Fireblight: Disease Development on Mayhaw and Available Treatments

- Dr. Charles J. Graham
- Noble Research Institute
- Ardmore, OK

It takes 3 things for you to have a Fire Blight outbreak:

- **The pathogen to be present.**
- **Warm conditions and humidity that favor disease development.**
- **A susceptible host.**

Fire Blight

Electron micrograph of an *Erwinia* cell showing peritrichous flagella. (Courtesy Oregon State University)

Erwinia amylovora cells are:

Gram negative
Rod shaped
Measure 0.6-0.9 X 1.1-1.6 μm
Flagellated on all sides (*peritrichous*)

Temperature Affects:

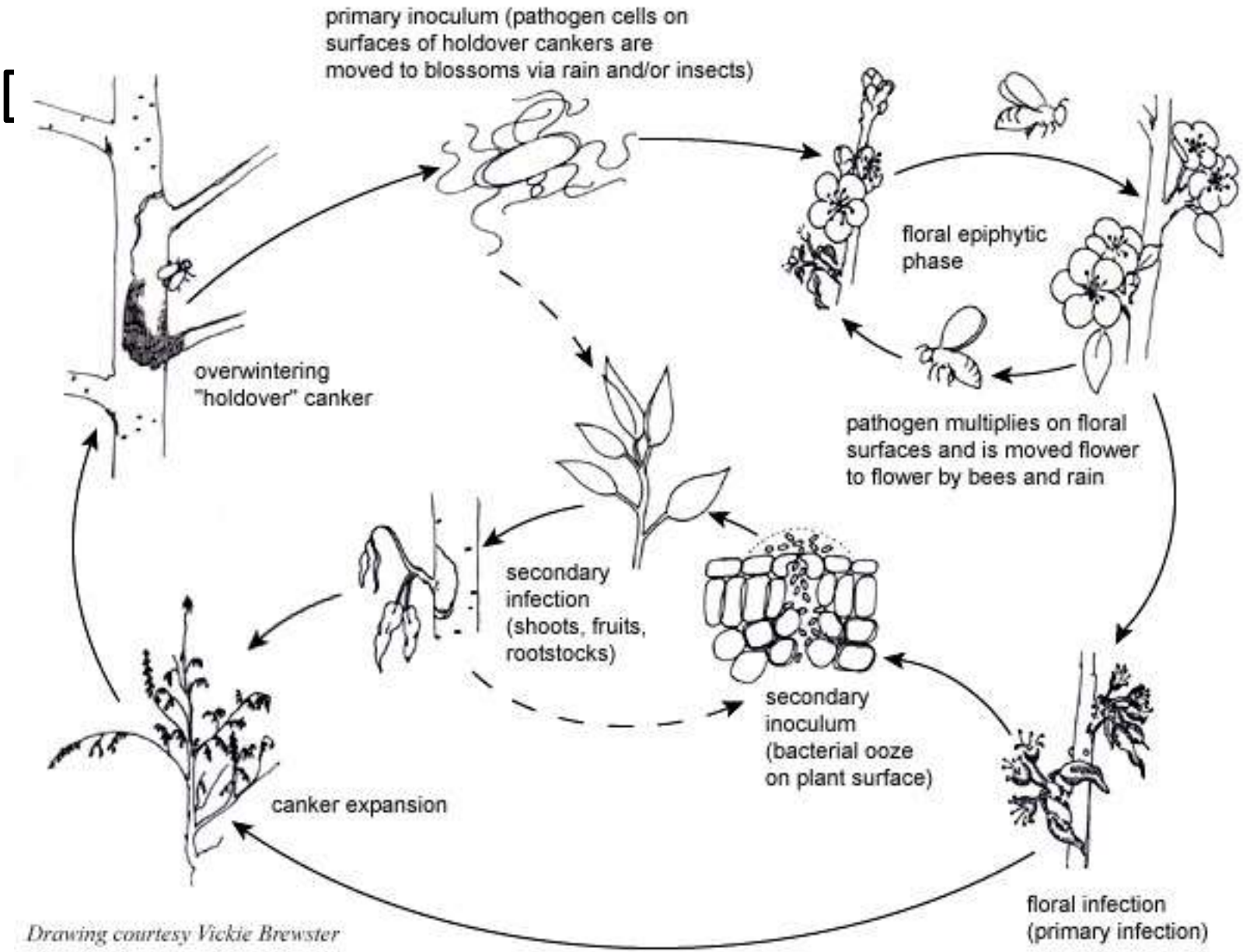
- Cell division is minimal below 50° F
- Very slow between 50° F and 70° F
- At temperatures above 70° F, the rate of cell division increases rapidly
- Optimum temperature for growth is 81° F.
- At temperatures above 95° F, population will generally decrease.

