CA, Not Ag yet

Monitoring/Detection is key, pheromones

Preventative applications of Bt to poinsettia

Neonates are most susceptible

Acephate, Bt, Flubendiamide, Rynaxypyr, Emamectin benzoate

LBAM - a Tortricid moth - a leaf rolling moth

Department of Primary Industries and Water, Tasmania Archive

LBAM - Damage

LBAM has been recorded from over 2,000 different types of plants, encompassing 50 plant families. Host plants include deciduous tree fruits, subtropical fruits, berry fruits, ornamentals, and forest and shade trees. LBAM larvae feed on leaves and buds reducing photosynthetic rate, deforming growth patterns, which leads to general plant weakness and disfigurement. In grapes, apples, kiwifruit, plums, avocados, and citrus, LBAM larvae can feed directly on the fruit, and resulting feeding damage renders fruit unmarketable. **Because of the economically important effects of larval feeding, LBAM has a high pest status because of zero tolerance requirements for presence in produce destined for the export markets.**

LBAM - Damage

Federal Order
State Interior Quarantine

http://www.cdfa.ca.gov/phpps/pdep/lbam/quarantine.html

- **In discussions with all trading partners, a federal order is issued to the infested state.**

- **Regulates movement of all regulated articles.**

- **The state uses the order to set the quarantine and take appropriate action.**

Who is Affected?

Anyone growing anything except some who grow vegetables that routinely treat for moths.

Growers vs Shippers

Choke Points will still be monitored and inspected, but the growers moving product to the shippers will be under the full quarantine orders.

Light Brown Apple Moth Regulatory Procedures Manual

Table of Contents

http://www.cdfa.ca.gov/phpps/pdep/lbam/quarantine.html

European Grapevine Moth

Lobesia botrana

- The EGVM undergoes two to four generations per year, depending on the temperature
- EGVM overwinters as a diapausing pupa and can often be found under the bark of the vine
- Eggs are flattened and elliptical, and are laid singly or in groups of two or three on or near the buds, flowers, and fruit

http://www.ipm.ucdavis.edu/EXOTICeurograpevinemoth.html
http://www.cdfa.ca.gov/plant/egvm/index.html

European Grapevine Moth

Damage

- First generation larvae feed on flower clusters inside a “nest” of webbing.
- Second and third generation larvae feed inside berries, hollowing them out and leaving the outer skin and the seeds.
- Webbing, excrement and fungal infections damage the bunch.
- Botrytis

