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Fire Blight

A BACTERIAL DISEASE OF APPLE, PEAR AND CERTAIN ORNAMENTALS

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Fire blight is a serious disease affecting more than 75 species of fruit and ornamental plants. Prominent among these plants are apple, pear, quince, mountain ash, hawthorne, pyracantha, spirea, cotoneaster, and flowering crabapple. In Idaho the disease is sproadic. Its prevalence and severity are influenced by weather conditions, cultural practices, and inherent resistance of the host to the pathogen. Some years, little fire blight is observed or reported; in others, many fruit trees and prized ornamentals are severely damaged or killed outright.

Cause of the Disease

Fire blight is caused by the bacterium **Erwinia amylovora.** Microscopic in size, individual bacterial cells survive the winter in living tissue at margins of cankers on 2-year or older wood of their hosts. The bacteria are active at temperatures between 65°F and 86°F. Temperatures below 65°F and above 86°F arrest bacterial growth and reproduction. Under ideal conditions the bacteria will double in population each hour or two. One canker can produce enough bacteria to infect an entire orchard.

The bacteria enter the host plants through blossoms, wounds, and natural openings (stomata, water pores, lenticels). Abundant rainfall followed by warm cloudy weather is favorable for the pathogen. Over-irrigation, irrigation with sprinkler systems, and other practices that induce high humidity or the accumulation of moisture on plant surfaces also are favorable. Over-fertilization, particularly with nitrogenous fertilizer, promotes succulent growth of terminals and water sprouts or "suckers." These plant parts are also very susceptible to attack by the bacterium.

Symptoms of the Disease

The disease usually appears in the spring as blossom, spur, and terminal blight. Infected blossoms suddenly wilt and turn a light to dark brown. As the disease progresses down the pedicel, the tissue becomes water-soaked and dark green. Droplets of clear to amber-colored moisture appear on the surface of the infected tissue. These droplets contain millions of bacteria which can initiate new infections.

The bacteria generally do not progress beyond the pedicel. However, they may invade the spur and the leaves, following the midrib and main veins. The leaves wilt and the entire spur growth turns brown or dark brown to black, depending upon the host. The blighted leaves remain attached throughout the growing season.

Fig. 1. Stages of twig infection: At left, all leaves and spurs are blackened and dead. At center, some spurs are blackened, some partially so. At right, the twig appears normal except for one infected fruit that is blackening.

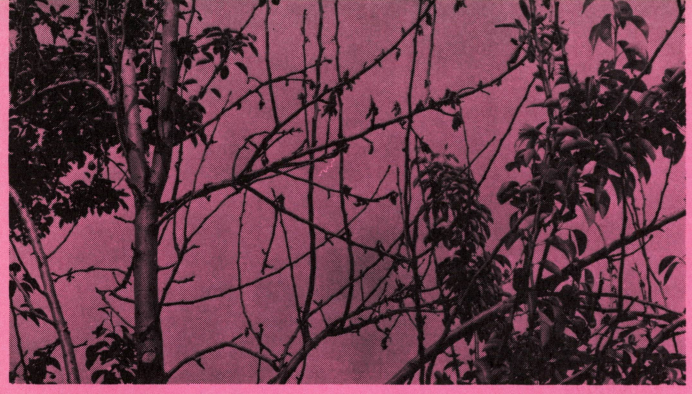

Fig. 2. Rapid dieback in a Bartlett pear tree caused by fire blight infection.

Fig. 4. Fruits from an infected Bartlett pear tree. On the upper branch, fruit at left is healthy but one at right is shriveled and hardened — cut off by fire blight that killed the twig it was growing on. The lower fruit is shriveled from infection. Most of the leaves on the lower twig are also blackened by fire blight.

Twig blight starts with the infection of the young, succulent growing tip of the terminal growth. The invading bacteria progress more rapidly down the terminal than in the fruit spur. Movement may be 6 to 12 inches per day. Newly infected tissue becomes watery, dark green, and somewhat oily. Droplets of moisture appear on the surface of infected terminals. The leaves on the blighted terminals, as in spur blight, turn brown to dark brown or black. They remain attached throughout the summer and often during the winter (Fig. 2).

A severely infected host may have so many blighted terminals and spurs that it has the appearance of being scorched or burned by fire. Thus, the name fire blight for the disease.

Fire blight bacteria may move down the spur or terminal into branches where a canker can be formed. The infected branches may become entirely girdled. As the infection spreads upward and downward, the canker enlarges. Should the scaffold system become attacked, the tree might be destroyed or its conformation ruined

Trunk and root infections can result from infection of water sprouts growing on the trunk. Cankers will form and enlarge like those on branches.

The fruit of host plants also may be infected. Such fruit becomes water-soaked with numerous exuding droplets of moisture. The diseased fruit is firm and rather leathery. Later, the fruit shrivels, turns brown on apple and black on pear, and usually remains attached to the spur

Fig. 3. Fire blight damage in the scaffold of a Bartlett pear tree. Tissue is dead beneath the shaved areas on left and right lower branches. The upper part of the leader has a canker. Note the crack at the margins of the canker. These cracks typically develop at the margins of cankers formed the previous season.