Host Range

Erwinia amylovora **has a wide host range with over 200 species being affected within Rosacea and Rubus.**

On Mayhaws, Fire Blight Symptoms Will Occur On:

- **Blossoms**
- **Fruits**
- **Shoots**
- **Branches and limbs**
- **In the rootstock near the graft union**


primary inoculum (pathogen cells on surfaces of holdover cankers are moved to blossoms via rain and/or insects)
floral epiphytic phase
overwintering "holdover" canker
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

Disease Cycle and Transmission:

Fire blight bacteria survive the winter primarily in the canker margins where healthy tissue intermingles with diseased tissue. 1/5 to 1/2 of the overwintering cankers will have surviving bacterial cells each year.

As temperatures warm in the spring, the cankers begin to ooze bacterial cells, which attracts bees, flies, and other insects.

Pathogen cells are transferred to flowers by these insects or by splashing from windblown rain. Upon contacting the nutrient rich stigmas, the bacterial cells multiply rapidly at temperatures between 70-90° F.

Disease Cycle and Transmission:

After the stigma has been colonized by high numbers of bacterial cells, the colony is washed down into the floral cup by rain, heavy dew, or irrigation sprinklers.

The bacteria can then invade the flower through the nectaries. Rain and insects can move the bacteria from infected flowers to uninfected flowers

Disease Cycle and Transmission:

