

Integrated Pest Management for Fruit Trees

International Master Gardener Conference
July 13, 2017

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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

- Keeping Trees Small

- Fruit bushes
- Espalier

- Diseases

- Peach leaf curl
- Fire blight
- Gummosis and canker diseases

- At end, not in talk:

- Aphids
- Apple & pear scab
- Brown rot

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Codling Moth

Cydia pomonella



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Codling Moth

Eggs and newly hatched larva



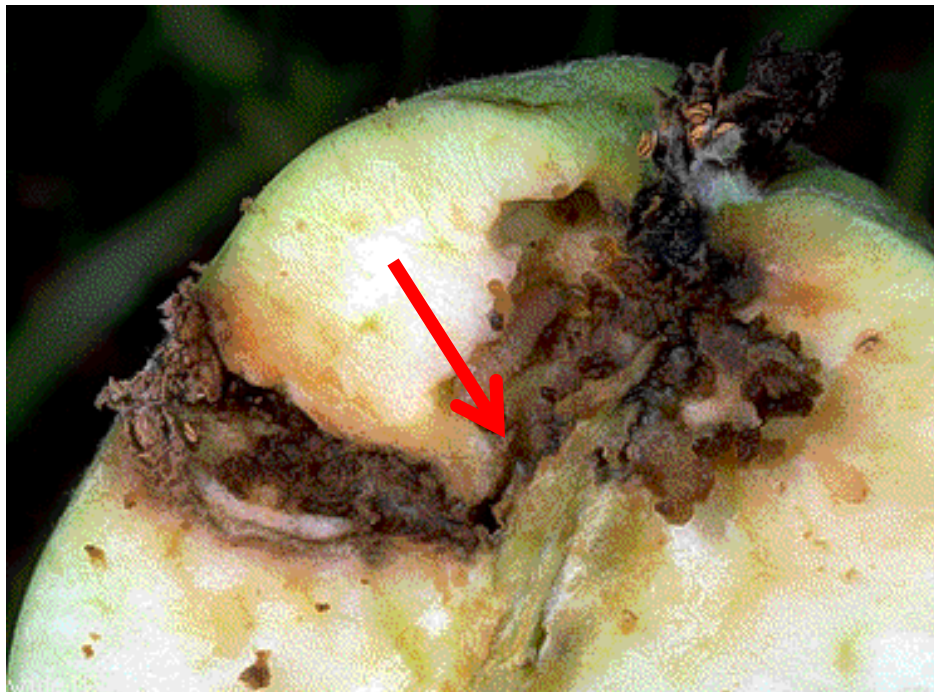
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Pupating
larvae



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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

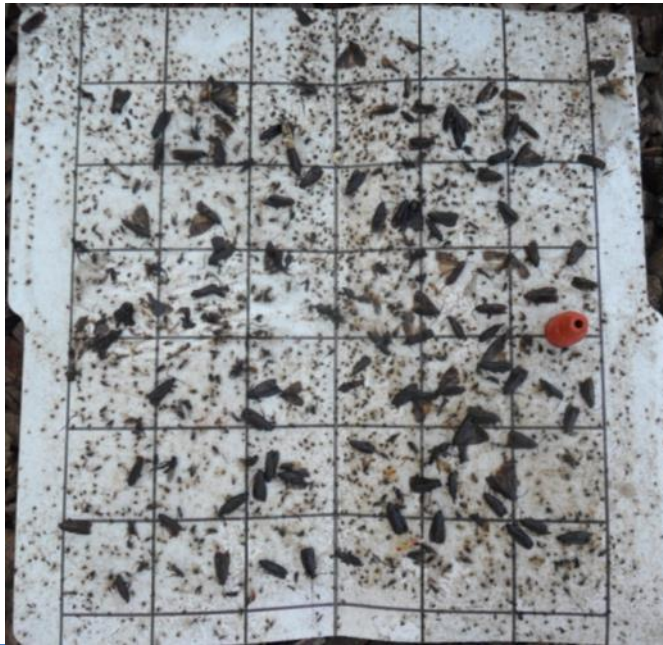
Codling Moth Phenology Model

- 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
- 1st 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

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UC IPM

Statewide Integrated Pest Management Program



What is IPM? Identify & Manage Pests Research Publications Training & Events Links About Us Contact Us Subscribe

