Common and Invasive Pests of Stonefruits:

Peaches and Nectarines – Arthropods

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Background

Tree in leaf

Tree in bloom

Flower

Nectarine fruit

Peach fruit

Young fruit

Image citations: peach tree in leaf - Howard F. Schwartz, Colorado State University, www.bugwood.org, #5359260; tree in bloom - Charles Drake, Virginia Polytechnic Institute and State University, www.bugwood.org, #5335075; flower - H.J. Larsen, ww.bugwood.org, #5365442; nectarine fruit - Howard F. Schwartz, Colorado State University, www.bugwood.org, #5359261; peach fruit - Carroll E. Younce, USDA Agricultural Research Service, www.bugwood.org, #1304024; young fruit - University of Georgia Plant Pathology Archive, University of Georgia, www.bugwood.org, 1492186

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

Directly

- Oriental Fruit Moth
- Peach Twig Borer
- Plum Curculio
- Western Flower Thrips
- Spotted Wing Drosophila
- Plant bugs and Stink bugs
- Peach Fruit Fly
- Mediterranean Fruit Fly

Indirectly

- Peachtree Borer
- Lesser Peachtree Borer
- White Peach Scale
- San Jose Scale

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected directly by the Oriental Fruit Moth.
  - Invasive species thought to have come from Asia between 1913 and 1916.
  - Cosmopolitan in distribution now

Image citations:
Eric LaGasa, Washington State Department of Agriculture, www.bugwood.org, #5015081

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of Oriental Fruit Moth

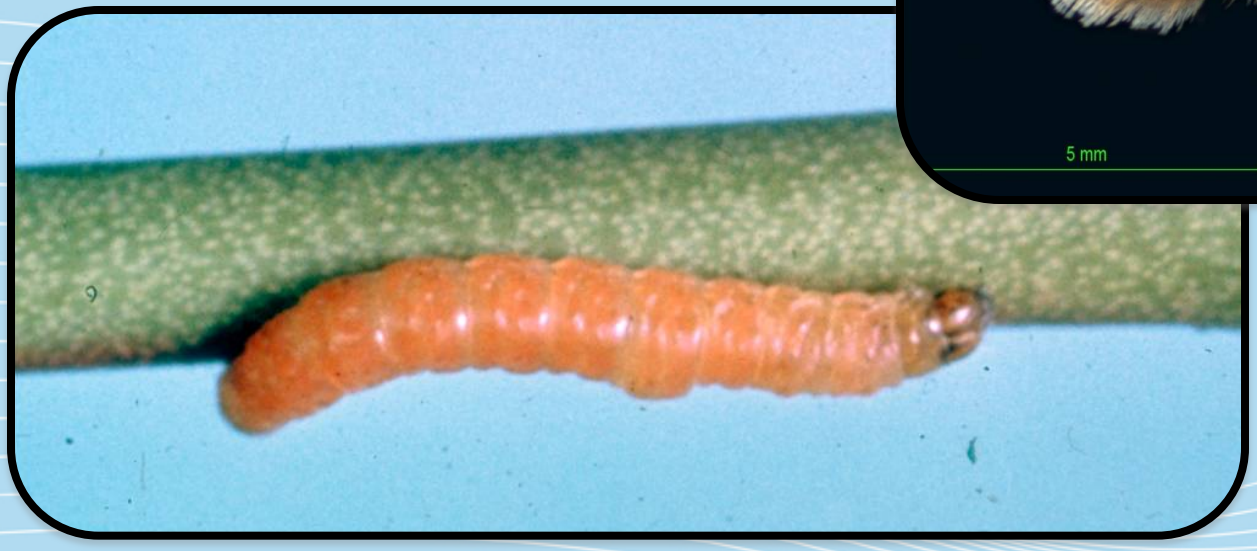
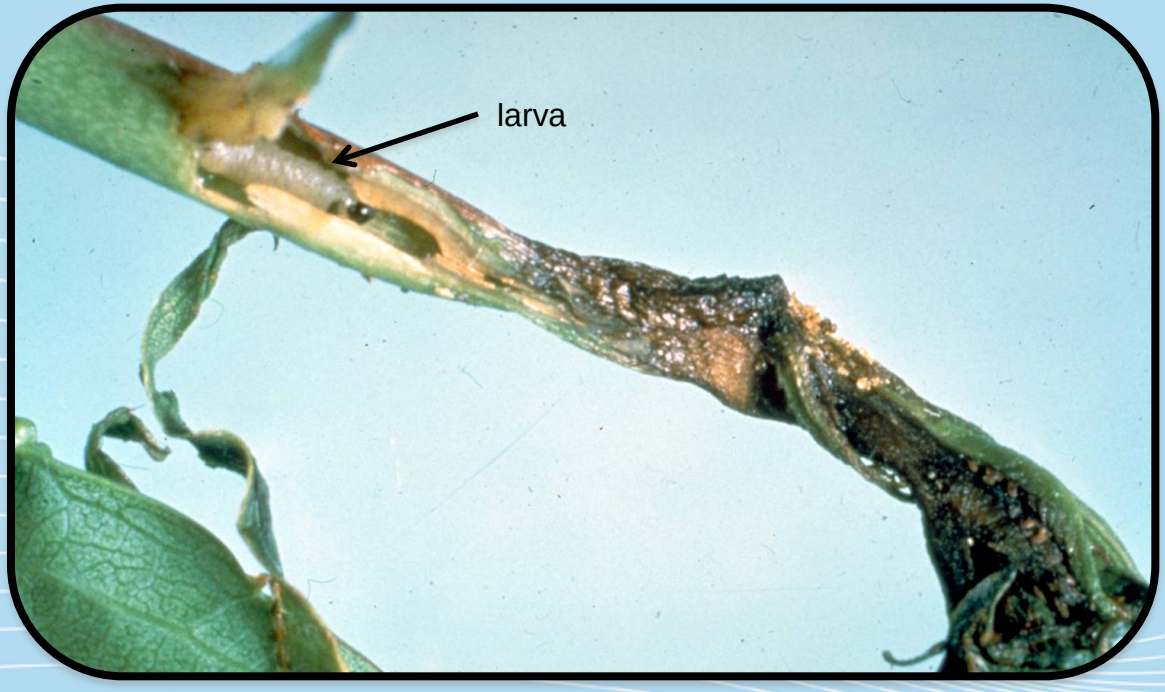


Image citations:
Right - Eric LaGasa, Washington State Department of Agriculture, www.bugwood.org, #5015081
Left - G. Morvan, INRA, Montfavet, www.bugwood.org, #0177008

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Oriental Fruit Moth damage on stems



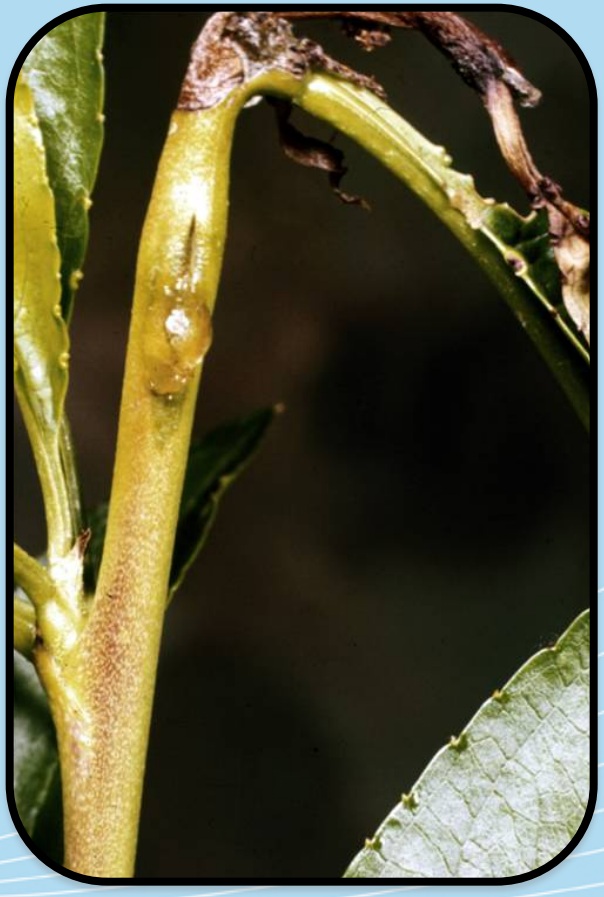


Image citations:
Right - Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #1435207
Left - H. Audemard, INRA, Montfavet, www.bugwood.org, #0660064

