DISEASES

Fire Blight

no. 2.907

by R.D. Koski and W.R. Jacobi[1] (10/09)

Quick Facts...

Fire blight is a bacterial disease that can kill branches and whole plants of many members of the rose family, including apple, pear, quince and crabapple.

Symptoms include dead branches, water-soaked blossoms, light brown to blackened leaves, discolored bark, black "shepherd's crook" twigs, and dried fruits.

Fire blight bacteria can be spread by insects, splashing rain or contaminated pruning tools.

Management includes resistant varieties, cultural practices, pruning and preventive chemical sprays.

Fire blight is a bacterial disease that affects certain species in the rose family (Rosaceae). It is especially destructive to apples (*Malus* spp.), pears (*Pyrus* spp.), and crabapples (*Malus* spp.). The disease also can occur on serviceberries (*Amelanchier* spp.), flowering quinces (*Chaenolmeles* spp.), cotoneasters *(Cotoneaster* spp.), hawthorns (*Crataegus* spp.), quinces (*Cydonia* spp.), pyracanthas (*Pyracantha* spp.), blackberries (*Rubus* spp.), raspberries (*Rubus* spp.), and mountain ashes (*Sorbus* spp.).

Disease incidence varies from year to year and severity is influenced by cultivar susceptibility, tree age, succulence of tissues and spring meteorological conditions. The disease is most serious when spring temperatures during pre-bloom and bloom are warmer than average. Warm rainy springs are particularly conducive to rapid spread of the pathogen, resulting in blossom blight. Blight of twig terminals can occur in late May through June during wind driven rain events. Hail and wind damage provide wounds that allow the pathogen to enter at other times. Hot summer weather generally slows or stops the disease.

Disease Cycle

Fire blight is caused by the bacterium *Erwinia amylovora.* The bacteria overwinter in blighted branches and at the edge of cankers (areas of bark killed by bacteria) (Figure 1). In spring, when temperatures frequently reach 65 F, the bacteria multiply rapidly.

Masses of bacteria are forced through cracks and bark pores to the bark surface, where they form a sweet, gummy exudate called bacterial ooze. Insects such as aphids, ants, bees, beetles, and flies, are attracted to this ooze, pick up the bacteria on their bodies, and inadvertently carry the bacteria to opening blossoms. Bacterial ooze splashed by rain can also spread the pathogen.

Once in the blossom, bacteria multiply rapidly in the nectar and eventually enter the flower tissue. From the flower, the bacteria move into the branch. When the bacteria invade and kill the cambial tissue of the branch, all flowers, leaves and fruit above the girdled area die.

Infection also can take place through natural openings in leaves (stomata), branches (lenticels), pruning wounds, insect feeding and ovipositing, and hail. Droplets of bacterial ooze can form on twigs within three days after infection.

Diagnosis

Symptoms of fire blight are first seen about the time of petal fall. Infected blossoms appear water-soaked and wilt rapidly before turning dark brown; this phase of the disease is referred to as blossom blight. As the bacterial invasion

