Integrated Pest Management for Fruit Trees

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http://ccag-eh.ucanr.edu/
http://sacmg.ucanr.edu/
Information was developed largely for California conditions; control methods may vary in other regions.
IPM for Fruit Trees

General Considerations

• Use resistant species and varieties
• Use appropriate training & pruning
  – Keep trees small for easier management
• Keep sprinkler water off trees
• The best thing to apply is your shadow
• Spray as a last resort, use organic/least toxic products (my emphasis in this talk)
Topics to be Covered

• **Insects**
  - Codling moth
  - Scale insects
  - Borers
  - Sp. wing drosophila
  - BMSB

• **Diseases**
  - Peach leaf curl
  - Fire blight
  - Gummosis and canker diseases

• **Keeping Trees Small**
  - Fruit bushes
  - Espalier

• **At end, not in talk:**
  - Aphids
  - Apple & pear scab
  - Brown rot
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Codling Moth

*Cydia pomonella*
Codling Moth

Eggs and newly hatched larva

Pupating larvae
Codling Moth
Codling Moth
Characteristics

- Pest of apple, pear, quince, walnut
- Overwinters as larva in cocoon
- Mating begins during or just after flowering (temp. dependent)
- 1-4 generations per year
- Extremely difficult to control
Codling Moth
Selected Control Methods

• Take what you get, cut damage out
• Remove/destroy infested fruit early
• Mass trapping of:
  ➢ Males (pheromone traps)
  ➢ Males & females (vinegar/molasses solution)
• Organic products: Hort. oil, granulosis virus (Cyd-X), spinosad, kaolin clay (Surround)
  ➢ Good coverage is essential
Mass Trapping
But Does it Work?

• Catches males & females (and many other insect species)

• Solution:
   1 c cider vinegar
   1/3 c dark molasses
   1/8 tsp ammonia
   Water to make 1.5 qts.

• 2/3 of the moths are in the upper 1/3 of the tree
Codling Moth Phenology Model

- Used by growers, too complicated for gardeners
- Trapping to establish biofix date
- Check traps 1-2 times a week until biofix is set, weekly thereafter
- $1^{st}$ Biofix = The first date that moths are consistently found in traps and sunset temperatures have reached 62° F
Pheromone Traps
Place High in Tree
Not a Control Method
Codling Moth Degree-Day Model
Codling Moth Degree-Day Model

Spray Timing

- **1st Spray**: 250 to 300 DD after biofix (egg hatch)
- **2nd Spray**: If significant moth catches continue after the first treatment, 650 DD for the second peak of the first generation
- Low trap catches – delay treatment
Typical Codling Moth Flight Pattern (Calif.)

- 1A Peak: 300 DD
- 1B Peak: 650 DD
- Biofix 1
- 2A Peak: 300 DD
- 2B Peak: 650 DD
- 3A & B
- Biofix 3

Date:
- 4/1
- 5/1
- 6/1
- 7/1
- 8/1
- 9/1
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Soft Scale
No Covering – Shell is Female Body

Lecanium scale
Kuno Scale
(Eulecanium kunoense)
(Mainly Northern Calif.)

Females in Winter

Females in Spring
Kuno Scale

Females in Late Spring
Eggs in late May

Kuno Scale

Nymphs in June

Photo by Joyce Gross
Armored Scales

San Jose scale

Females - Cover removed
Scale Insects

Characteristics

• Soft scale
  ➢ Lecanium, brown, black, kuno, etc.
  ➢ Covering is body of adult female
  ➢ Excrete honeydew

• Armored scale
  ➢ San Jose, red, etc.
  ➢ Waxy covering over adult
  ➢ No honeydew

• Cottony cushion scale
Double Sided Sticky Tape
Late Spring - Crawler timing for oil spray
**Scale Insects**

**Control Methods**

- Tanglefoot to prevent ants (soft scale)
- Promote natural enemies
  - Avoid broad spectrum insecticides
  - Provide pollen & nectar sources
- Dormant spray – Horticultural oil
- Monitor crawlers with sticky tape (May)
- Spray oil after crawlers emerge (early June)
  - But foliage hinders good coverage
Soft Scale Management