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Oriental Fruit Moth damage leaves and fruit

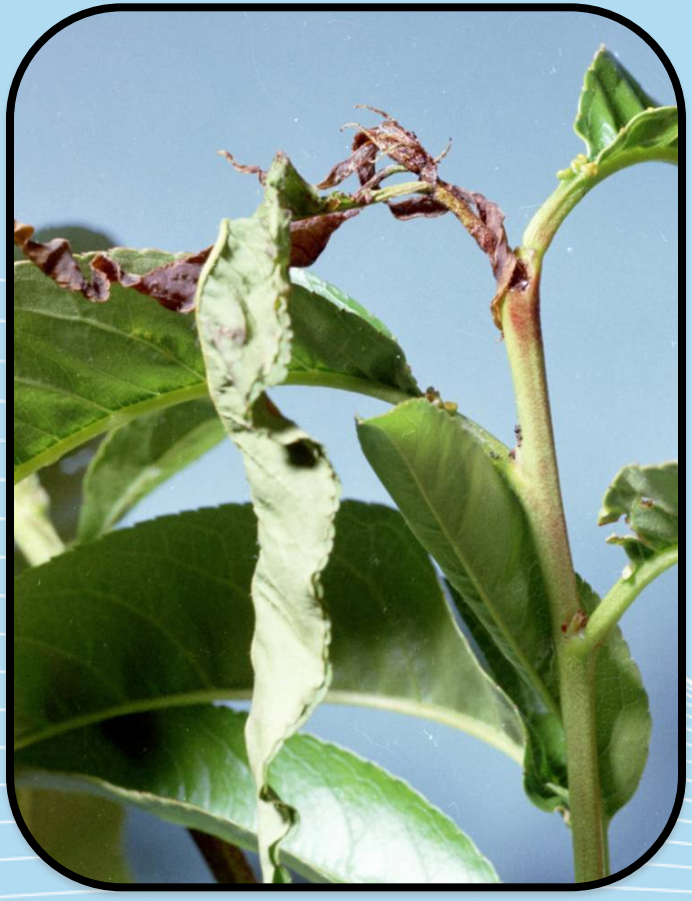


Image citations:
Right - Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #1234036
Left - G. Morvan, INRA, Montfavet, www.bugwood.org, #0177009

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Oriental Fruit Moth: Monitoring
  - Daily until first adults are caught, then weekly
  - Replace lure every 4 to 6 weeks
  - Examine fruit as well

Image citations:
William M. Brown Jr., www.bugwood.org, #5356828

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Oriental Fruit Moth: Chemical control*
  - Apply insecticides based on same biofix point
    - First generation
      - spray first between 75 and 175 DD then again 175 DD after that
    - Second generation
      - First spray 850-950 DD or 1150-1200 DD and again 300 DD later
    - Third generation
      - 1800-1900 DD or 2100-2200 DD and again 300 DD (10-18 days) later
  - Chlorantraniliprole, flubendiamide, methoxyfenozide, spinetoram, phosmet, indoxacarb, esfenvalerate, spinosad, and carbaryl are recommended
  - Mating disruption treatments are also available for this moth

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Oriental Fruit Moth: biological control
  - Encourage populations of braconid wasp *Macrocentrus ancylivorus* by planting sunflowers
  - Cannot use broad spectrum pesticides

Macrocentrus sp.

Image citations:
M. Scott, Illinois Natural History Survey, www.bugwood.org, #1739074

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected directly by the Peach Twig Borer.
  - Invasive species from Europe introduced in 1860
  - Important pest of peaches in the western U.S.

Image citations:
Wikimedia Commons

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of Peach Twig Borer

Image citations:
Left - H. Audemard, INRA, Montfavet, www.bugwood.org, #0660061
Right – wikimedia commons

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Peach Twig Borer damage on stems

Image citations:
Left - G. Morvan, INRA, Montfavet, www.bugwood.org, #0660062
Right -

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Peach Twig Borer damage on leaves and fruit

Image citations:
Top left - Eugene E. Nelson, www.bugwood.org, #5356783
Bottom left - H.J. Larsen, www.bugwood.org, #5365402

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Peach Twig Borer: monitoring
  - Use pheromone baited traps to time the application of insecticides
    - 2 traps per orchard placed 6-7 feet in canopy
    - Check every 1 to 2 days until first moth is caught, then check daily
    - Biofix point = more than 2 moths in 2 consecutive nights
    - For second generation, begin monitoring at 900 DD
  - Monitor for shoot strikes
    - May be able to see at 400 DD, but definitely by 700 to 800 DD
  - Monitor fruit as well for damage

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Peach Twig Borer: cultural and chemical control*
  - Cultural
    - Prune and destroy infected twigs
  - Chemical
    - Bloom time - spinosad, methoxyfenozide, spinetoram, chlorantraniliprole, and diflubenzuron
    - Post bloom - endosulfan, azinphosmethyl, phosmet, spinetoram, chlorantraniliprole, flubendeiamide, methoxyfenozide, spinosad, esfenvalerate, and carbaryl
    - Dormant time - oil plus methidathion or endosulfan or spinetoram, or spinosad, or diflubenzuron
    - Mating disruption techniques can be used

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Peach Twig Borer: Biological control
  - *Formica aerata,* the gray field ant
  - *Copidosoma varicorne* , a chalcid wasp
  - *Euderus lividus,* another chalcid wasp
  - *Macrocentrus ancylivorus*, a braconid wasp
  - *Pyemotes ventricosus,* the grain or itch mite
  - Applications of *Bacillus thuringiensis*
    - 2 to 3 sprays, 5 to 7 days apart

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected directly by the Plum Curculio.
  - Native to U.S.
  - Problematic in eastern U.S.

Image citations:
Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #2912075

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of Plum Curculio

Image citations:
Left - Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #1435205
Right - Jennifer C. Giron Duque, University of Puerto Rico, www.bugwood.org, #5411135

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Plum Curculio damage on leaves and fruit