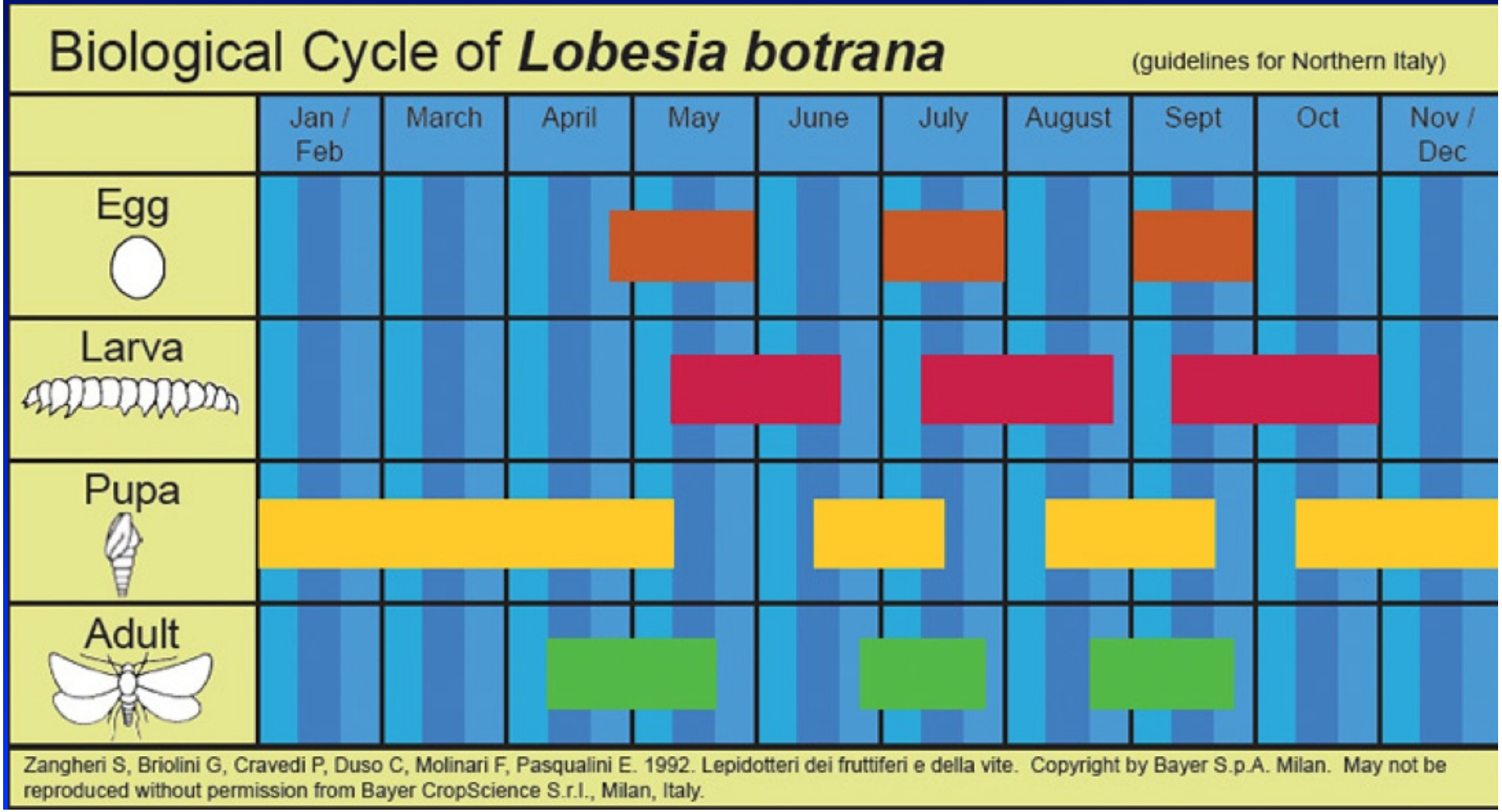
European Grapevine Moth

Management

- Monitoring
  - Delta Traps for adult monitoring
  - Isomate Lures for mating disruption
- Control measures are targeted at the second generation
- Insecticides are less effective after bunch closure
- Insect growth regulators, spinosyns, and *Bacillus thuringiensis*

European Grapevine Moth

Management



European Grapevine Moth

Monitoring

Set red delta traps with *Lobesia botrana* lures two weeks before bud break. Attach trap to trellis immediately above the canopy. Set at least 2 traps per vineyard with a minimum of 1 trap per 30 acres. Monitor trap weekly through harvest

Invasive Psyllids in California

What is a Psyllid?

Class Insecta

Order Hemiptera Homoptera

Heteroptera

Aphids, Whiteflies, Adelgids, Leafhoppers, Scale insects, Mealybugs, Cicadas, Spittlebugs, and Psyllids

Sucking mouthparts - xylem and phloem feeders

Psyllid Biology

- Year round cycle
- Slower in cooler months
- Bloom in spring during new flush
- Peak in summer