Exclude ants with Tanglefoot

– They protect scales from parasitoids
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Pacific Flatheaded Borer

(C. mali)

Larva

Adult
Shothole Borer
(Scolytus rugulosus)
(Bark Beetle)
Flatheaded and Shothole Borers

Control Methods

• Control methods:
  – Keep trees healthy
  – Prevent sunburn in hot climates
    • Paint new trees and exposed branches white
    • Proper dormant & summer pruning
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Spotted Wing Drosophila
*Drosophila suzukii*

**male**
- Gnat-sized
- Native to Asia
- Found in Calif., spread to PNW in 2009

**female**
- Infest mature and rotting fruit
- Overwinter as adults
- Active throughout the year
SWD Damage (Maggots)

Cherry
D. simulans/melanogaster

Photos by Martin Hauser, CDFA

Unique Ovipositor

Spotted wing drosophila

D. suzukii
Crops Affected by SWD

• **Cherries**

• **Berries**
  – Raspberries, blackberries, strawberries, blueberries

• **Stone Fruits**
  – Plums, pluots
  – Nectarines
Monitoring (Challenging)

• ½ to 1 gal plastic bottle baited with:
  – 1-2 inches of apple cider vinegar
• Replace solution weekly
• Monitor twice weekly from first color change
• Count flies with spots on wings (male SWD)
• Hand lens used to identify SWD females
Monitoring (Challenging)

Yogurt Container

Rescue Fly Trap
Spotted Wing Drosophila

Control Methods

• Plant early maturing varieties
• Insecticides:
  ➢ Spinosad (malathion & others too)
  ➢ 2-3 sprays; begin at fruit color change (straw/pink)
  ➢ Spray before fruit softening
• Cover trees
  ➢ Fruit bushes, espalier - Agribon, Fruit Shield, etc.
  ➢ Clip edges together
  ➢ For about 1 month before harvest
Exclusion
Fair Oaks Horticulture Center
Topics to be Covered

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Brown Marmorated Stink Bug

(Halyomorpha halys)

Photos: Baldo Villegas
Two white bands on antennae

Smooth "shoulder" edges

Banded abdominal edge extending beyond wings

Actual adult size 1/2 to 5/8 inch

Rust color with broad brown markings

Banded legs

Mature nymph (5th instar)

Photo: UC IPM
20-30 eggs (often 28)

Nymph (3rd of 5)  Adult
Major Host Plants
Selected Ornamentals

- Butterfly bush
- Catalpa
- Chinese pistache
- Fruiting mulberry
- English holly
- Maple

- Princess tree (*Paulownia*)
- Redbud
- Tree of heaven
- Waxleaf privet
- Zelkova
Host Plants

Crops

• Stone fruits (esp. peach), pome fruits
• Berries
• Grapes (not a major host)
• Eggplant, tomato, okra, pepper, corn, beans, sunflower
The image shows various fruits with different levels of damage caused by BMSB (Brown Marmorated Stink Bug) in 2014:

- **Peach**
- **Apricot**
- **Asian pear**
- **Fig**
- **Nectarine**
- **Plum – no damage**
BMSB - Apples
Sept. 2015
BMSB - Persimmons
Sept. 2015
Organically Acceptable BMSB Insecticides

Partial to fairly good control of nymphs only:

- Pyrethrins
- Azadirachtin
- Spinosad
- Sabadilla
- Insecticidal soap
- Some combinations
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Peach Leaf Curl
Peach Leaf Curl

- Affects peaches, nectarines
- Fungal spores spread by rain, wind
- Spores overwinter in buds and tree surfaces
Control of Peach Leaf Curl

- Lime sulfur, Microcop no longer available
- Copper sprays
  - Tribasic or basic copper sulfate (hard to find)
  - Copper ammonium complex (e.g., Liqui-Cop)
  - Copper soap (e.g., Concern)