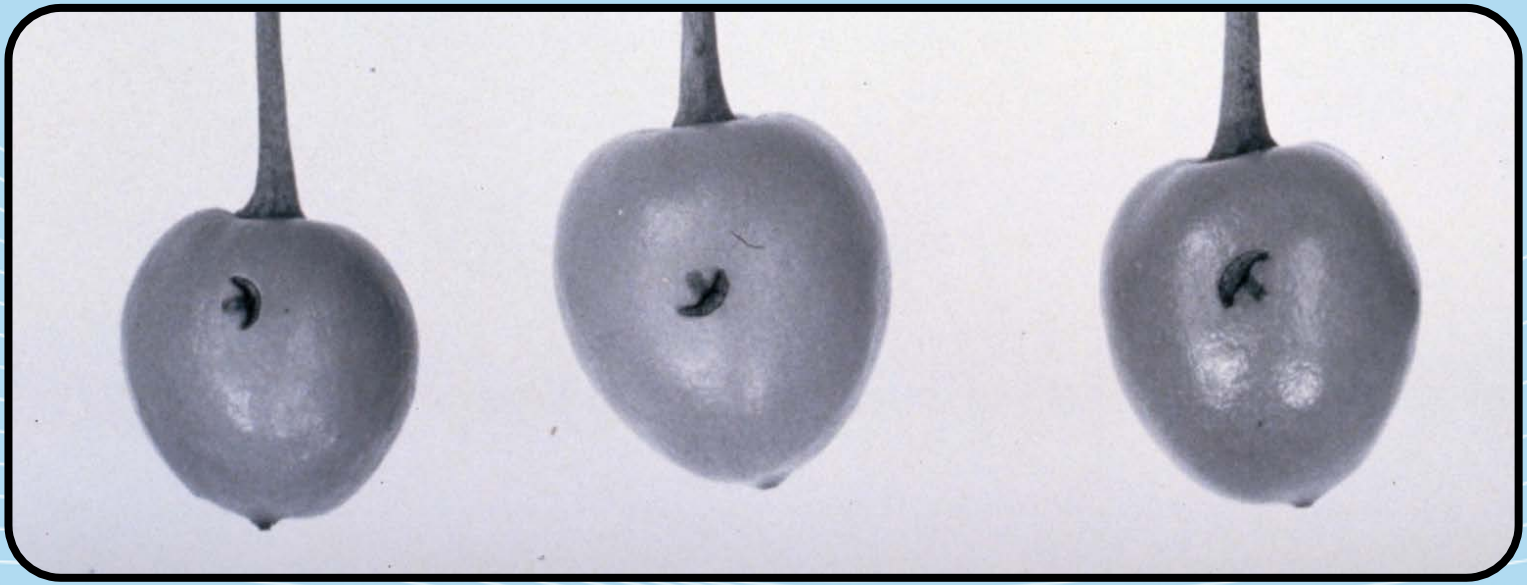


Image citations:
Left - P.J. Chapman, New York State Agricultural Experiment Station, www.bugwood.org, #0656063
Right - E. Levine, The Ohio State University, www.bugwood.org, #1949055

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Plum Curculio: Monitoring
  - Pyramid traps
    - Begin DD calculation when temperatures reach 70˚F for two consecutive days
    - Baited with plum essence or benzaldehyde
    - Deployed at 2 to 4 per block
    - Check twice weekly
      - At 50 to 100 DD, you should have adults in the trap
    - Check fruit as well beginning at 50 to 100 DD for damage
  - Can also use the "beat sheet" method

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Plum Curculio: Chemical control*
  - Phosmet, thiamethoxam, carbaryl, malathion, esfenvalerate, and permethrin are recommended
  - In areas with 2 generations or more
    - Spray on a 14 day schedule
  - Dormant season spraying for overwintering populations
    - 2 to 3 sprays at 10 to 14 day intervals

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Plum Curculio: Biological and Cultural control
  - Other techniques for control of this pest are being looked at
    - Entomopathogenic nematodes, cellulose sheeting, and finely ground kaolin particle films
  - Removal of fallen fruit will help control this year's adult population
  - Clean up of orchard debris will control next year's population

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected directly by the Western Flower Thrips.
  - Particularly problematic in arid production areas
    - Such as the southwestern United States

Image citations:
Stan Diffie, University of Georgia, www.bugwood.org, #5186056

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of Western Flower Thrips

immature

adult

Image citations:
Left - Whitney Cranshaw, Colorado State University, www.bugwood.org, #1476101
Right - Jack T. Reed, Mississippi State University, www.bugwood.org, #5370035

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Western Flower Thrips

Image citations:
Top right - Carroll E. Younce, USDA Agricultural Research Service, www.bugwood.org, #1304026

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Western Flower Thrips: Monitoring
  - Shake the flowers over a white piece of paper
  - Seal buds in bag and let them be warmed by the sun

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Western Flower Thrips: Cultural, Biological, and Chemical control*
  - Cultural control
    - Manage weeds in the orchard and don't disc in spring
  - Biological control
    - Several have been tested, but none produce significant control of the pest population
  - Chemical control
    - Difficult due to behavior of the pest
    - Spinosad, spinetoram, methomyl, abamectin, and formetanate hydrochloride are recommended

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

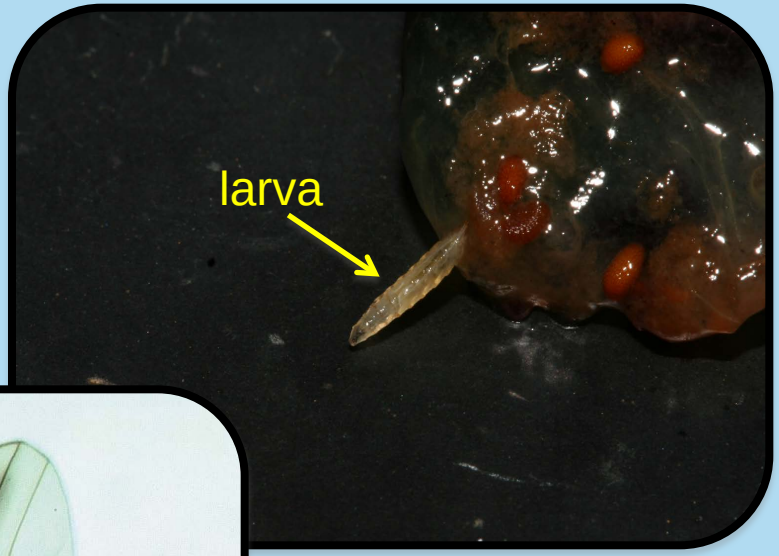
- The fruit of peaches and nectarines can be affected directly by the Spotted Wing Drosophila.
  - Spread to throughout the eastern United States and along the Pacific coast.

Image citations:
Gevork Arakelian, Los Angeles County Department of Agricultural Commissioner/Weights and Measures

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of Spotted Wing Drosophila



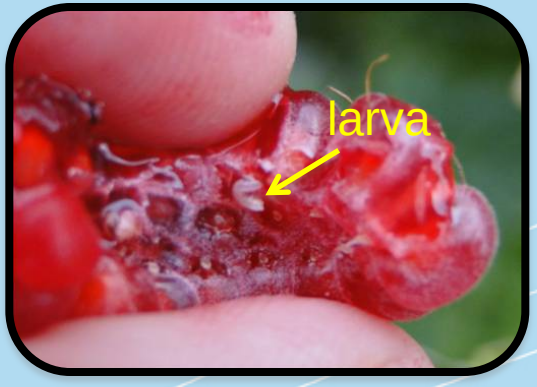


Image citations:
top right - Oregon State University
Bottom right - Hannah Burrack, North Carolina State University, www.bugwood.org, #5444186
Adults - Gevork Arakelian, Los Angeles County Department of Agricultural Commissioner/Weights and Measures

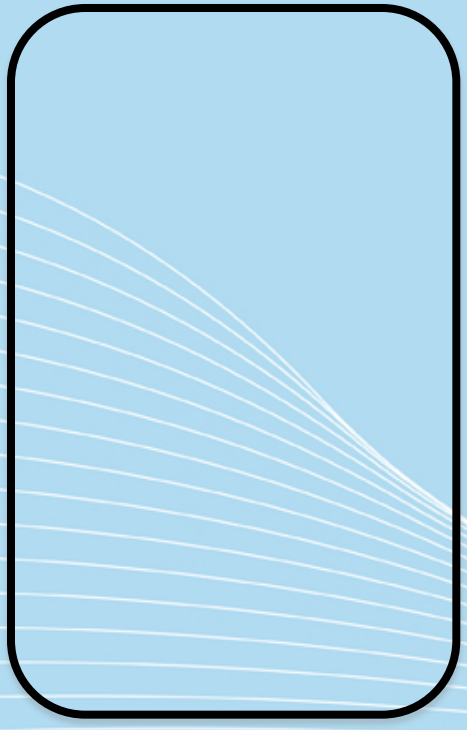
protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