Monitoring
Watch for activity on new flush growth

- Beat sampling
- Sweep netting
- Sticky cards

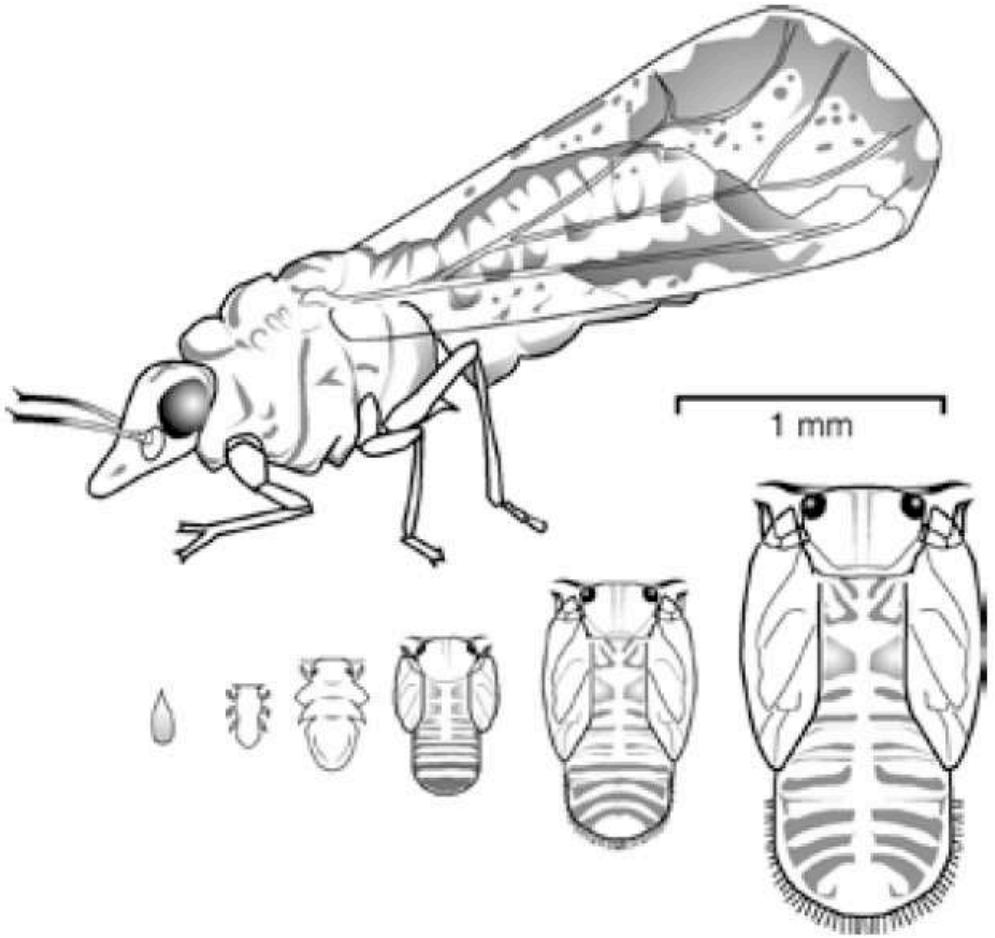


Figure 4. Life cycle of Asian citrus psyllid. Illustration by G. O. Conville after Catling 1970.