Solve your pest problems with UC's best science

What's New

- Highlights: [2015 Annual Report](#)
- [Strategic plan 2015-2025](#)
- New videos in Spanish: [Plagas de Alacena](#), [Hormigas & Malezas](#)
- Ag Pest Management: [Turfgrass updated](#), [Avocado revised](#)
- Green Bulletin: [December 2016](#)
- Retail Nursery & Garden Center IPM Newsletter: [December 2016](#)
- [More...](#)

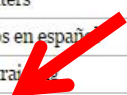
QUICK LINKS

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[Recursos en español](#)

[Online training](#)

[Weather, models, & degree-days](#)



Home, Garden, Turf & Landscape Pests



Agricultural Pests



Natural Environment Pests



Exotic & Invasive Pests

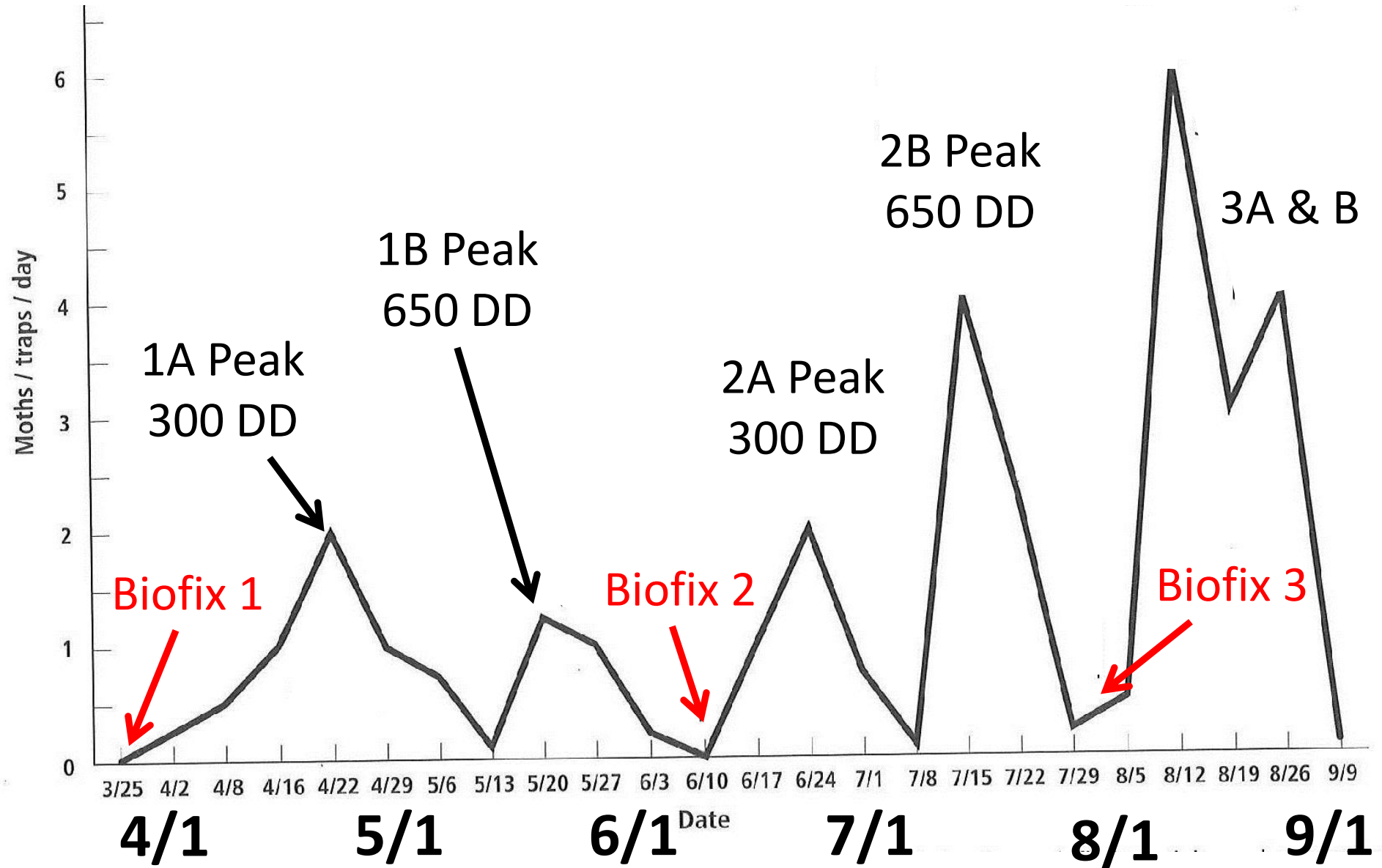


Codling Moth Degree-Day Model

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.)