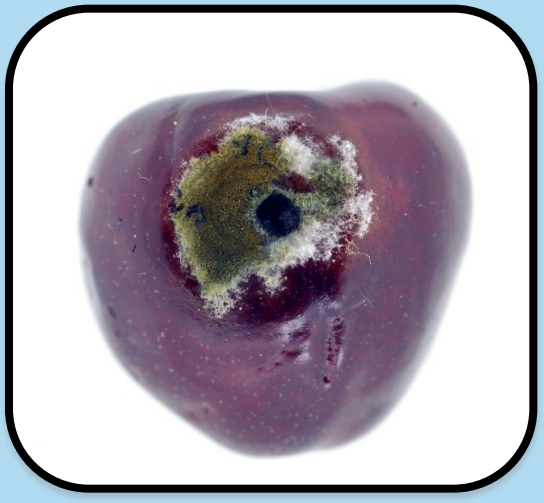
Arthropod Pests

- Spotted Wing Drosophila damage on fruit

undamaged damaged

“pin pricks” left by ovipositor





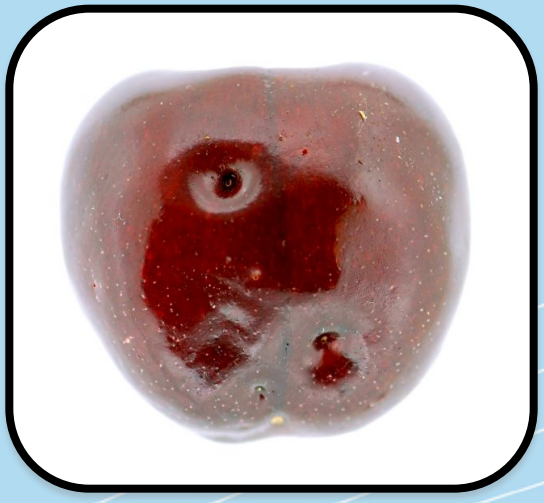


Image citations:
Bottom right and middle – Martin Hauser, California Department of Food and Agriculture
Left - British Columbia Ministry of Agriculture
Top right – Oregon State University

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Spotted Wing Drosophila: Monitoring
  - Building or purchasing traps
  - Using bait for the traps
  - Inspecting the fruit itself for puncture marks

Image citation:
Trap and adult on trap - Hannah Burrack, North Carolina State University, www.bugwood.org, #5444190 and #5444191

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Spotted Wing Drosophila: Chemical control*
  - Malathion
  - Spinetoram
  - Spinosad
  - Zeta-cypermethrin
  - Diazinon
  - Imidacloprid

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Spotted Wing Drosophila: Biological and Cultural control
  - Biological control
    - Not much is known
      - Wasps in the families Diapriidae, Braconidae, and Cynipidae are possible candidates
      - *Orius insidiosus*
      - Predaceous bugs (i.e. big-eyed bugs and other minute pirate bugs) and lacewing larvae
  - Cultural control
    - Cull fruit, keep processing area and equipment clean, harvest frequently, and mow after harvest
    - Create a physical barrier if possible

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected directly by plant bugs and stink bugs.
  - Plant bugs
    - Tarnished plant bug (*Lygus lineolaris*)
    - Western tarnished plant bug (*Lygus hesperus*)
    - Pale legume bug (*Lygus elisus*)
  - Stink bugs
    - Green stink bug (*Chinavia hilare*)
    - Brown stinkbug (*Euschistus servus*)
    - Consperse stink bug (*Euschistus* conspersus)
    - Brown marmorated stink bug (*Halyomorpha halys*).

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

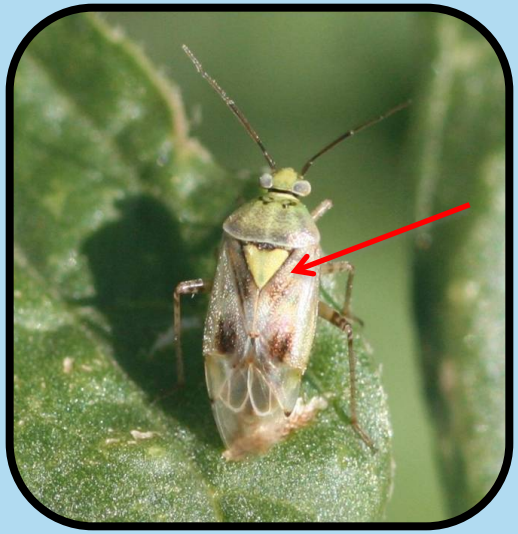
Arthropod Pests

- Description of the plant bugs

Lygus lineolaris

Piercing mouthpart

Lygus hesperus



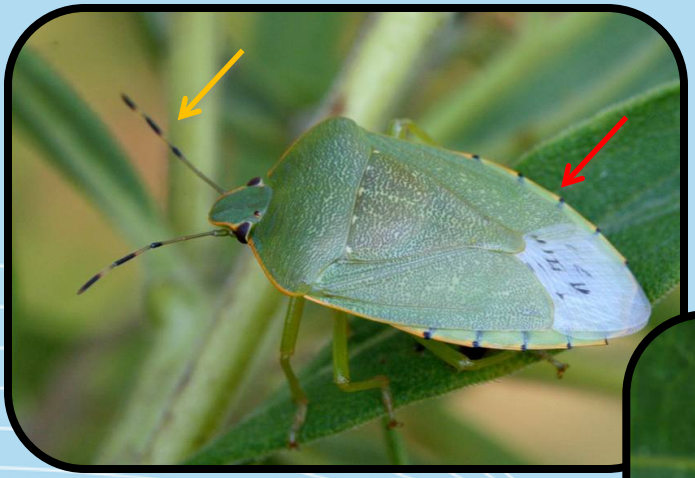
Lygus elisus

Image citations:
Piercing mouthpart - Allen Cohen, USDA Agricultural Research Service, www.bugwood.org, #1319048
Lygus lineolaris - Scott Bauer, USDA Agricultural Research Service, www.bugwood.org, #1318094
Lygus hesperus – Whitney Cranshaw, Colorado State University, www.bugwood.org, #5083025
Lygus elisus - Whitney Cranshaw, Colorado State University, www.bugwood.org, #5304100

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

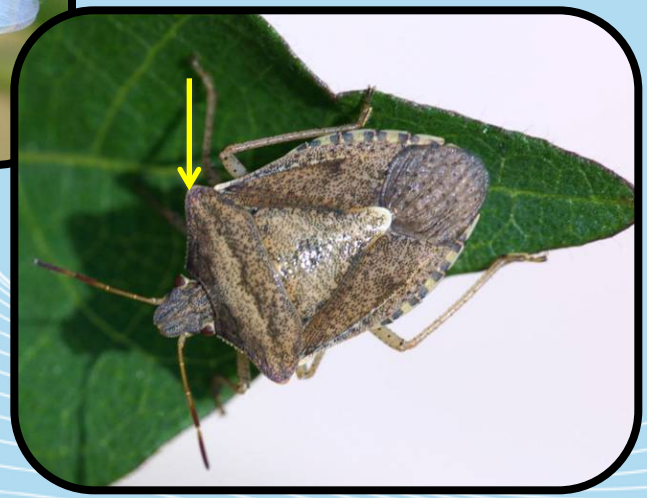
Arthropod Pests

- Description of the stink bugs



Chinavia hilare

Piercing mouthpart



Euschistus servus

Euschistus conspersus

Image citations:
Piercing mouthpart - Russ Ottens, University of Georgia, www.bugwood.org, #1242029
Chinavia hilare - David Cappaert, Michigan State University, www.bugwood.org, #2116061
Euschistus servus - Russ Ottens, University of Georgia, www.bugwood.org, #1242027
Euschistus conspersus - Steven Valley, Oregon Department of Agriculture, www.bugwood.org, #5458955

