Bacterial Diseases of Fruit Trees

Steven Swain
Environmental Horticulture Advisor
UCCE Marin & Sonoma Counties
The Diseases

- **Fire blight**
  - *Erwinia amylovora*
  - Common name after the scorched appearance of leaves
  - Pome fruits and relatives only
  - Focus of this talk

- **Bacterial blight**
  - *Pseudomonas syringae*
  - Mostly stone fruits
  - Discuss this as an exception

- **Management**
  - Treatments are often similar for both diseases
  - IPM approach in the landscape will almost certainly be different
## The organism

<table>
<thead>
<tr>
<th><strong>Bacteria</strong></th>
<th><strong>Fungi</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Visible: no?</td>
<td>- Visible: yes?</td>
</tr>
<tr>
<td>- Body: single celled</td>
<td>- Body: multicellular</td>
</tr>
<tr>
<td>- Nucleus: small ring</td>
<td>- Nucleus: multinucleate?</td>
</tr>
<tr>
<td>- Gene transfer: plasmids</td>
<td>- Gene transfer: sex</td>
</tr>
<tr>
<td>- Cell walls: peptidoglycan</td>
<td>- Cell walls: chitin</td>
</tr>
<tr>
<td>- Reproduction: division</td>
<td>- Reproduction: fragmentation, spores</td>
</tr>
<tr>
<td>- Dispersal: cysts, spores? (not Erwinia!)</td>
<td>- Dispersal: spores</td>
</tr>
</tbody>
</table>


The Environment

• Adapted to attacking flowers and new growth
• Active in spring, during bloom
• Really a problem on:
  – Pear & Asian pear
  – Quince
• Other hosts:
  – Apple
  – Loquat
  – Pyracantha
  – Cotoneaster
  – Toyon
  – Photinia
  – Sorbus
The Environment

• Adapted to attacking flowers and new growth
• Active in spring, during bloom
• Really a problem on:
  – Pear & Asian pear
  – Quince
• Other hosts:
  – Apple
  – Loquat
  – Pyracantha
  – Cotoneaster
  – Toyon
  – Photinia
  – Sorbus
The Environment

• Adapted to attacking flowers and new growth
• Active in spring, during bloom
• Really a problem on:
  – Pear & Asian pear
  – Quince
• Other hosts:
  – Apple
  – Loquat
  – Pyracantha
  – Cotoneaster
  – Toyon
  – Photinia
  – Sorbus
The Environment

- Adapted to attacking flowers and new growth
- Active in spring, during bloom
- Really a problem on:
  - Pear & Asian pear
  - Quince
- Other hosts:
  - Apple
  - Loquat
  - Pyracantha
  - Cotoneaster
  - Toyon
  - Photinia
  - Sorbus
The Environment

- Adapted to attacking flowers and new growth
- Active in spring, during bloom
- Really a problem on:
  - Pear & Asian pear
  - Quince
- Other hosts:
  - Apple
  - Loquat
  - Pyracantha
  - Cotoneaster
  - Toyon
  - Photinia
  - Sorbus
The Environment

• Adapted to attacking flowers and new growth
• Active in spring, during bloom
• Really a problem on:
  – Pear & Asian pear
  – Quince
• Other hosts:
  – Apple
  – Loquat
  – Pyracantha
  – Cotoneaster
  – Toyon
  – Photinia
  – Sorbus
The Environment

• Adapted to attacking flowers and new growth
• Active in spring, during bloom
• Really a problem on:
  – Pear & Asian pear
  – Quince
• Other hosts:
  – Apple
  – Loquat
  – Pyracantha
  – Cotoneaster
  – Toyon
  – Photinia
  – Sorbus
The Environment

- Adapted to attacking flowers and new growth
- Active in spring, during bloom
- Really a problem on:
  - Pear & Asian pear
  - Quince
- Other hosts:
  - Apple
  - Loquat
  - Pyracantha
  - Cotoneaster
  - Toyon
  - Photinia
  - Sorbus
The Environment

• Adapted to attacking flowers and new growth
• Active in spring, during bloom
• Really a problem on:
  – Pear & Asian pear
  – Quince
• Other hosts:
  – Apple
  – Loquat
  – Pyracantha
  – Cotoneaster
  – Toyon
  – Photinia
  – Sorbus
primary inoculum (pathogen cells on surfaces of holdover cankers are moved to blossoms via rain and/or insects)

overwintering "holdover" canker

floral epiphytic phase

pathogen multiplies on floral surfaces and is moved flower to flower by bees and rain

secondary infection (shoots, fruits, rootstocks)

secondary inoculum (bacterial ooze on plant surface)

canker expansion

floral infection (primary infection)

Drawing courtesy Vickie Brewster
Conditions for contagion

• Several days of warm temperatures during bloom
  – Temp mediates
    • Bee flights
    • Bacterial reproduction
  – BOTH increase when it’s warm
  – Extensive spread to new trees
  – 50-60°F: meh
  – 60-75°F: warning
  – 75-90°F: BOOM
Conditions for contagion

- Pathogen survives on stigmas
  - Nutrient rich
  - Point of contact for bees
- Three weeks for twig death to occur
Conditions for contagion

- Prolonged rains during leaf flush
  - Spread of cankers to new sites within the same tree
    - Some inter-tree movement may occur in storms
    - This is why pruning cankers out is important
    - Neglected trees get worse
Symptoms

- Dead flowers
  - Sometimes baby fruit
  - Almost always black (brown in apples)
- Blackened leaves still attached
  - Infected through petiole
- Bacterial oozing
- Red streaking in phloem
- These can be challenging to find on some hosts
  - ELISA field tests
Symptoms