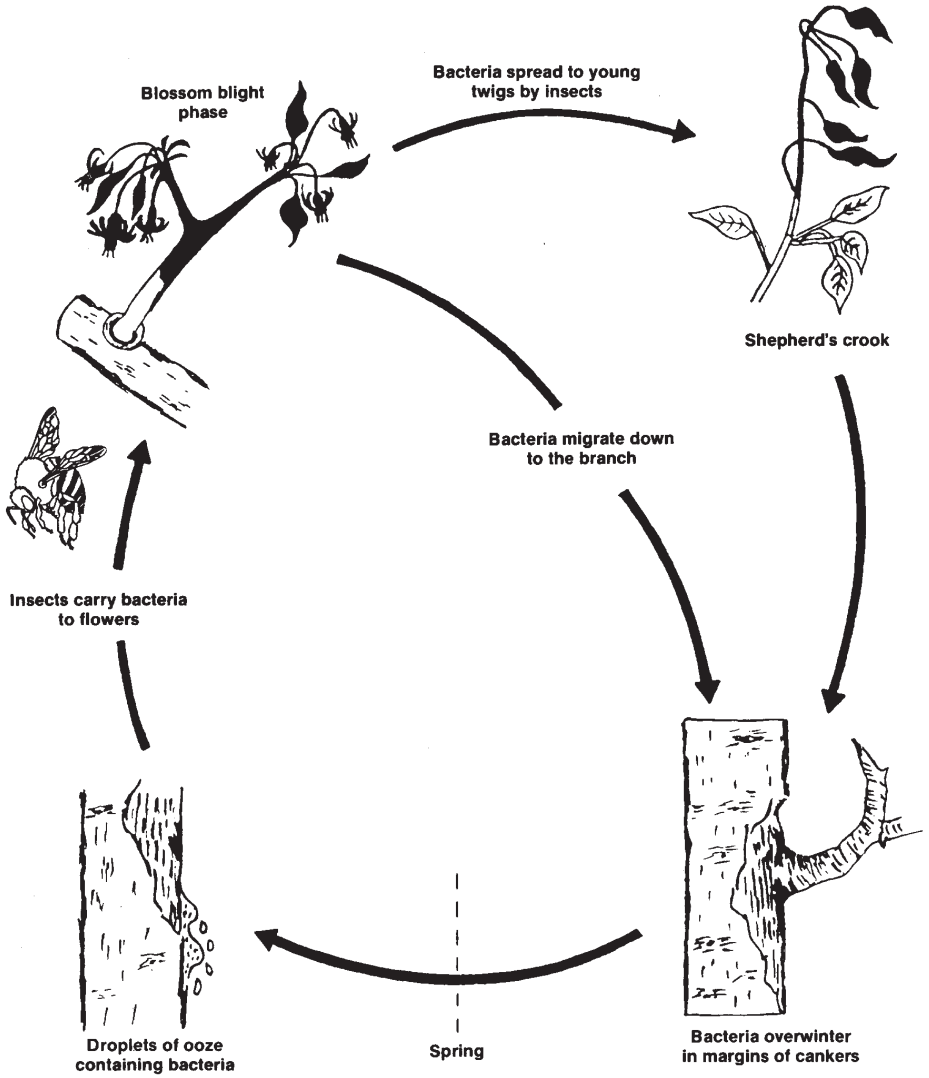

Figure 1: Fire blight life cycle.

progresses, leaves wilt, darken and remain attached to the tree (Figure 2); this gives the tree a fire-scorched appearance, thus the name "fire blight."

Infected twigs darken and branch tips may bend over forming a "shepherd's crook." During wet conditions infected tissue may exude creamy bacterial ooze in droplets or fine, hair-like strands. Infected fruits also exude bacterial ooze. Rather than dropping from the tree, infected fruits gradually dry and remain attached to the branch.

Figure 2: Blighted leaves on ornamental apple.

Fire blight cankers on branches or stems appear as dark discolored areas that are slightly sunken, with a narrow callus ridge along the outer edge (Figure 3). The narrow callus ridge is diagnostic for differentiating fire blight cankers from fungal cankers. Under the bark associated with a canker, the inner bark turns from green to brown, but the appearance varies depending on plant variety. Droplets of bacterial ooze may appear on the canker.

Disease Management

There is no cure for this disease, so prevention is the best solution for the management of fire blight. Fire blight management methods include: planting resistant varieties, implementing cultural practices that favor growth of the plant rather than the pathogen, pruning to remove infected plant parts, and chemical sprays. Using resistant varieties is the most effective prevention method. Spraying chemicals is not recommended for homeowners because of chemical

Figure 3: Sunken black canker on apple branch.

availability, potential phytoxicity and the critical timing of sprays.

Resistant varieties: Cultivars of apple, crabapple, and pear differ in their degree of susceptibility to the bacterium (Table 1) although some cultivars are less susceptible than others, no cultivar is immune to infection when the pathogen is abundant and conditions are favorable for infection. Avoid blight susceptible apple rootstocks especially when grafted to susceptible scions (Table 2). To minimize stress that may predispose the tree to other disease-causing agents, select varieties adapted to the growing area. Local weather conditions from year to year also affect the amount of fire blight found in a variety.

Cultural practices: Minimizing rapid growth and succulent tissue will reduce the risk of fire blight developing on the susceptible young, succulent tissue. Annual pruning with avoidance of major cuts will help minimize tree vigor. Similarly, limiting the amount of nitrogen fertilizer will reduce twig terminal growth. Fertilization should be based on the results of foliar and/or soil nutrient analysis and should not be applied in excess.