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of the brown marmorated stink bug

Image citations:
Whitney Cranshaw, Colorado State University, www.bugwood.org, #5393470

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Damage on fruit

Image citations:
http://nfrec.ifas.ufl.edu/MizellRF/stink_bugs/stink_bugs.htm

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing plant bugs and stink bugs: Monitoring
  - Using a beat sheet or sweep net
  - Inspecting fruit
  - Trapping with white traps or yellow traps baited with pheromones

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

Managing plant bugs and stink bugs: Chemical control*

- Plant bugs
  - Esfenvalerate
  - Phosmet
  - Formetanate hydrochloride
  - Methomyl
  - Indoxacarb
- Stink bugs
  - Indoxacarb
  - Formetanate hydrochloride
  - Carbaryl
  - Endosulfan
  - Esfenvalerate

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing plant bugs and stink bugs: Biological and Cultural control
  - Biological control
    - *Trissolcus halymorphae* (a parasitic wasp)
    - Generalist predators
  - Cultural control
    - Mow overwintering hosts of these pests (before green fruit is present) .
    - Clean debris from orchard floor that might serve as overwintering hosts for these pests.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected directly by the Peach Fruit Fly.
  - Not established in the U.S., but intercepted quite often.

Image citations:
Natasha Wright, Florida Department of Agriculture and Consumer Services, www.bugwood.org, #5189098

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of the Peach Fruit Fly

Image citations:
Left – wikimedia commons
Right - Gary Steck, Department of Agriculture and Consumer Services, Division of Plant Industry

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Damage by the Peach Fruit Fly on fruit

Image citations:
Wikimedia commons

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

Jackson trap

- Managing the Peach Fruit Fly: Monitoring

Delta trap

Image citation:
Top left - William A. Carothers, USDA Forest Service, www.bugwood.org, #1515064
Bottom left - Chris Evans, River to River CWMA, www.bugwood.org, #2126069

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing the Peach Fruit Fly: Chemical control*
  - Adult males
    - Methyl eugenol and an insecticide
  - Adult females
    - Protein source and an insecticide
  - Pupae
    - Diazinon

McPhail trap

Image citation:
Peggy Greb, USDA Agricultural Research Service, www.bugwood.org, #1316099

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing the Peach Fruit Fly: Cultural control
  - Fruit stripping
  - Removal of fallen fruit
  - Wrapping or bagging fruit

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected directly by the Mediterranean Fruit Fly.
  - Not established in the U.S., but intercepted quite often.

Image citations:
USDA ARS Photo Unit, USDA Agricultural Research Service, www.bugwood.org, #1317083

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of the Mediterranean Fruit Fly

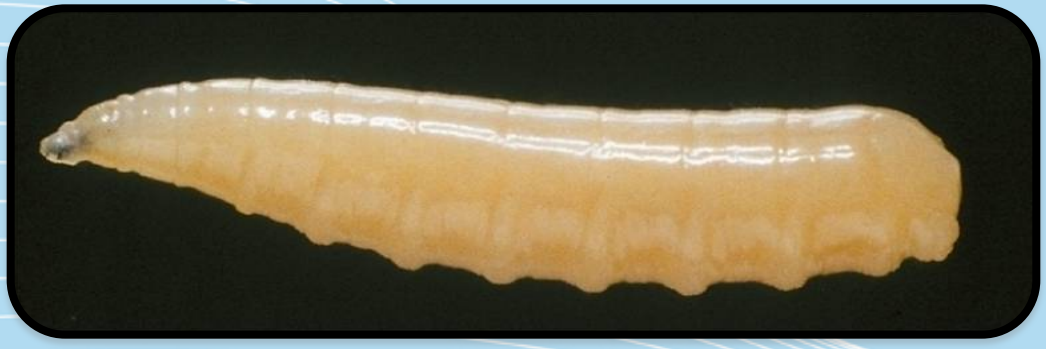


Image citations:
Top left – Pest and Diseases Image Library, www.bugwood.org, #5311094
Bottom left - Florida Division of Plant Industry Archive, Florida Department of Agriculture and Consumer Services, www.bugwood.org, #5193031
Right - Scott Bauer, USDA Agricultural Research Service, www.bugwood.org, #1317085

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Damage on fruit by the Mediterranean Fruit Fly

Image citations:
Scott Bauer, USDA Agricultural Research Service, www.bugwood.org, #1322040

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing the Mediterranean Fruit Fly: Monitoring

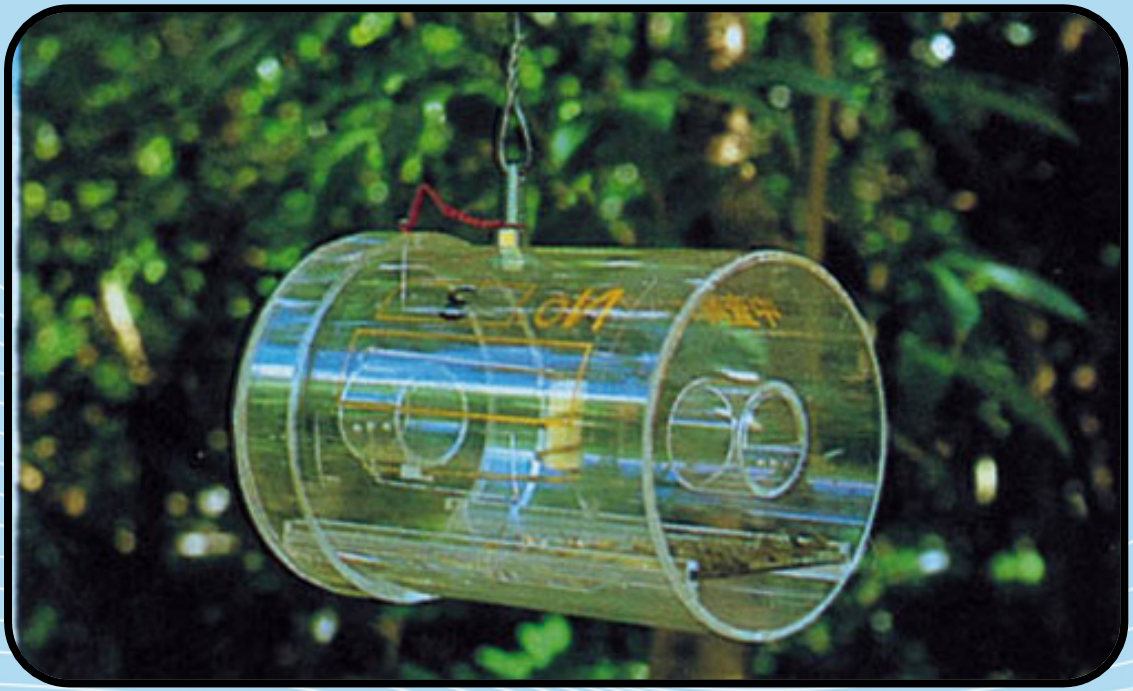


Image citation:
http://entnemdept.ufl.edu/creatures/fruit/tropical/oriental_fruit_fly.htm

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing the Mediterranean Fruit Fly: Chemical control*
  - Males
    - Trimedlure and Terpinyl acetate mixed with an insecticide
  - Males and females
    - Protein source mixed with an insecticide
  - Pupae
    - Soil drench
  - Foliar spray with spinosad

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing the Mediterranean Fruit Fly: Biological and Cultural control
  - Biological control
    - Sterile insect technique
  - Cultural control
    - Removing (and destroying) fallen fruit
    - Stripping fruit from trees in the area around the detection
    - Wrapping fruit to create a physical barrier thus preventing the pest from ovipositioning on the fruit

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected indirectly by the Peachtree Borer and the Lesser Peachtree Borer.
  - Both are native to eastern North America
  - Have adapted well to feeding on cultivars of *Prunus* spp.