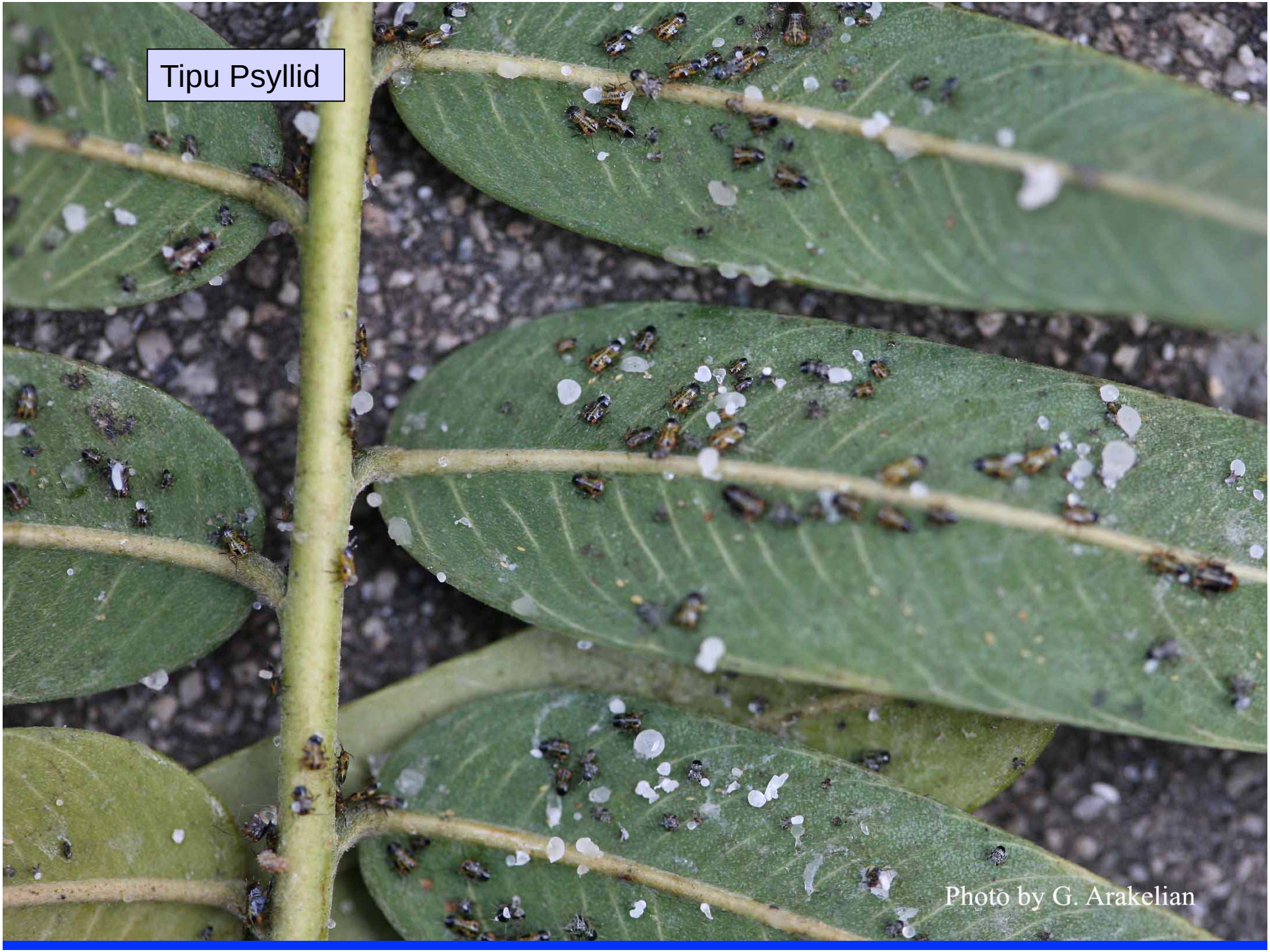
Common and Invasive Psyllids

Psyllids of economic importance

http://www.psyllids.org/psyllidsPests.htm

http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7423.html#MANAGEMENT


Platycorypha nigrivirga TIPU PSYLLID


Tipu Psyllid
Photo by G. Arakelian

Tipu Psyllids

Photo by G. Arakelian


Tipu Psyllid

Bactericera cockerelli POTATO PSYLLID

Bactericera cockerelli POTATO PSYLLID NYMPHS


Asian Citrus Psyllid
UF

The Asian Citrus Psyllid and the Citrus Disease Huanglongbing

The pest insect

The eggs are yellow-orange, tucked into the tips of tiny new leaves, and they are difficult to see because they are so small

The nymphs produce waxy tubules that direct the honeydew away from their bodies. These waxy tubules are unique and easy to recognize.

Nymphs can only survive by living on young, tender leaves and stems.

Thus, nymphs are found only when the plant is producing new leaves.

What plants can the psyllid attack?
All types of citrus and closely related plants in the Rutaceae family

Plants affected

- ***Citrus*** **(limes, lemons, oranges, grapefruit, mandarins…)**
- ***Fortunella*** **(kumquats)**
- ***Citropsis*** **(cherry orange)**
- ***Murraya paniculata*** **(orange jasmine)**
- ***Bergera koenigii*** **(Indian curry leaf)**
- ***Severinia buxifolia*** **(Chinese box orange)**
- ***Triphasia trifolia*** **(limeberry)**
- ***Clausena indica*** **(wampei)**
- ***Microcitrus papuana*** **(desert-lime)**
- **Others…..**

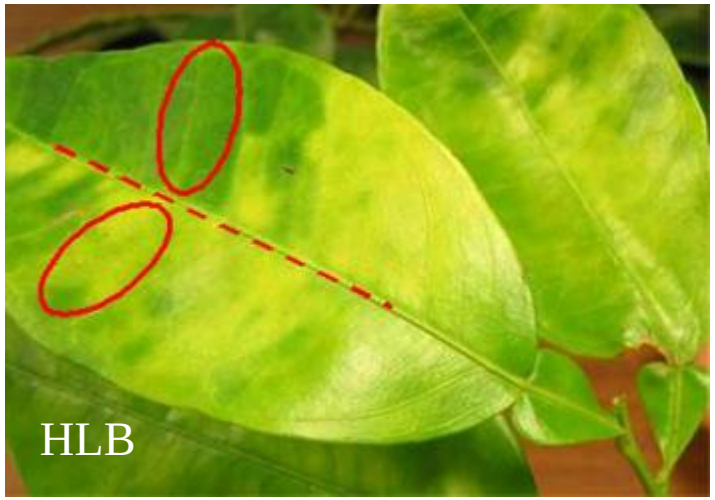
Asian citrus psyllid feeds and reproduces on Indian Curry Leaf