Pruning: Remove all blighted twigs and cankered branches. Prune twigs and branches 8 to 12 inches below the edge of visible infection. CAUTION! After each cut, surface sterilize all tools used in pruning. Dip tools in household bleach or ethyl alcohol, or use household spray disinfectants. Spreading the blight bacteria risk is lowered if pruning is delayed until mid winter. Winter pruning can also be accomplished more efficiently because pruning tools need not be disinfected between cuts if pruning is done when trees are fully dormant. To decrease the chance of new infections, promptly remove from the site and destroy all infected branches.

To remove a canker that does not extend more than 50 percent around a large stem, first make a cut through the bark down to the wood 1 to 2 inches outside the canker margin. The cut should not have any sharp angles. Next, cut and scrape away all infected bark down to the wood. Treat exposed wounds with a 70 percent alcohol solution. The whole stem should be removed if a canker extends around more than 50 percent of the stem.

During pruning, take care to avoid unnecessary wounds to the tree. When climbing trees, wear soft-soled shoes to prevent bark injuries.

Remove fire blight infected branches during summer if one or more of the following conditions exist:

- Infections are in young, vigorous trees and the bacteria may girdle the main stem or main branches.
- Infections are in dwarfing trees on highly sensitive rootstocks, such as M.9 or M.26.
- The number of infections in older trees is limited and can easily be removed.
- It is a dry, sunny day when there is no chance of rain for 48 hours.

Chemical sprays: Chemical sprays are preventive treatments that must be applied prior to the onset of fire blight symptoms; sprays have little effect after the onset of symptoms. Expect blossom infections and plan to apply chemical sprays if: temperatures remain between 65 F and 86 F for a day or more during flower bloom, there is at least a trace of rainfall, the relative humidity remains above 60 percent for 24 hours, there is abundant succulent shoot growth, or there are fruit injuries from hail or other agents. For specific instruction on sprays and timing please use the Midwest Tree Fruit Spray Guide at www.extension.iastate.edu/Publications/PM1282.pdf. The chemicals may be sold on various trade names.

Streptomycin is an antibiotic that is acceptable for use to protect trees but may be difficult to obtain. Do not use streptomycin after symptom development since it may lead to antibiotic resistance in the bacterial population.

Always follow label directions for any pesticide. For updated spray rates and related information, consult the Midwest Tree Fruit Spray Guide, your Colorado State University Extension county office and other resources.

Aluminum tris is a bactericide used prior to and during bloom.

Copper sprays are toxic to many species of bacteria. Copper sprays are best used during dormancy and prior to bud break because they may damage leaves and young fruit. Do not apply sprays within 50 days of apple harvest or within 30 days of pear harvest. Do not mix with oils or phytotoxicity issues can occur. Copper is available in several forms and sold under various trade names, including Bordeaux mixture.

Prohexadione-calcium is a plant growth regulator that reduces longitudinal shoot growth by inhibiting gibberellin biosynthesis. Prohexadione-calcium does not possess antibacterial activity but alters host biochemistry and tissues in ways that are not favorable for infection by E. amylovora. The length of time that shoot growth is inhibited depends on the application rate and tree vigor. Prohexadione-calcium is ineffective for control of the blossom blight phase of fire blight.

Biocontrol: Blight Ban is a formulation of the bacteria Pseudomonas fluorescens, strain A506, and is effective in controlling the growth of the fire blight bacterium when applied before and during bloom. It is available only in quantities for commercial application. Effectiveness of control by Blight Ban is dependent on proper application timing.

Additional Information

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Beckerman, Janna. 2006. *Disease Susceptibility of Common Apple Cultivars.* Purdue University, Purdue Extension Publication BP-132-W. Available online at: www.ces.purdue.edu/extmedia/BP/BP-132-W.pdf. This publication contains an extensive list of apple and edible crabapple cultivars and cultivar susceptibility to common diseases, including fire blight.

Table 1: Varietal susceptibility to fire blight.