Synanthedon exitiosa

Synanthedon pictipes

Image citations:
Top - Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #1435199
Bottom – Lyle Buss, Department of Entomology and Nematology, University of Florida

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of Peachtree Borer

female

male

Image citations:
Left - Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #1435204
Top right - - Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #1435199
Bottom right - Wendell Snow, USDA Agricultural Research Service, www.bugwood.org, #1361111

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of Lesser Peachtree Borer

female

male

Image citations:
Left - Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #12603, and Lyle Buss, Department of Entomology and Nematology, University of Florida6

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Peachtree Borer and Lesser Peachtree Borer damage on stems

Image citations:
Top, left, and middle - Carroll E. Younce, USDA Agricultural Research Service, www.bugwood.org, #1304004, #1304014, and #1304013
Right - Eugene E. Nelson, www.bugwood.org, #5360746

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Peachtree Borer and Lesser Peachtree Borer: monitoring
  - Hung before petal fall between shoulder height and eye level
  - 2 per orchard per species
    - Spaced at least 60 feet apart when trapping for both species
  - Replace bait every 4 weeks

Image citations:
Right - Whitney Cranshaw, Colorado State University, www.bugwood.org, #5443187

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Peachtree Borer and Lesser Peachtree Borer: chemical control*
  - Post harvest
    - Chlorpyrifos, permethrin, esfenvalerate, carbaryl, lambda-cyhalothrin and a mix of lambda-cyhalothrin and chlorantraniliprole.
  - Pre-harvest (by 14 days)
    - Chlorpyrifos
  - Application should be made at peak egg laying time
    - 7 to 14 days after peak capture of males in a pheromone trap
  - Pheromone mating disruption is also commonly used

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing Peachtree Borer and Lesser Peachtree Borer: biological and cultural control
  - Biological
    - Nematodes
  - Cultural
    - Tree health
    - Manual removal of the larvae had been done with a knife, but this can lead to more damage to the tree than the insect itself inflicts

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- The fruit of peaches and nectarines can be affected indirectly by the White Peach Scale.
  - Invasive species from southeast Asia
  - It has a wide range of host plants
  - Can be found in the U.S. from Texas to Maine.
    - Has also been found in Hawaii

Image citations:
Eric R. Day, Virginia Polytechnic Institute and State University, www.bugwood.org, #1122021

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of White Peach Scale

Females under their scales

males

Female with scale covering removed exposing eggs

Image citations:
Top left - Lyle Buss, Department of Entomology and Nematology, University of Florida
Bottom left - Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, www.bugwood.org, #5198088
Top left - Lyle Buss, University of Florida, www.bugwood.org, #5446769

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- White Peach Scale damage on stems

Image citations:
Clemson University - USDA Cooperative Extension Slide Series, www.bugwood.org, #1233228

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing White Peach Scale: Monitoring
  - Use double-sided transparent tape or black electrical tape coated in petroleum jelly
  - Place on branch where scales are present
  - Monitor twice weekly
  - Replace every 2 weeks

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing White Peach Scale: Chemical control*
  - Malathion, carbaryl, permethrin, and esfenvalerate are recommended
  - Oils are also recommended in dormant season
  - All can be applied twice during dormant season
  - Can also time application in conjunction with monitoring for the crawlers

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

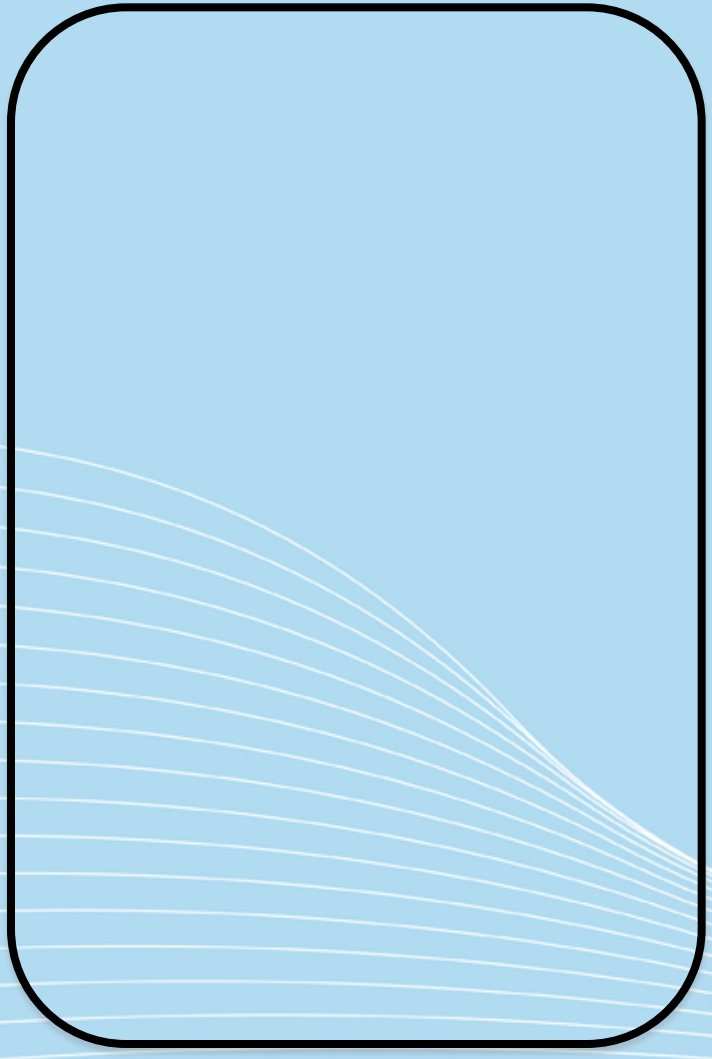
protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing White Peach Scale: Biological and Cultural control
  - Biological
    - Chalcid wasp parasitoid, *Encarsia berlesei*
    - Ladybird beetles
    - Common lacewings
  - Cultural
    - Removal of hosts is impractical

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests



- The fruit of peaches and nectarines can be affected indirectly by the San Jose Scale.
  - Invasive species from Asia that has spread worldwide
  - Has many hosts plants besides peaches and nectarines

Image citations:
Lyle Buss, Department of Entomology and Nematology, University of Florida

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Description of San Jose Scale

nymph

Image citations:
Left – United States National Collection of Scale Insects Photographs Archive, USDA Agricultural Research Service, www.bugwood.org, #5109050
Right - D.R. Miller, www.bugwood.org, #5109047

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- San Jose Scale damage on stem

Image citations:
Left – United States National Collection of Scale Insects Photographs Archive, USDA Agricultural Research Service, www.bugwood.org, #5111024

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing San Jose Scale: Monitoring
  - Use double-sided transparent tape or black electrical tape coated in petroleum jelly
  - Place on branch where scales are present
  - Monitor twice weekly
  - Replace every 2 weeks
  - Pheromone traps will also work in monitoring for this pest

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Arthropod Pests

- Managing San Jose Scale: Chemical* and Biological control
  - Chemical
    - Malathion, carbaryl, permethrin, and esfenvalerate are recommended
    - Applied 400-700 DD after biofix
    - Continue spraying every 10 days until there are no crawlers on the tape
    - Oil applied during dormant season
  - Biological
    - Lots of natural enemies, none that are really effective

*Be sure to check with your local county agent to find out which chemicals are certified for use in your state, on what crop it is allowed to be used, if it is allowed to be used post-harvest or pre-harvest, and if it should be applied by a licensed applicator.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Questions?