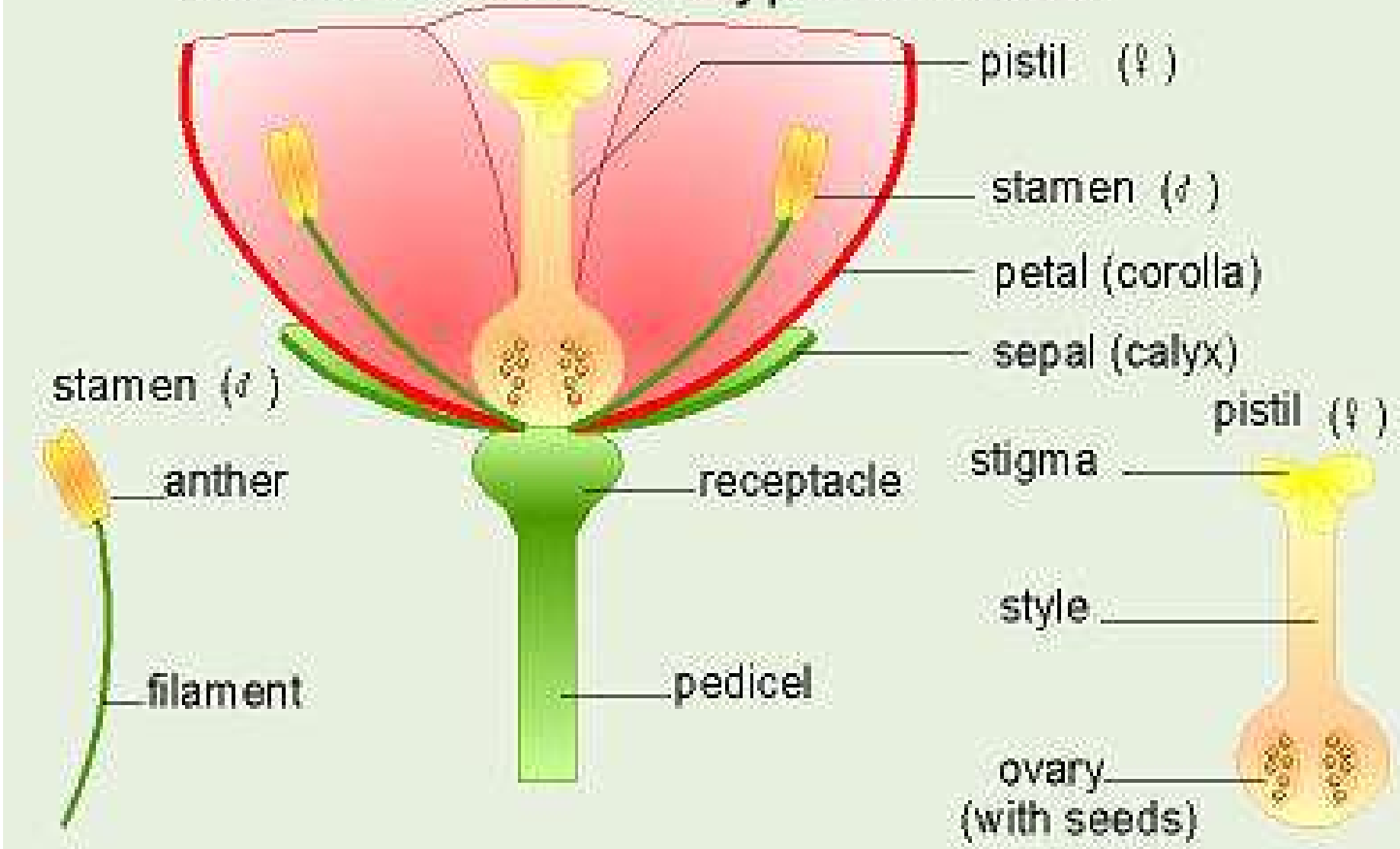
After infecting the fruit, the bacteria can move into the cambium, killing succulent tissue as it spreads, developing characteristic cankers and strikes.

Pathogen cells migrate inside the tree well ahead of visible symptoms. They can accumulate in one-year-old shoot tips and susceptible rootstocks, resulting in infections well removed from the initial infection site.

Symptoms

ANGIOSPERM FLOWERS

Cross Section of Typical Flower



Flower Symptoms:

Following infection, symptoms will develop within one to two weeks.

The floral receptacle, ovary, and peduncles develop a water-soaked appearance which transitions to a dull, grayish green.

Under high humidity, it is not uncommon for small droplets of bacterial ooze to exude from the infected tissue.


Bloom symptoms 12
days after infection.
Photo: T. Dupont, WSU.

Shoot Symptoms:

Shoot tips may rapidly wilt before becoming necrotic forming what is commonly referred to as a "Shepherd's crook"

The midrib of the leaf will generally darken before the entire leaf becomes necrotic, with the leaves staying attached to the shoot.

When multiple shoots die, the overall tree appearance has a burnt, blighted appearance.

Fire Blight

Shepherd's-crook Symptom

Rootstock infections:

Usually develop near the graft union as a result of internal movement of the pathogen through the tree or from infections through water sprouts or bur knots.

Bark may show water soaking, a purplish to black discoloration, cracking, and signs of bacterial ooze.

Dark streaking can occur in the wood under the bark.

Fire Blight

Fire blight severity ratings

(based on 3 or more trees)

Disease was rated visually on a 0-4 scale where

0 = 0%

1 = < 5%

2 = 5-10%

3 = 10-25%

4 = > 25%

of the shoots/spurs were blighted.