	Degree of Susceptibility		
Host	**Highly Susceptable**	**Moderately Susceptable**	**Moderately Resistant**
Apple	Baldwin*	Baldwin*	Arkansas Black
Malus pumila	Barry	Beacon*	Ace Delicious
	Beacon*	Belle de Boskoop	Akane
	Ben Davis	Blushing Golden	Britemac
	Binet Rouge	Cortland*	Carroll
	Black Twig	Discovery	Cascade Spur Delicious
	Braeburn	Delbarestival	Classic Delicious
	Brown Snout	Dutchess	Cox's Orange Pippin
	Burgundy	Earligold*	Dana Red Delicious
	Chisel Jersey	Early McIntosh	Dixi Red Delicious
	Cortland*	Elstar Red	Early McIntosh
	Dabinette	Elstar*	Early Red One Delicious
	Durello di Forli	Empire*	Empire*
	Earli Jon	Enterprise*	Enterprise*
	Earligold*	Florinia	Empire*
	Early Spur Rome	Freedom*	Freedom*
	Ellis Bitter	Fulford Gala	Goldrush
	Elstar*	Gloster	Gold Spur
	Fuji	Gala*	Haralson*
	Gala*	Golden Delicious	Jamba
	Geneva Early	Granny Smith	James Grieve
	Ginger Gold	Gravenstein Holly	Jonafree*
	Gloster 69	Grimes Golden	Jonamac*
	Golden Delicious*	Haralson*	Honeygold
	Golden More Super	Imperial Gala	Keepsake
	Golden Russet	Jersymac	Kidd's Orange Red
	Granny Smith*	Jonafree*	Liberty*
	Hereford Redstreak	Jonagold*	Lurared
	Idared	Jonamac	Lustre Elstar
	Jonafree*	Julyred	Lysgolden
	Jonagold*	Liberty*	Macfree
	Jonathan	Macoun	Macspur
	Jonnee	Maiden Blush	Marshall McIntosh
	Kingston Black	McIntosh	Melba
	Late Harrison	Minyon	Melrose
	Lodi	Missouri Pippin	Mor Spur Mac
	Magog's Restreak	Milton	Northern Spy
	Margil	Mollies Delicious	Northwestern Greening
	Medaille d'Or	Monroe*	Nova Easygro
	Milwa	Mutsu*	Nured Delicious
	Monroe*	Northern Spy	Nured Winesap
	Mutsu* (Crispin)	Novamac	Ozark Gold
	Niagra	Northern Spy	Perfect Spur Criterion
	Nicobel Jonagold	Pinova	Pioneer Mac
	Nittany	Prima*	Prima*
	Northwest Greening*	Puritan	Priscilla
	Nured Jon	Quinte*	Quinte*
	Otava	Red Cort	Reanda
	Paulred	Redfree [Red Free]*	Red Chief (Cambell) Delicious
	Pink Lady	Red Fuji	Red Chief (Mercier) Delicious
	Porter's Perfection	Red Fuji 4	Red Winesap
	Ramey York	Reinette Grise du	Redfree [Red Free]*
	Raritan	Royal Gala*	Red Max
	Red Fuji Nagano	Rubinette	Red Winesap
	Red Yorking	Scotia	Regent
	Reglindis	Sharon	Remo
	Reine de Hatives	Sir Prize*	Rubinola
	Reine des Reinettes	Smoothee*	Scarlet Gala
	Rhode Island Greening	Spartan	Scarlet Spur Delicious
	Roberts crab	Spijon	Sir Prize*

Table 1: Varietal susceptibility to fire blight (cont.)