- For more information, check out www.protectingusnow.org

- You can also contact:
  - Amanda Hodges, University of Florida, achodges@ufl.edu
  - Stephanie D. Stocks, University of Florida, sstocks@ufl.edu

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Author Credits and Date of Publication

- Stephanie Stocks, M.S., Assistant –In, Extension Scientist, Department of Entomology and Nematology, University of Florida
- Mercy Olmstead, Ph.D., Assistant Professor, Horticultural Sciences Department, University of Florida

- July 2013

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Reviewers Credits

- Amanda Hodges, Ph.D., Associate Extension Scientist, Department of Entomology and Nematology, University of Florida
- Stephen Mclean, DPM, Department of Entomology and Nematology, University of Florida

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Educational Disclaimer and Citation

- This presentation can be used for educational purposes for NON-PROFIT workshops, trainings, etc.
- Citation:
  - Stocks, S. and M. Olmstead. 2013. Common and Exotic Diseases and Pests of Stonefruits: Peaches and Nectarines – Arthropod Section. accessed (add the date) – www.protectingusnow.org.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

Our Partners

Much of the authorship of e-learning content has occurred through partnerships. Some of our partnering organizations have included:

National Institute of Food and Agriculture (NIFA)

Center for Invasive Species and Ecosystem Health (i.e. the Bugwood Network)

Local and Regional Integrated Pest Management programs (IPM)

U.S. Department of Homeland Security (DHS)

USDA-APHIS

Extension Disaster Education Network (EDEN)

U.S. Forest Service

Cooperative Agriculture Pest Survey Program (CAPS)

National Plant Board (NPB) and State Departments of Agriculture

National Plant Diagnostic Network (NPDN)

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- Alston, D. and M. Murray. 2010. Greater Peachtree Borer (*Synanthedon exitiosa*). Utah State University Cooperative Extension. accessed 12/30/2011 –
  - http://utahpests.usu.edu/ipm/htm/fruits/fruit-insect-disease/greater-peachtree-borer07
- Anonymous. 2011a. Spotted Wing Drosophila (Fruit Fly) Pest Alert. Ministry of Agriculture, British Columbia. accessed on 10/10/2011 –
  - http://www.agf.gov.bc.ca/cropprot/swd.htm
- Anonymous. 2011b. Spotted Wing Drosophila (*Drosophila suzukii*) in the Southern Interior Valleys of British Columbia. Produced by the Okanagan Kootenay Cherry Growers Association, the field staff of Okanagan Tree Fruit Cooperative, and the B.C. Ministry of Agriculture. accessed 10/18/2011 –
  - http://www.agf.gov.bc.ca/cropprot/swd.pdf
- Beers, E.H., T. Smith, and D. Walsh, 2010. Spotted Wing Drosophila, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilida). Washington State University, Orchard Pest management Online. accessed 10/18/2010 –
  - http://jenny.tfrec.wsu.edu/opm/displaySpecies.php?pn=165
- Bentley, W., S.B. Mallek, and A. Molinar. 2005. Biological Control of Oriental Fruit Moth, *Grapholita molesta* (Busck)". UC Plant Protection Quarterly, Vol. 15, no. 2&3. accessed 12/30/2011 –
  - http://www.uckac.edu/files/123931.pdf

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- Bentley, W.J., J.K. Hasey, and K.R. Day. 2010a. Peach Twig Borer. UC IPM Online. accessed 12/30/2011 –
  - http://www.ipm.ucdavis.edu/PMG/r602300611.html
- Bentley, W.J., J.K. Hasey, and K.R. Day. 2010b. Peach - Oriental Fruit Moth. UC IPM Online. accessed 12/30/2011 –
  - http://www.ipm.ucdavis.edu/PMG/r602300211.html
- Bentley, W.J., J. K. Hasey, and K. R. Day. 2010c. Peach – Western Flower Thrips. UC IPM Online. accessed 1/25/2012 –
  - http://www.ipm.ucdavis.edu/PMG/r602301611.html
- Bentley, W.J., J. K. Hasey, and K. R. Day. 2010d. Peach – Stink Bugs. UC IPM Online. accessed 1/26/2012 –
  - http://www.ipm.ucdavis.edu/PMG/r602300111.html
- Bentley, W.J., J. K. Hasey, and K. R. Day. 2010e. Peach – Plant Bugs. UC IPM Online. accessed 1/26/2012 –
  - http://www.ipm.ucdavis.edu/PMG/r602300511.html
- Bentley, W.J., J.K. Hasey, and K.R. Day. 2010f. Peachtree Borer. UC IPM Online. accessed 12/30/2011 –
  - http://www.ipm.ucdavis.edu/PMG/r602301211.html

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- CABI. 2011. *Bactrocera zonata*. Invasive Species Compendium (BETA). accessed 1/30/2012 –
  - http://www.cabi.org/isc/?compid=5&dsid=17694&loadmodule=datasheet&page=481&site=144
- CABI. 2011. *Ceratitis capitata* (Mediterranean fruit fly). Invasive Species Compednium. Beta. accessed 1/30/2012 –
  - http://www.cabi.org/isc/?compid=5&dsid=12367&loadmodule=datasheet&page=481&site=144
- Capinera, J. 2001. Handbook of Vegetable Pests. Academic Press, New York.
- Caprile, J., M.L. Flint, M.P. Bolda, J.A. Grant, R. van Steenwyk, and D. Haviland. 2011. Provisionary Guidelines: Management of Spotted Wing Drosophila in Home Garden Situations. UC IPM online. accessed 10/17/2011 –
  - http://www.ipm.ucdavis.edu/EXOTIC/drosophila.html
- Dixon, W. 2009. Tarnished Plant Bug. Featured Creatures. accessed 1/26/2012 –
  - http://entnemdept.ufl.edu/creatures/trees/tarnished_plant_bug.htm

References

- Dreves, A.J., V. Walton, and G. Fisher. 2009. A New Pest Attacking Healthy Ripening Fruit in Oregon – Spotted wing Drosophila: *Drosophila suzukii* (Matsumura). Oregon State University Extension Service, EM 8991. accessed 10/10/2011 –
  - http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/13090/em8991.pdf;jsessionid=2335D5DC564861AB1B14FC3986733B07?sequence=1
- Dreves, A. J. and G.A. Langellotto-Rhodaback. 2011. Protecting Garden Fruits from Spotted Wing Drosophila. Oregon State University. accessed 10/10/2011 –
  - http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/20883/em9026.pdf
- EPPO. 2005. *Bactrocera zonata*. Data sheets on quarantine Pests. Accessed 1/25/2012 –
  - http://www.eppo.org/QUARANTINE/insects/Bactrocera_zonata/DS_Bactrocera_zonata.pdf
- EPPO. *Ceratitis capitata*. Data sheets on quarantine pests. accessed 1/30/2012 –
  - http://www.eppo.org/QUARANTINE/insects/Ceratitis_capitata/CERTCA_ds.pdf
- Fadamiro, H., R. Boozer, C. Akotsen-Mensah, K. Rice, and J. Jacobi. 2009. Crop Profile for Peaches in Alabama. accessed 12/30/2011 –
  - http://www.aces.edu/anr/ipm/documents/AlabamaPeachCropprofile-submitted111509.pdf