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- **Keeping Trees Small**

- Fruit bushes
- Espalier

- **Diseases**

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- Brown rot

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



Photo by Joyce Gross

Nymphs in
June



Kuno Scale

Armored Scales



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San Jose scale

Females -
Cover removed



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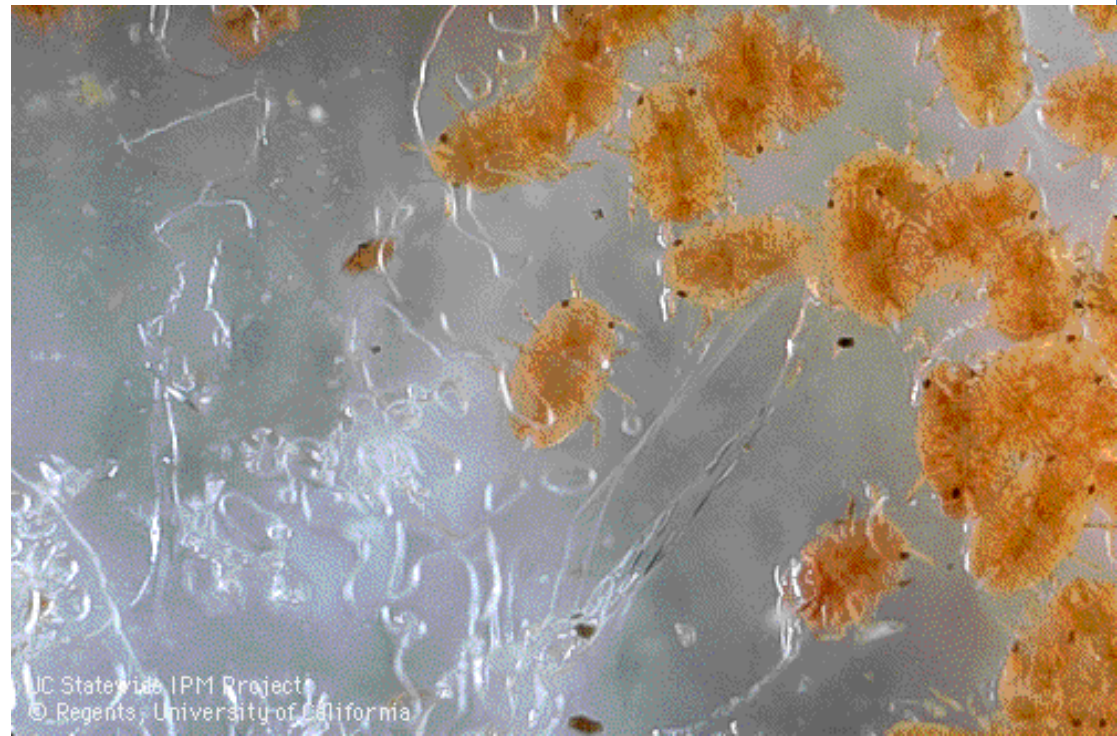
Scale Insects

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 *(Chrysobothris 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



female



- Gnat-sized
- Native to Asia
- Found in Calif., spread to PNW in 2009
- Infest mature and rotting fruit
- Overwinter as adults
- Active throughout the year

SWD Damage (Maggots)

Cherry



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Unique Ovipositor

Spotted wing
drosophila

D. suzukii

*D. simulans/
melanogaster*

Photos by Martin
Hauser, CDFA



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



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Brown Marmorated Stink Bug (*Halyomorpha halys*)