1. Early Dec.
2. In late winter, a bud swell

- Consider covering trees
Available Copper Products
Selected Brand Names (in CA)

Liquid copper (copper ammonium complex)  Copper soap (liquid!)  
(copper octanoate)
2013 Research Project
Individual Branches Treated

Sprayed branches
Agribon on branch

Untreated
Lime sulfur & Microcop
2012 Peach Leaf Curl Trial

Conclusions

• Very effective:
  ➢ Lime sulfur / Microcop
  ➢ Agribon + Liquicop

• Somewhat less effective:
  ➢ Copper soap, Liquicop, and Agribon
  ➢ But still provided 60-80% control
Best Delayed Dormant Peach Leaf Curl Spray Timing

Dormant  First swell  Green tip
Peach Leaf Curl

Why to Also Spray in Fall
Peach Leaf Curl
Why to Also Spray in Fall

Spray now

10-Day Weather Forecast
Copper Spray
Eva’s Pride (early!)

- Ripens in May
- Photos taken 1/20/2016
- New growth started - too late to spray
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Fire Blight

$Erwinia$ amylovora
Fire Blight
Characteristics

- Bacteria – enters through flowers under warm, moist conditions
- Affects apple, pear (esp. Bartlett), Asian pear, flowering pear, quince, loquat, pyracantha, hawthorne
Fire Blight
Control Methods

• Plant resistant varieties
• Cut back to lateral branch, 12 in. below infection
  – Sterilize shears between cuts (20% bleach)
    • Soak for 1 min. or spray = more effective than dip
    • Lysol or Pine Sol also work; not rubbing alcohol
  – More important than steriliz.: avoid “short cuts”
• Spray copper twice – early bloom & full bloom

See: http://calag.ucanr.edu/Archive/?article=ca.v045n04p21
Scraping Bark
(Followed by bleach spray)
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  ➢ Fire blight
  ➢ **Gummosis and canker diseases**

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Gummosis

Gummosis ("oozing"): The production & exudation of gum by a diseased or damaged tree
- Can result from environmental stress, mechanical injury, disease, or insect infestation
- Oozes mainly spring (soft), hardens in summer, may disappear with fall rains
Bacterial Blast

*Pseudomonas syringae*
Bacterial Canker

*Pseudomonas syringae*
Bacterial Canker
Red flecks early on;
Shallow canker
Choose less susc. rootstock (Maheleb>Colt>Mazzard)
Summer prune only
Cover tree if frost during bloom
Avoid watering trunk/branches
Proper N fertilization
Cytospora Canker

Fungus enters through injuries, cuts, & buds
Infections occur winter, fall, early spring
Summer prune only
Remove branch 4+” below canker margin
Leave no stubs
Canker surgery

Sources: Utah State Univ.
Penn. State Univ. Extension
Eutypa, Botryosphaeria
Prune Apricots and Cherries in August
Preventing Canker Diseases

- Prevent trunk damage
- Summer pruning; prevent winter injuries
- Large winter cuts - leave stump, remove in spring
- Keep trees healthy - adequate water, fertilizer
- Prevent insect boring damage
  - Paint south & west-exposed branches white before damage occurs
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Keeping Trees Small

- Fruit bush or espalier training
- Easier, safer tree & crop management
- Easier for spraying, better coverage

Photo by Mary Flewelling Morris
Excluding Pests Easier with Small Trees

Fair Oaks Horticulture Center
Bird Netting (Avigard)
Another pest management benefit with small trees!
Fruit Bushes
Pruning – Years 1 & 2

• At planting, head trees to 18-24 in.
• Mid-spring – cut back new growth by half
• Mid-summer – cut subsequent growth back by half
• Thinning cuts for sunlight penetration
• May need to prune 1-2 more times
Cutting New Shoots in Half
Mid-Summer
Summer Pruning a Mature Fruit Bush
(Pluot in May)

Before

After
Espalier

Peach
360 fruits (4th year)

Cherry (4th year)
Asian Pear Espalier
Fair Oaks Horticulture Center
Questions?