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- FAO/IAEA. 2000. Action Plan: Peach Fruit Fly, *Bactrocera zonata* (Saunders). accessed 1/30/2012 –
  - http://www-naweb.iaea.org/nafa/ipc/public/ipc-zonata-action-plan.pdf
- Gill, S., J.A. Davidson, and M.J. Raupp. 1992. "Control of Peachtree Borer using Entomopathogenic Nematodes". Journal of Arboriculture, vol. 18, issue 4, pp. 184-187.
- Gorsuch, C. and J. McLeod Scott. 2007. Peach Insect Pests. Clemson Cooperative Extension. HGIC 2210. accessed 12/30/2011 –
  - http://www.clemson.edu/extension/hgic/pests/pdf/hgic2210.pdf
- Gyeltshen, J., G. Bernon, A. Hodges, S. Stocks, J. Brambila. 2011. Brown Marmorated Stink Bug. Featured Creatures. accessed 1/27/2012 –
  - http://entnemdept.ufl.edu/creatures/veg/bean/brown_marmorated_stink_bug.htm
- Hauser, M. 2011. "A historic account of the invasion of *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae) in the continental United States, with remarks on their identification". Pest Management Science. doi: 10.1002/ps.2265. accessed 10/10/2011 –
  - http://onlinelibrary.wiley.com/doi/10.1002/ps.2265/pdf

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- Hogmire, H.W., editor. 1995. Mid-Atlantic Orchard Monitoring Guide, published by NRAES, 152 Riley-Robb Hall, Ithaca, New York.
- Horton, D. and D. Johnson, editors. 2011. Southeastern Peach Growers' Handbook. University of Georgia Extension and Outreach. accessed 12/15/2011 –
  - http://www.ent.uga.edu/peach/peachhbk/toc.htm
- Jamison, T. 2005. *Euschistus servus*. E.H. Strickland Entomological Museum of the Department of Biological Sciences at the University of Alberta. accessed 1/27/2012 –
  - http://entomology.museums.ualberta.ca/searching_species_details.php?s=5908
- Kanzawa, T. 1941. "Studies on *Drosophila suzukii* Mats.". The Review of Applied Entomology, vol. 29, page 622.
- Landolt, P.J., T. Adams, and H. Rogg. 2011. "Trapping spotted wing drosophila, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae), with combinations of vinegar and wine, and acetic acid and ethanol". Journal of Applied Entomology, doi: 10.1111/j.1439-0418.2011.01646.x. Accessed 10/17/2011 –
  - http://onlinelibrary.wiley.com/doi/10.1111/j.1439-0418.2011.01646.x/pdf
- Layne, D.R., and D. Bassi, editors. 2008. The Peach: Botany, Production, and Uses. CABI, Cambridge, Massachusetts.

References

- McPherson, J.E. and R. M. McPherson. 2000. Stink Bugs of Economic Importance. CRC Press LLC.
- Mueller, S.C., C.G. Summers, and P.B. Goodell. 2003. A Field Key to the Most Common *Lygus* Species Found in Agronomic Crops of the Central San Joaquin Valley of California. accessed 1/26/2012 –
  - http://lygus.uckac.edu/PDF/ANR%208104.pdf
- NAPIS. Survey Status Map of the Brown Marmorated Stink bug. Accessed 7/6/2013 –
  - http://pest.ceris.purdue.edu/map.php?code=IQAQQKA#
- Ogawa, J.M., editor. 1995. Compendium of Stone Fruit Diseases. American Phytopathological Society Press, St. Paul, Minnesota.
- Pajac, I. and B. Baric. "*Drosophila suzukii* (Matsumura, 1931) - a potential pest of stone fruits in Croatia". Pomologia Croatica: Journal of the Croatian Society of Agronomy (1330-6626) 16 (2010), 1-2, 43-49. accessed 10/17/2011
  - http://hrcak.srce.hr/file/97470

References

- Palumbo, J.C. 2011. Insect Management on Desert Produce Crops - Western Flower Thrips. VegIPM Update, Vol. 2, No. 4. accessed 1/25/2012 –
  - http://extension.arizona.edu/sites/extension.arizona.edu/files/resourcefile/resource/marcop/Insect%20Management%20on%20Desert%20Produce_Thrips_2011.pdf
- Reading, M.E. and D.G. Alston. 2003. Peach Twig Borer *Anarsia lineatella.* Utah State University Extension. accessed 12/30/2011 –
  - http://extension.usu.edu/boxelder/files/uploads/twigbore.pdf
- Regional Pest Alert. Brown Marmorated Stink Bug. accessed 1/27/2012 –
  - http://www.ncipmc.org/alerts/stinkbug_alert.pdf
- Rings, R. 1970. "Economic Aspects of the Biology and Control of the Oriental Fruit Moth, *Grapholita molesta* Busck, in the United States". The Ohio Journal of Science, vol. 70, issue 1, pp. 58-61.

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- Sorenson, C.J. and F. H. Gunnell. 1955. Biology and Control of the Peach Twig Borer (*Anarsia lineatella* Zeller) in Utah. Agricultural Experiment Station, Division of Agricultural Sciences, Utah State Agricultural College. Bulletin 379. accessed 12/30/2011 –
  - http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1342&context=uaes_bulletins&sei-redir=1&referer=http%3A%2F%2Fwww.google.com%2Furl%3Fsa%3Dt%26rct%3Dj%26q%3Dwhen%2520was%2520peach%2520twig%2520borer%2520introduced%2520into%2520teh%2520us%26source%3Dweb%26cd%3D3%26ved%3D0CDEQFjAC%26url%3Dhttp%253A%252F%252Fdigitalcommons.usu.edu%252Fcgi%252Fviewcontent.cgi%253Farticle%253D1342%2526context%253Duaes_bulletins%26ei%3DgfH9TpafJaeBsgLq_8CeAQ%26usg%3DAFQjCNHR5_sutPJ0adVzmVucrFjecnHwMA#search=%22when%20peach%20twig%20borer%20introduced%20into%20teh%20us%22
- Steck, G.J., W. Dixon, and D. Dean. 2009. Spotted Wing Drosophila, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae), a fruit pest new to North America. FDACS-DPI Pest alert. accessed 10/17/2011 –
  - http://www.freshfromflorida.com/pi/enpp/ento/drosophila_suzukii.html

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- Steck, G. 2010. A peach fruit fly, *Bactrocera zonata* (Saunders) (Tephritidae). Pest Alert for Florida Department of Agriculture and Consumer Services, Division of Plant Industry. accessed 1/30/2012 –
  - http://www.freshfromflorida.com/pi/pest_alerts/pdf/peach-fruit-fly-pest-alert.pdf
- Thomas, M.C., J.B. Heppner, R.E. Woodruff, H.V. Weems, G.J. Steck, and T.R. Fasulo. 2010. Mediterranean fruit fly. Featured Creatures. accessed 1/30/2012 –
  - http://entnemdept.ufl.edu/creatures/fruit/mediterranean_fruit_fly.htm
- Walsh, D.B., M.P. Bolda, R.E. Goodhue, A.J. Dreves, J. Lee, D.J. Bruck, V.M. Walton, S.D. O'Neill, and F. G. Zalom. "*Drosophila suzukii* (Diptera: Drosophilidae): Invasive Pest of Ripening Soft Fruit Expanding Its Geographic Range and Damage Potential". Accessed 10/18/2011 –
  - http://extension.wsu.edu/swd/Documents/Drosophila%20suzukii%20Invasive%20Pest%20of%20Ripening.pdf
- Welty, C. 2000. Lesser Peachtree Borer. Ohio State University Extension Fact Sheet. HYG-2033-94. accessed 12/30/2011 –
  - http://ohioline.osu.edu/hyg-fact/2000/2033.html

protect u.s.
community invasive species network
First Detectors Protecting U.S. from Pests

References

- Whalon, M., D. Nortman, J. Wise, L. Gut, D. Epstein. 2007. Plum curculio management and spray timing. accessed 12/30/2011 –
  - http://ipmnews.msu.edu/fruit/Fruit/tabid/123/articleType/ArticleView/articleId/987/Plum-curculio-management-and-spray-timing.aspx
- USDA-ERS. Spreadsheet A-5, A-8, and A-18. accessed 12/30/2011 –
  - http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377