This Indian curry leaf, *Bergera koenigii*, is grown in Hawaii and the leaves are shipped to California for use in restaurants. It is a favorite host of the psyllid and infested leaves shipped in boxes have been intercepted at airports.

An early sign of the disease is uneven (asymmetrical) yellowing of the leaves

The bacterial disease

Leaves with HLB disease have a blotchy mottled yellow pattern that is not the same on both sides of the leaf.



Leaves with nutrient deficiencies (Zinc is an example) have the same yellow pattern on both sides of the leaf.

Even more devastating, HLB causes the fruit to be small and oddly shaped with aborted seeds and off-tasting juice

The bacterial disease

The fruit grows crookedly, forming uneven segments

How does the quarantine affect plant movement?

• Citrus and closely related plants can not be moved out of the quarantine area.

• Wholesale nurseries treat their plants with insecticides just prior to shipping if the plants are destined for retailers who lie within the quarantine area.

<u>systemic insecticides</u>

imidacloprid (Admire, Merit, Marathon, Discus, CoreTect)
thiamethoxam (Flagship)
dinotefuran (Safari)

<u>foliar insecticides</u>

fenpropathrin (Danitol, Tame)
cyfluthrin (Baythroid XL, Tempo SC Ultra)
chlorpyrifos (Chlorpyrifos Pro)
carbaryl (Sevin XLR Plus, Sevin SL)
spirotetramat (Movento)

http://phpps.cdfa.ca.gov/PE/InteriorExclusion/acptreatments.pdf


Olive Psyllid Adults
Photo by G. Arakelian


Olive Psyllid Nymph
Photo by G. Arakelian


Olive Psyllid
Photo by G. Arakelian


Olive Psyllid


Olive Psyllid

Psyllid Control

Most psyllids are under natural control, especially native psyllids

Most invasives need additional control measures until they are under some form of natural control - lady bugs, lacewings, parasitoids (Tamarixia)

Psyllid Control

Chemical control

Preservation of natural enemies

Azadirachtin (Azatin), neem oil (Green Light Garden Safe), insecticidal soap (40% potassium salts of fatty acids), and horticultural oil (an insecticide labeled "narrow range," superior, or supreme oil, such as Ultra-Fine, Purespray)

Psyllid Control

Chemical control

Many are well protected by waxy deposits, or in galls or pits

Old products like Malathion, Orthene

Vascular feeders - use a systemic insecticide

The neonicotinoids - imidacloprid, dinotefuran, thiamethoxam, acetamiprid (spray only)

Soil drench treatments for extended control

Spotted Wing Drosophila

Drosophila suzukii

Spotted Wing Drosophila

Drosophila suzukii

Spotted Wing Drosophila

Short life cycle (one to several weeks depending on temperature)
10 generations a year
A female may lay as many as 300 eggs during its lifespan

Spotted Wing Drosophila

Damage

- Readily attacks undamaged fruit
- Each clutch of eggs is from one to three
- Common vinegar flies (*Drosophila melanogaster)* may also oviposit in the damaged fruit
- Damage can provide an entry site for infection by secondary fungal and bacterial pathogens

Spotted Wing Drosophila

Management

- Monitoring for the pest is important
- Eliminate any fruit that has fallen on the ground and any infested fruit
- Remove overripe fruit, wild host
- plants such as wild grape, raspberry, blackberry, etc. from nearby fields
- Ensure timely crop harvest

Spotted Wing Drosophila

Management

- Organophosphate and synthetic pyrethroid insecticides
- Lower activity and residual control from spinosyn and organic pyrethrum class insecticides
- GF-120 (spinosyn) baited toxicant for fruit flies