Cultivar	Rating	(# trees)
Elite	1.22	(9)
Super Spur	1.75	(8)
Heavy	2.00	(3)
Big Red	2.20	(5)
Cajun	2.36	(7)
Crimson	2.40	(5)
Royalty	2.75	(4)
Texas Star	3.12	(25)
Royal Star (G5)	3.75	(4)

Disclaimer: These disease severity ratings are very subjective because of the small numbers of trees evaluated. Also, location within the orchard and proximity to susceptible varieties may have skewed the results. However, it does give a starting point for further evaluations.

Cultural Controls

Considerations for Fire Blight Management

- **Plant only more resistant varieties, but also graft scion onto only the most resistant rootstock.**

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Fire blight severity ratings

(based on single trees)

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of the shoots/spurs were blighted.

Cultivar	Rating
Big V	1
Blaze Star	1
Classy	1
Gem	1
Goliath	1
Maxine	1
Reliable	1
Spectacular (G2)	1
Styro	1
Vernon	1
Warren Otega	1
Winnie #1	1
Winnie #10	1
Winnie #5	2
Charlie Johnson	3
Mason	3
Saline	3
Radiant Red	4
Double G	Susc.
Red Majesty (W23)	Very Susc.

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- Plant varieties that flower at the same time in blocks to facilitate spraying.
- Pruning is of paramount importance in reducing fire blight infections in existing orchards.

Orchard Production of Mayhaws

Pruning Infected Trees:

Cankers are areas of dead tissue. There are other types of cankers but fire blight cankers are reasonably easy to identify. They are greyish, lavenderish and sometimes almost black. The tissue may be somewhat sunken and cracked. It is best to prune the cankers before the tree is shaped for structure, and remove the blighted prunings from the orchard as they can be a source of pathogen cells in spring. Compared to cuts made in summer, winter removal cuts can be made closer to the visible canker edge because the pathogen is confined to the cankered area. Cut at the next "horticulturally sensible" site below the canker. You do not need to sterilize tools when you are cutting on fully dormant trees. Focus your efforts in blocks where you had fire blight last year.

Canker on apple.
Photo: T. Dupont, WSU

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- Don't overfertilize or prune excessively, keep tree vigor at a moderate level.

Chemical Controls

Chemical Control

When are you at risk for a fire blight infection outbreak?

Any time there are flowers on the tree, the weather is warm, and wetting occurs. Watch for and protect secondary blossoms during the three weeks after petal fall, which is the most common time of fire blight infection.

Most sprays only protect the blooms that are open. Protect new blooms as they open. In warm weather, follow-up sprays are needed every few days.

Chemical Control

- Antibiotics
- Copper Compounds
- Biological
- SAR Products

Antibiotics

Antibiotics

- **Kasugamycin – Tradename Kansumin**
- **Oxytetracycline – Tradenames Mycoshield, Fireline**
- **Streptomycin – Tradenames Agri-Mycin, Firewall**

Antibiotics

- **Kasugamycin – Labeled, but 90 PHI**
- **Oxytetracycline – Not labeled**
- **Streptomycin – Not labeled**

Antibiotics

- **So Kasugamycin won't work for *C. opaca* and *C. aestivalus*, but potentially could be used on Turkey Haw.**

Copper Compounds

Copper Sprays for Mayhaw

Copper sprays control plant pathogens because copper ions denature proteins, thereby destroying enzymes that are critical for cell functioning.

Copper can kill pathogen cells on plant surfaces, but once a pathogen enters host tissue, it will no longer be susceptible to copper treatments.

Thus, copper sprays act as protectant fungicide/bactericide treatment, but lacks postinfection activity."

Copper Sprays for Mayhaw

One way to avoid plant injury is to limit the copper ion concentration on plant surfaces by using copper products that are relatively insoluble in water.

Because of its high solubility in water, copper sulfate can cause phytotoxicity even at relatively low application rates.

The high solubility also means that copper sulfate residues can be rapidly removed by rainfall.

Copper Sprays for Mayhaw

"Copper products registered for tree fruits are almost all fixed coppers that have low solubility in water.