- Dead flowers
  - Sometimes baby fruit
  - Almost always black
    (brown in apples)
- Blackened leaves still attached
  - Infected through petiole
- Bacterial oozing
- Red streaking in phloem
- These can be challenging to find on some hosts
  - ELISA field tests
Symptoms

- Dead flowers
  - Sometimes baby fruit
  - Almost always black (brown in apples)
- Blackened leaves still attached
  - Infected through petiole
- Bacterial oozing
- Red streaking in phloem
- These can be challenging to find on some hosts
  - ELISA field tests
Symptoms

- Dead flowers
  - Sometimes baby fruit
  - Almost always black
    (brown in apples)
- Blackened leaves still attached
  - Infected through petiole
- Bacterial oozing
- Red streaking in phloem
- These can be challenging to find on some hosts
  - ELISA field tests
Symptoms

- Dead flowers
  - Sometimes baby fruit
  - Almost always black (brown in apples)
- Blackened leaves still attached
  - Infected through petiole
- Bacterial oozing
- Red streaking in phloem
- These can be challenging to find on some hosts
  - ELISA field test
Symptoms

• Dead flowers
  – Sometimes baby fruit
  – Almost always black (brown in apples)
• Blackened leaves still attached
  – Infected through petiole
• Bacterial oozing
• Red streaking in phloem
• These can be challenging to find on some hosts
  – ELISA field tests
Symptoms

• Dead flowers
  – Sometimes baby fruit
  – Almost always black (brown in apples)

• Blackened leaves still attached
  – Infected through petiole

• Bacterial oozing

• Red streaking in phloem

• These can be challenging to find on some hosts
  – ELISA field test
IPM

• Planning
  – Some landscapes have fire blight problems built in
  – Never mix ornamental pears with other fire blight hosts
    • Cotoneaster
    • Toyon
    • Pyracantha
  – Choose resistant varieties
    • UC IPM
    • Commercial grower sites (e.g. Dave Wilson Nurseries)
IPM

• Planning
  – Some landscapes have fire blight problems built in
  – Never mix ornamental pears with other fire blight hosts
    • Cotoneaster
    • Toyon
    • Pyracantha
  – Choose resistant varieties
    • UC IPM
    • Commercial grower sites (e.g: Dave Wilson Nurseries)
IPM

- Pruning
  - Spring:
    - Less time to spread
    - Clearer delineation of extent
    - Possible reinfection
  - Fall:
    - Lower contamination risk
    - Bigger cuts required
  - Disinfection of tools
- Stuff UC IPM doesn’t tell you
- No fertilizer
- Flower thinning
  - But this gets done with Bordeaux mixture …
- Blowtorch
- Resistant rootstocks (?)
  - Won’t keep your tree looking good
  - Will help prevent spread into the trunk
IPM

• Sprays
  – Copper
    • Repeat every 2-3 days while humidity is high
    • 5-20 applications / year?
  – Bordeaux mixture?
    • Mix it yourself!
    • Burns stigmas
IPM

• Antibiotics
  – Kasugamycin (new)
  – Oxytetracycline
  – Streptomycin
  – Spray every 2-5 days
    • Up to ~ 80% effective
  – Affect all epiphytic bacteria
  – Remember plasmids?
  – Resistance management
IPM

• Biological bactericides
  – Bacillus subtilis
    – Rhapsody
    – Serenade
  – Streptomyces lydicus
    – Actinovate
  – Pseudomonas fluorescens
    – Blight ban
  – Others
  – Application frequency (2-5 days)
  – Landscape efficacy?
IPM

- **SAR’s**
  - Acibenzinol S-methyl
  - Mimics salicylic acid in plant
  - Primes plant immune system
  - Smaller response than antibiotic
  - Lasts longer (1 week)
  - Efficacy approaches antibiotics

- **Phosphonates**
  - AgriFos
  - Reliant
  - Aliette
  - Not a stand alone treatment
  - Some studies suggest near zero efficacy
IPM

• Concern about the long-term viability of pear orchards in Lake County
• We aren’t orchards
  – Monoculture
  – Relevance of orchard-derived research?
  – They can get 80% control using IPM programs
Bacterial blight

• Doesn’t move on bees
• Freeze specialist, entering frost damaged tissue after thaw  
  – Late frosts
• Looks like abiotic frost damage  
  – Not as uniform  
  – More host specific
• Ice nucleator  
  – Via hydrophilic & hydrophobic proteins  
  – Snomax is so effective it’s used by ski resorts
Bacterial Blight Management

• Similar to fireblight
  – Copper kills bacteria
  – Prune out damaged twigs
• Keep plants hydrated
• Larger host list
• Less common in Marin
• Some forms are epiphytes, not pathogens
  – Pseudomonas “Ice minus”
    • Frostban (GMO)
Landscape Summary

• Blight Mgmt fundamentals:
  – Planning
    • Global warming
  – Pruning

• If damage to foundation plants is unacceptable
  – Remove alternate hosts and/or replant with resistant varietals

• If you wait to prune, infections may move into the trunk
  – How do you prune this out?

• Sprays work best as prophylactics
  – Cost?
  – Efficacy?
  – Do SAR compounds retain efficacy in the landscape?
Resources

- UC IPM website: [http://ipm.ucanr.edu/](http://ipm.ucanr.edu/)
- Presentation will be on-line at: [http://ucanr.edu/MarinIPM](http://ucanr.edu/MarinIPM)
- Steven Swain: svswain@ucanr.edu
  415 473 4226