	Degree of Susceptibility		
Host	**Highly Susceptable**	**Moderately Susceptable**	**Moderately Resistant**
	Rome	Stark Gala	Smoothee*
	Rome Beauty	Starkspur Earliblase	Stamared
	Royal Gala*	Starr	Stark Bounty
	Sampion	Staybrite	Stark Splendor
	Santana	Summerred	Starking Delicious
	Sir Prize*	Summer Treat	Starkrimson [Delicious]
	Sommerset Redstreak*	Super Chief Red Delicious	Starkspur Ultra Stripe Delicious
	Sops of Wine	Topaz	Starkspur Supreme Red Delicious
	Spigold	Tydeman's Red	Starkspur Compact Red Delicious
	Spur Gala Go Red	Wayne*	Stayman
	Starkspur Law Rome	Wealthy*	Sturdeespur Delicious
	Starr	Winesap*	Swiss Gormet (Arlet)
	Stembridge Jersey	Virginiagold	Top Spur Delicious
	Stokes Red		Turley
	Sun Fuji		Viking
	Super Jon		Wellington
	Summer Rambo		Williams Pride
	Tremletts Bitter		Williams Red
	Twenty Ounce		Winesap*
	Ultra Red Jonathan		
	Wayne*		
	White Jersey		
	Yellow Transparent		
	York Imperial		
Crabapple (*Malus* species)	Bechtel	Brandywine	Centurion
	Hyslop	Dolgo	Coralburst
	Mary Potter	Hopa	David
	Old Hope	Indian Magic	Evereste
	Ormiston Roy	Kelsey	Indian Summer
	Red Barron	Red Splendor	Prairie Fire
	Red Jade	Snow Cloud	Profusion
	Royalty	Spring Snow	Radiant
	Snowdrift	Hilleri	Red Vein Russian
	Strathmore	Golden Hornet	Thundercloud
	Transcendent	Manchurian	Vanguard
		Rosedale	White Cascade
		Thunderchild	
Common Pear (*Pyrus communis)*	Abbe Fete	Anjou	Ayers
	Aurora	Barlett*	Beurre Bosc
	Bartlett*	Comice*	Bradford
	Bosc	Coscia	Carrick
	Capp's Favorite	Dawn	Harrow Delight
	Conference	Douglas	Harrow Sweet
	Comice*	Duchess	Harvest Queen*
	Flemish Beauty	Ewart	Honey Sweet
	Flordahome	Garber	Kieffer*
	Gorham	Harvest Queen*	Le Contet
	Hardenpont	Kieffer*	Lincoln*
	Hardy	Lincoln*	Luscious*
	Hood	Luscious*	Magness

Table 1: Varietal susceptibility to fire blight (cont.)

	Degree of Susceptibility		
Host	**Highly Susceptable**	**Moderately Susceptable**	**Moderately Resistant**
	Max-Red Barlett Oliver de Serres Passe Crassane Red Bartlett Reimer Red Sheldon Spalding Starkrimson Williams Winter Nallis	Maxine* Red Rogue* Seckel Sparklett Worden Seckel*	Maxine* Moonglow [Moon Glow] Montgomery Old Home Orient Potomac Starking Delicious Tyson Waite Warren
Asian Pear *(Pyrus pyrifolia)*	Hosui* Nijisseki (20th Century)*	Chojuro* Hosui* Nijisseki (20th Century)* Shinseiki (New Century)*	Chojuro* Hosui* Kosui Shinko Shinseiki (New Century)*

**Degree of susceptibility may vary in different locations.*

Rootstocks of fruit trees also differ in susceptibility to fire blight (Table 2). Cultivars are usually grafted onto a different rootstock in order to control tree height, apple cultivars on dwarfing rootstocks usually begin bearing fruit at an earlier age compared to cultivars growing on their own rootstock.

Table 2: Susceptibility of Apple Rootstocks to infection by *Erwinia amylovora.*

Host Rootstock	Highly Susceptible	Moderately Susceptible	Moderately Resistant
Apple *(Malus* species*)*	Alnarp Malling 26 Malling 9 Malling 26 Malling 27 Malling Merton 111 Malling Merton 106 Mark series Ottawa 3 Poland 2 Poland 16 Poland 22 Vineyard 4	Malling 7 EMLA Budagovsky 9* Vineland 3 Geneva 16 Malling Merton 106 Malling Merton 111	Bemali Budagovsky 118 Budagovsky 490* Geneva series Malling 7 Malling Merton 106 Malling Merton 111 Robusta Vineyard 1 Vineyard 2 Vineyard 5 Vineyard 6 Vineyard 7
Pear *(Pyrus* species*)*	Provence quince *(Cydonia obonga)* *Pyrus communis* 'Bartlett' *Pyrus communis* 'Winter Nelis'		*Pyrus betulaefolia* 'Old Home X Farmingdale' *Pyrus calleryana* *Pyrus communis* 'Old Home' *Pyrus communis* 'Old Home X Farmingdale

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