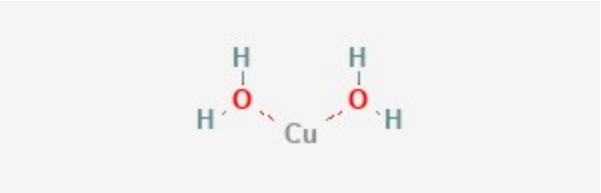
When mixed with water, the spray solution is actually a suspension of copper particles, and those particles persist on plant surfaces after the spray dries.

Copper ions are gradually released from these copper deposits each time the plant surface becomes wet. The gradual release of copper ions from the copper deposits provides residual protection against plant pathogens. At the same time, the slow release of copper ions from these relatively insoluble copper deposits reduces risks of phytotoxicity to plant tissues."

Copper Sprays for Mayhaw

Fixed coppers include basic copper sulfate (e.g., Cuprofix Ultra Disperss), copper oxide (e.g., Nordox), copper hydroxide (e.g., Kocide, Champ), copper oxychloride sulfate (e.g., COCS), and copper ions linked to fatty acids or other organic molecules (e.g., TennCop, Cueva).

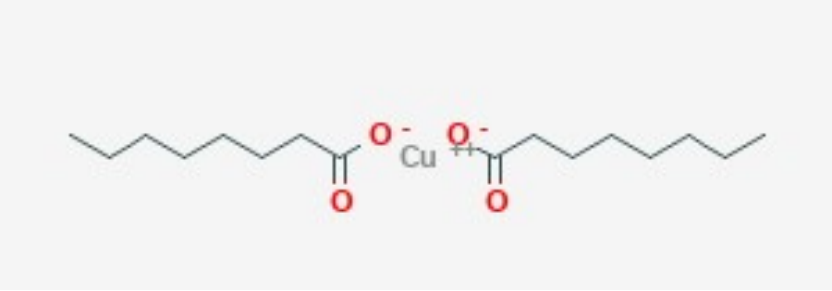
Coppers



“Fixed” (copper hydroxides, copper oxychlorides)

- copper products have a longer residual time and are generally used for delayed dormant (green tip) in bearing orchards and summer shoot blight protection in non-bearing (young) orchards.
- In fixed coppers, most of the copper is insoluble with soluble copper ions released slowly over time.
- Copper is toxic to plants when a sufficient concentration of ions penetrates tissue. Growers should avoid spray additives such as foliar nutrients and surfactants when applying coppers.
- Fixed-coppers should not be used with Imidan, Sevin, Thiodan, Captan, or phosophorus acid compounds (Fosphite, Prophyt, Phostrol, Agri-Fos, Alliete) (Shane and Sundin 2011).