• For more information:
  • The Home Orchard... (UC publication 3485)  
    (http://anrcatalog.ucanr.edu/Details.aspx?itemNo=3485)
  • UC Integrated Pest Management Program  
    (http://ipm.ucanr.edu/)
  • Managing diseases and insects in home orchards  
    (https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/ec631_0.pdf)
  • Organic pest and disease management in home fruit trees and berry bushes  
  • Fair Oaks Horticulture Center  
    (http://sacmg.ucanr.edu/Fair_Oaks_Horticulture_Center/)
Aphids on Plum

Egg near dormant bud
Managing Aphids
Cultural Control Methods

• Monitor foliage in early spring
• Promote natural enemies
  – Avoid broad spectrum insecticides
  – Provide pollen & nectar sources
• When localized, cut off infested shoots
• Avoid high N fertilization
• Forceful spray of water
• Use tanglefoot to control ants
Managing Aphids
Chemical Control Methods

• In-season: Insecticidal soaps and oils
  – Soap + pyrethrum formulations slightly better
  – Petroleum-based or plant-derived (neem, canola)
  – Early season, before leaves curl
  – Thorough coverage essential, repeat sprays

• Bud swell: Horticultural oil
  – Partial control

• Avoid broad-spectrum insecticides
Natural Enemies

Predators
Natural Enemies
Parasitoids

Parasitized aphids
Woolly Apple Aphid

Branch gall

Root galls
Wooly Apple Aphids
*Eriosoma lanigerum*

- Feed mainly on bark
- Become active in March & April
- Found on spurs & branches spring, early summer, especially around pruning wounds
- Nymphs move up & down trunk in summer, fall
- Move to roots in winter
- Less problematic on sandy soils
Woolly Apple Aphid

Resistant rootstocks?
M111, M106

Natural enemies
Predators & parasitoids
Promote earwigs with rolled cardboard
Soap or oil sprays (3x):
Delayed dormant, petal fall, summer

M111 rootstock
Peachtree Borer
(Synanthedon exitiosa)
Peachtree Borer
Control Methods

• Monitor with pheromone traps
• Spray trunks with parasitic nematodes or insecticides (neem oil, pyrethrins, azadirachtin)
• Applications of beneficial nematodes
  – Steinernema carpocapsae
  – Heterorhabditis bacteriophora
• Clear vegetation away from base of tree
Apple Scab
Venturia inaequalis

Primary lesions
Secondary lesions
Pear Scab
Venturia pirina

Primary lesion

Primary and secondary lesions
Apple and Pear Scab
Characteristics

• Worst in regions with cool, wet springs
• Rapid infection at 55-75°F and 9 hrs. moisture
• Initial infections early spring, secondary infections 2 weeks later
• Spores overwinter on infected fallen leaves
Apple and Pear Scab
Control Methods

• Scab-resistant cultivars
• Avoid sprinklers hitting foliage
  – Or irrigate in morning only
• Remove dropped leaves in fall or winter
• Add lime to leaf piles under trees
• Spray before spring rains starting at green tip
  – Copper, sulfur, mineral or neem oil, or myclobutanil
Brown Rot
Monolinia spp.

Flower and Twig Infections
Brown Rot
Monolinia spp.

Fruit Infections

Mummy
Brown Rot
Control Methods for Stone Fruits & Almonds

- Plant resistant varieties, if available
- Fruit thinning, pruning for air circulation
- Remove infected fruit, pick all fruit when ripe, remove mummies and infected twigs
- Keep sprinkler water off trees
- If infections were serious, consider spraying copper starting at pink bud
Simple Garden Sprayers

- **Hand-pump sprayer**
- **Backpack sprayer**
- **Hose-end sprayer**
  - Excess liquid
  - Not ideal for fruit tree pest management
Sprayer with Extension
Sprayer with Extension
(H&G Promotions, UK)

See anything wrong in these photos? Something missing?
Mist Blower Backpack Sprayers