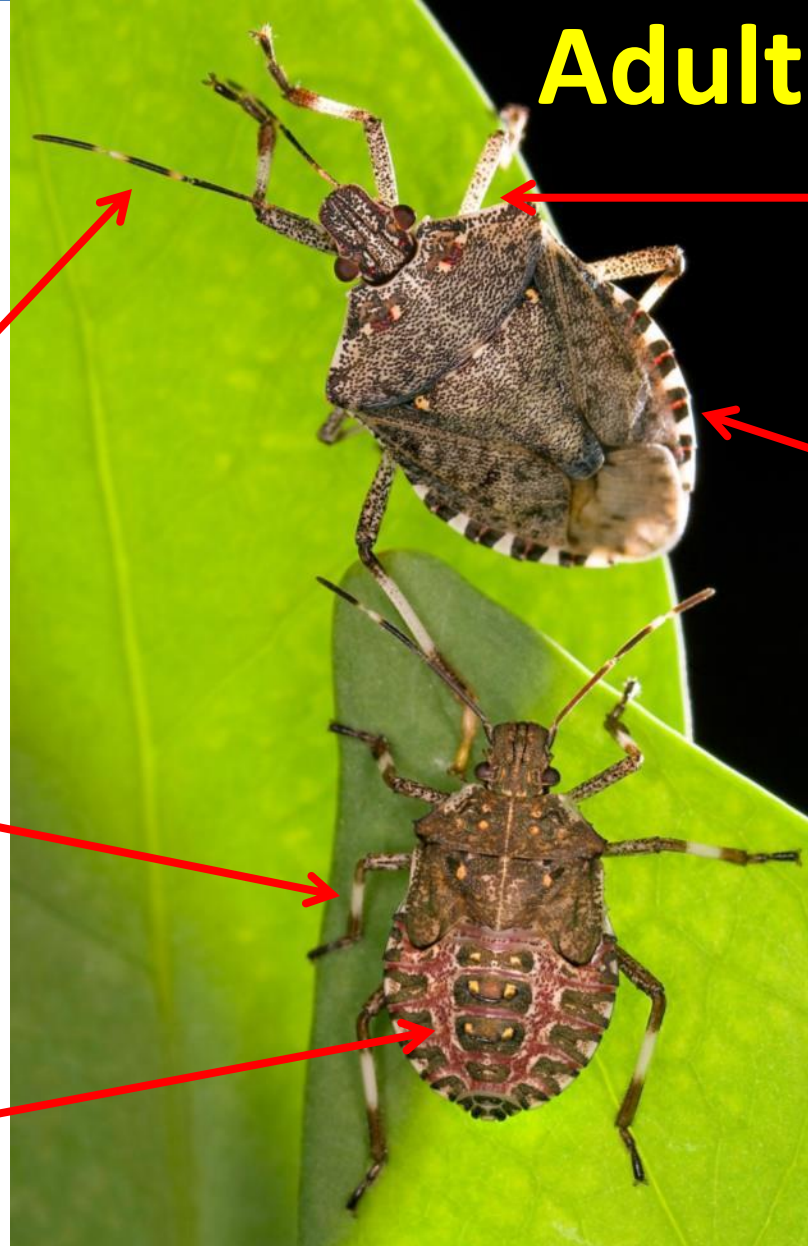
Photos: Baldo Villegas

Adult

Smooth
“shoulder” edges

Banded
abdominal edge
extending
beyond wings

Mature nymph (5th instar)