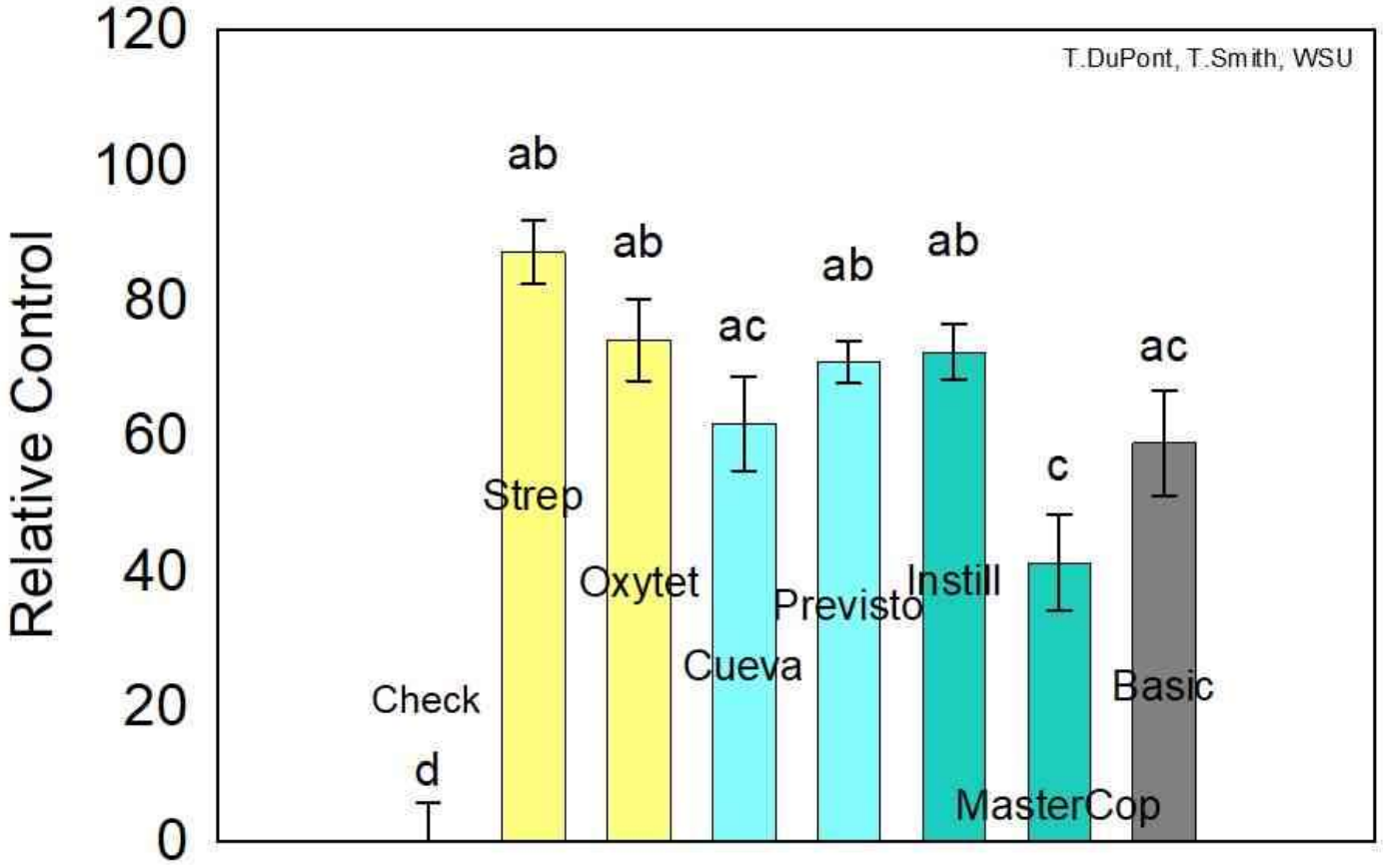
Coppers



“Soluble” (copper octanoate, copper oxychlorides)

- Newer copper formulations are designed to reduce copper phytotoxicity and fruit russeting potential by introducing far few copper ions to the plant surface and adding safeners that also reduce injury potential.
- Cueva (copper octanoate), which is a salt of copper and a fatty acid (copper soap), .
- Previsto, which is copper ions in a matrix with alginate (polymer from seaweed).
- Both Cueva and Previsto have shown little phytotoxicity in semi-arid conditions but have shown some risk of russeting in wetter areas. Cueva is compatible in tank-mixes with *Bacillus*-based biopesticides, while Previsto is not due to its high pH.

Coppers



WSU Trials 2013, 2014, 2016, 2017. Cueva (copper octanoate) 3-5 qt; Previsto (copper hydroxide) 3-5 qt; Instill (copper sulfate pentahydrate) 1-1.85 qt; Mastercop (copper sulfate pentahydrat) 0.25-1.25 qt; Basic coppers Champ, Kocide (0.5 lb), Badge (1.25 pt). Rates 100 gall/Acre.