Actual adult size
1/2 to 5/8 inch

Two white bands
on antennae

Banded legs

Rust color with
broad brown
markings

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



BMSB Damage 2014



Peach



Apricot



Nectarine



Asian pear



Fig



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



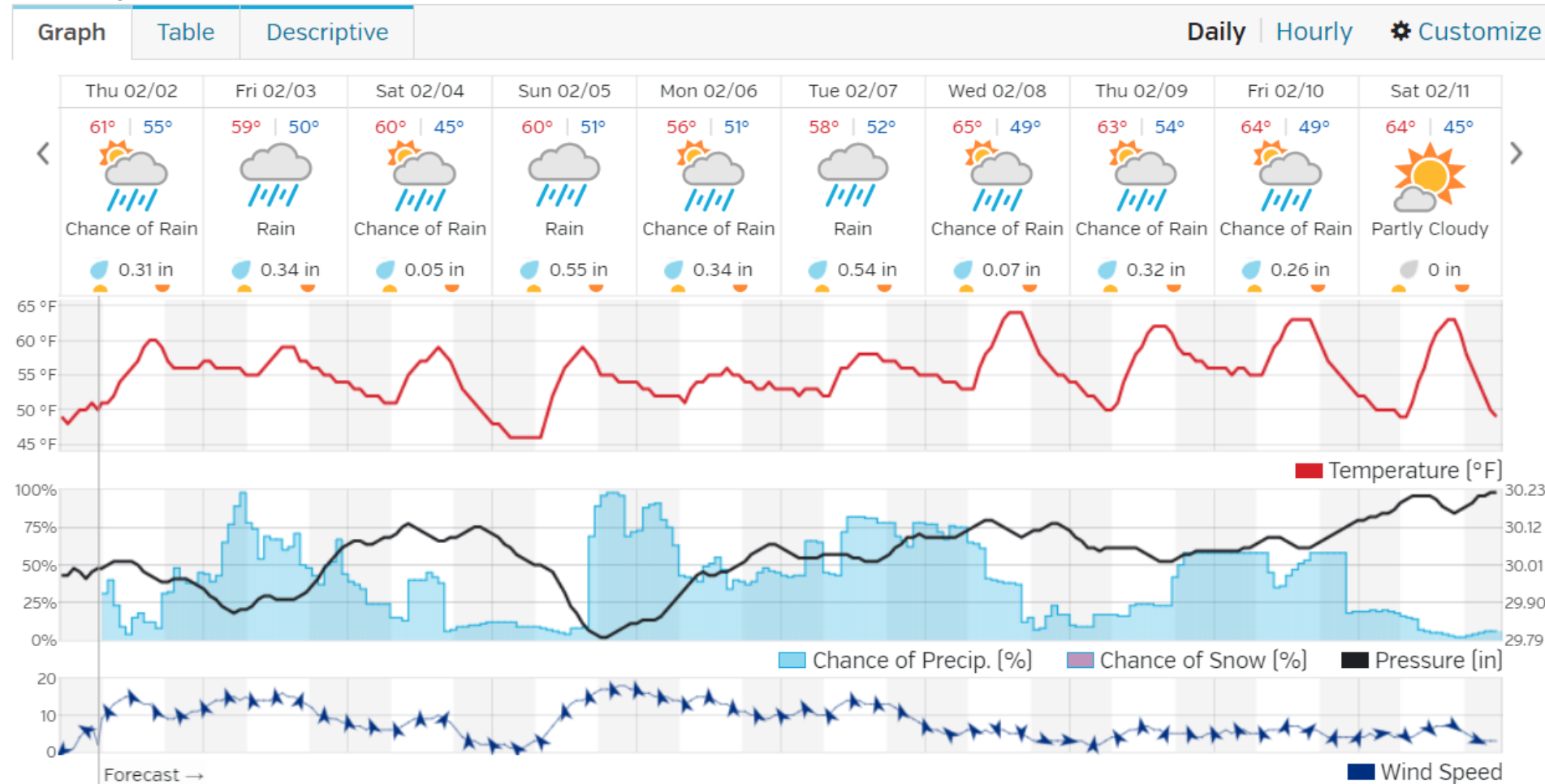
Green tip



Peach Leaf Curl

Why to Also Spray in Fall

10-Day Weather Forecast

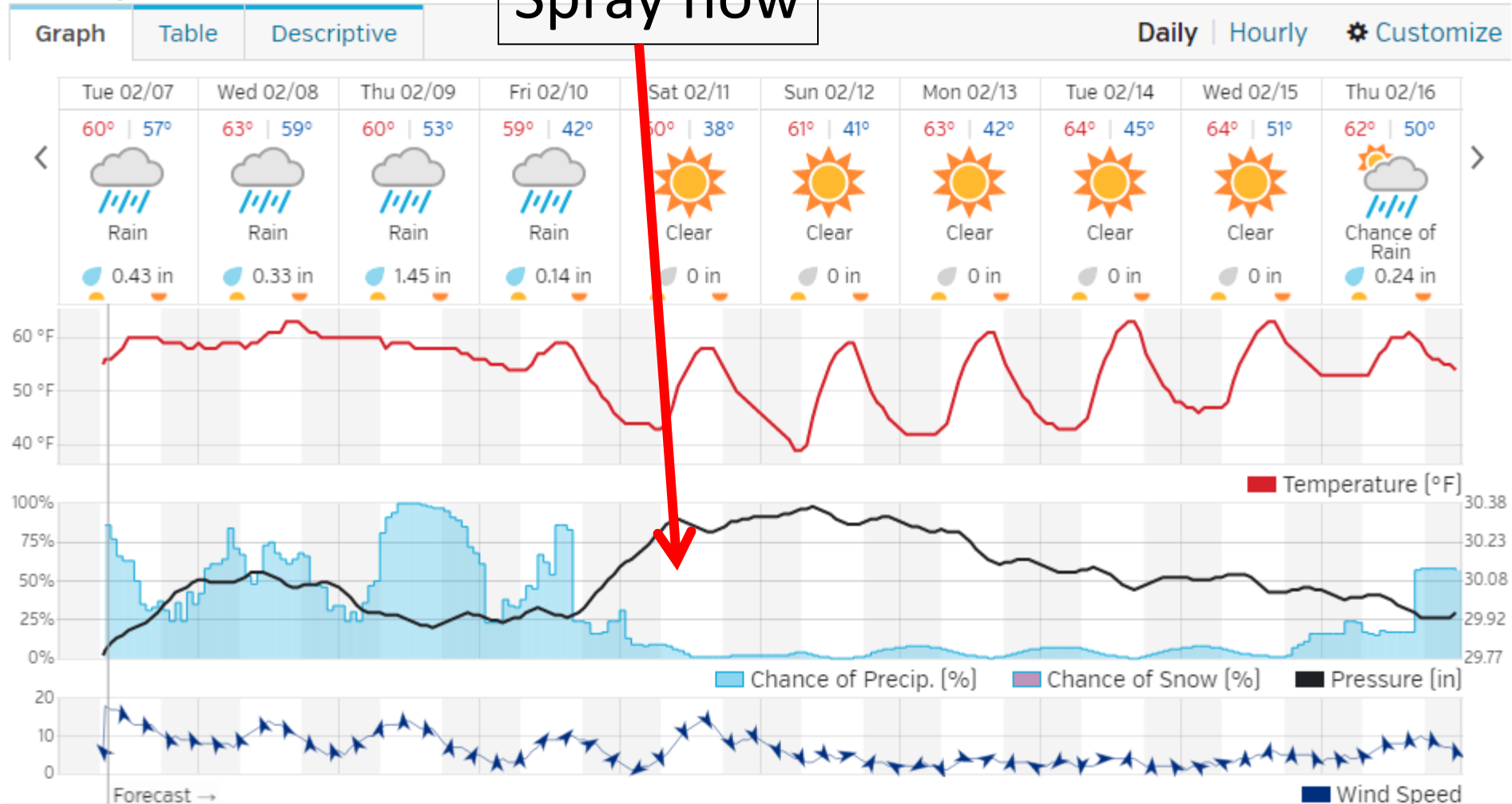


Peach Leaf Curl

Why to Also Spray in Fall

10-Day Weather Forecast

Spray now



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



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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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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





Bacterial Canker Solutions



- 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





Cherry (4th year)

Espalier

Peach
360 fruits (4th year)



Asian Pear Espalier

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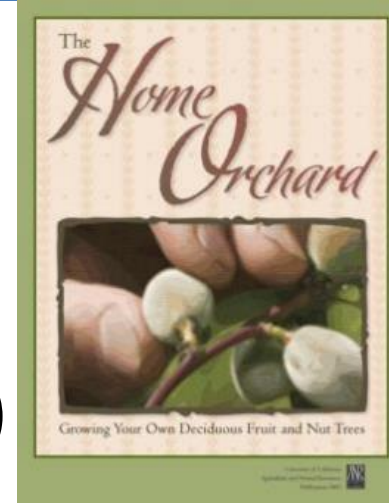
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Questions?

- 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
(<http://extension.wsu.edu/publications/wp-content/uploads/sites/54/publications/em066e.pdf>)
- 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



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Parasitized aphids



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Branch gall



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Woolly Apple Aphid



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Root galls



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Woolly 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



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

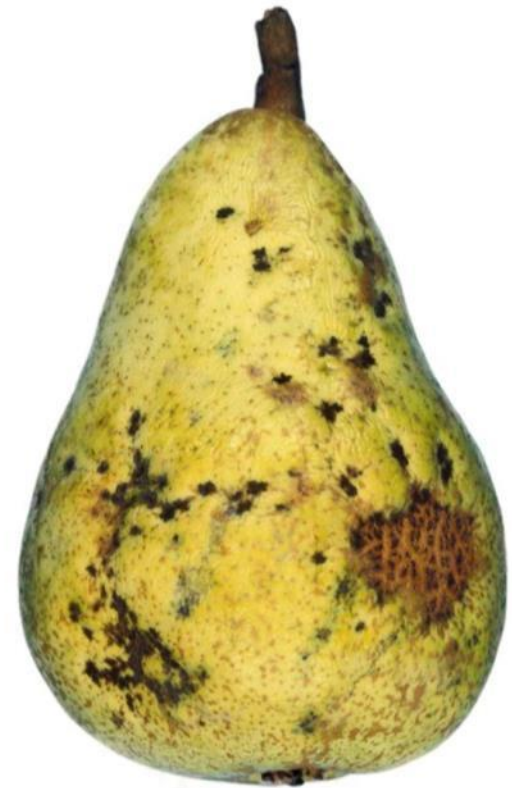
Pear Scab

Venturia pirina



Primary
lesion

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Primary and
secondary lesions



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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



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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