Biological Controls

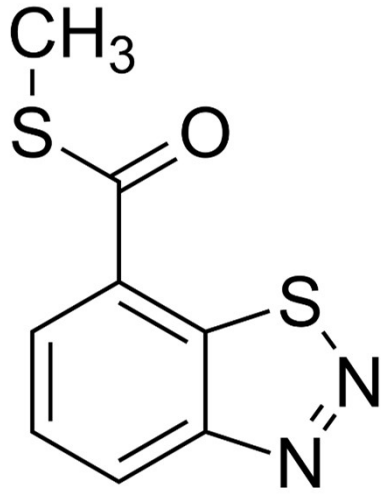
Biofungicides/Biobacteriacides

- **Actinovate AG – *Streptomyces lydicus***
- **Blossom Protect - *Aureobasidium pullulans***
- **BotryStop – *Ulocladium oudemansii***
- **Serifel – *Bacillus amyloliquefaciens***
- **Serenade Opti – *Bacillus subtillis***

Biological Products.

When applied to open flowers, these micro-organisms produce colonies on the stigma surfaces and nectary, and compete directing with the fire blight pathogen for the nutritional resource available on these surfaces. With biological materials (e.g., Blossom Protect), spray treatments need to be initiated relatively early in the bloom period before high fire blight risk has developed.

SARs

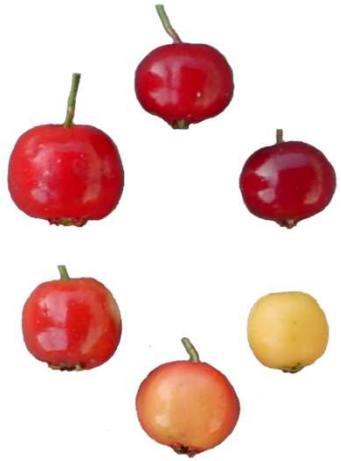


Acibenzolar-S-methyl (ASM, Actigard 50 WG),

A synthetic inducer of systemic acquired resistance (SAR). Its mode of action is to mimic the plant hormone, salicylic acid, which is responsible for priming the plant's defense system. The level of protection is smaller compared to an antibiotic but it lasts longer, approximately a week (Maxson-Stein et al. 2002).

- Pome Crop Group 11-10: Apple; azarole; crabapple; loquat; mayhaw; medlar; pear; pear, Asian; quince; quince, Chinese; quince, Japanese; tejocote; cultivars, varieties, and/or hybrids of these

Actigard 50 WG



Application Rate: 1-2 oz/Acre

- Foliar Application: For best results for suppression and to improve activity of standard products, apply Actigard in a tank mix with antibiotic products.
- Apply 1 - 2 oz/A in a tank mix with a fire blight treatment (generally an antibiotic) that is standard in your area. This is generally 2-3 applications between 20% bloom and petal fall depending on the environmental conditions. Do not apply closer than a 7 day interval.

- **60 day PHI**

Actigard 50 WG

Application Rate: 0.0012-0.035 oz/tree.

- Soil applications via drench or chemigation:
- Begin applications at green tip.
- Drench Application: Apply as a drench in the desired amount of the mix solution (8-16 fl oz of solution) around the base of the tree – within the first 4-6 inches around the tree.
- NOTE: Lower rates are recommended for younger trees while higher rates for trees over 4 years old. Refer to Table 1 below to determine amount of Actigard in solution needed. Do not exceed 3.2 oz/A/application at any time.

- **0 day PHI**

Other SAR Compounds

- **Linebacker WDG – *Aluminum tris***
  PHI = 14 days
- **K-Phite 7LP – *potassium phosphonate***
  PHI = 0 days
- **Rampart – *potassium phosphonate***
  PHI = 0 days
- **Regalia – Extract of *Reynoutria sachalinensis***
  PHI = 0 days
- **Vacciplant – Extract of *Laminaria digitate***
  PHI = 0 days

Antisense Peptide Nucleic Acid-Cell Penetrating Peptide.

This PNA breaks into the cells of the bad bacteria and scans the bacteria's DNA to find the essential gene that keeps the bacteria alive. This antibiotic can be made to kill only the bad bacteria, unlike others which kill both good and bad. So, they will come and bind to those essential genes, and once the essential genes are bound by these molecules, those genes will be destroyed

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