Disease Cycle

The bacteria in the cankers start to multiply as spring approaches. When trees are in the late pink to early bloom stage, a bacterial ooze appears on the surface of the canker. This oozing may continue until midsummer. Rains, wind, and insects—mostly flies and bees—spread bacteria from the oozing cankers to blossoms and new leaves. At optimum temperature of 76°F, the incubation period (the time between infection and symptom expression) on newly formed blossoms and tender succulent leaves is about 4 to 5 days. Bacterial ooze appears on the new infections shortly after the first symptoms and provides a source of inoculum for secondary infections.

Most terminal blight infection is caused by bacteria which are blown through the air in bacterial strands. These strands become lodged in various portions of the host. Rain or other moisture dissolves the gelatinous matrix of the strand and the bacteria enter the natural openings of the leaf tissue. Water-soaked leaves are extremely susceptible to bacterial invasion. The more tender or succulent the leaf, the more it is subject to water-soaking. Thus, the tender leaves of the terminal growths are the ones most likely to become infected.

Control of the Disease

The disease can be controlled and its destructiveness greatly reduced with a balanced program of sanitation, plant or orchard management, varietal selection, and chemical applications. The program is applicable to both commercial orchards and home gardens.

Sanitation

Sanitation is the most important aspect of a fire blight control program. Remove all infected limbs during the dormant season or as they appear in the spring. Blighted twigs can be removed easily from young trees or dwarf varieties. Removing twigs from large standard trees presents a labor problem which may be uneconomical, since the pathogen seldom survives in twig cankers.

Remove the limbs or twigs 12 to 18 inches below any external evidence of blight. If there is a reddish color in the cambial layer when the bark is cut, active bacteria are probably present and a lower cut should be made on the limb.

Tools must be disinfected between each cut or pruning may spread the disease further. Disinfect with a 100 ppm streptomycin nitrate solution or with a 10 percent solution of household bleach (5 percent sodium hypochlorite). This solution is prepared by mixing 1 part household bleach with 9 parts water. Dip the tools at least 2 seconds in either disinfectant.

During the dormant period, cut or scrape off cankers on the larger limbs and trunks, removing all discolored tissue. To be certain all diseased tissue is removed, cut away at least 1 inch of healthy tissue on the sides of the canker and 3 inches at the ends of the canker. Disinfect the wound with a solution of streptomycin nitrate.

Patrol orchards from the bloom period to midsummer to locate oozing cankers. Remove these by pruning the limbs or scraping away the cankers. Disinfect the cut surfaces and tools.

Remove all blighted prunings from the orchard and destroy them.

Orchard Management

Since fire blight is much more severe on succulent tissues, manage the orchard or plants to prevent excessively rapid growth of young shoots. Do not use excessive amounts of nitrogen fertilizers. Don't cultivate or prune host plants heavily to promote fast growth. Reasonable plant vigor is essential for good fruit production, but be realistic and follow practices that promote moderate growth of young tissues.

Remove water sprouts as they are formed. Their removal will often prevent infection from occurring on the limbs, trunk, and roots of the tree.

Reduce the humidity in an orchard during the spring and early summer when trees are growing rapidly. Keep ground cover mowed short. Avoid excessive irrigation and aim sprinkler heads low so that foliage remains dry during irrigation. Prune the trees for maximum aeration and rapid drying of the foliage after rains.

Do not interplant varieties when establishing a new orchard. A susceptible variety, interplanted with a tolerant variety, can maintain a high level of inoculum that will cause extensive spur blight in the tolerant variety.

Varietal Selection

No known varieties of cultivated apple and pear are immune to fire blight. Some varieties, however, are more susceptible than others (Table 1). If fire blight has been a perennial problem, varietal susceptibility should be considered when selecting new orchard trees. Don't interplant highly susceptible varieties with less susceptible varieties, and don't interplant apples with Bartlett pears. If possible, plant the more susceptible varieties downwind from those that are less susceptible.

The same principles apply for home plantings. In addition, select planting sites that provide maximum aeration. Good air movement and sunny sites reduce the humidity and provide for rapid drying of succulent, susceptible plant parts.

Table 1. Reaction of apple and pear varieties to fire blight.

Apple varieties	
Very susceptible	
Jonathan	Alexander
Rome Beauty	Willow Twig
Yellow Transparent	Yank
Winter Banana	Beacon
Ida Red	Lodi
Wealthy	Paulared
Transcendent Crab	
Moderately susceptible	
Delicious	Gano
Golden Delicious	Ben Davis
Winesap	Hibernal
McIntosh	Hanalson
Duchess	Northern Spy
Baldwin	Prima
Stayman	Florence Crab
Pear varieties	
Very susceptible	
Bartlett	Flemish Beauty
d'Anjou	Howell
Basc	Clapp Favorite
Moderately susceptible	
Kieffer	Douglas
Sechel	German Sugar
Winter Nelis	Estella
Old Home	Orient

Pesticide Application

Three types of chemicals—Bordeaux mixture, fixed coppers, and streptomycin—are effective in preventing blossom and terminal infections of fire blight **providing the other control measures have been followed.** Spray schedules for these materials differ slightly.

Bordeaux Mixture and Fixed Coppers

When using coppers, either Bordeaux mixture or fixed coppers, spray as follows:

1. **If fire blight has been sparse or nonexistent the previous year:**
   a. When trees are in full bloom or when cankers ooze.
   b. Two weeks later (sooner in case of heavy rains).
   c. Two weeks later (in rainy seasons, continue at 2-week intervals as long as flowers continue to develop).

Apply a spray immediately after harvest to discourage late season flare-ups.

Growers have also had success with 30 pounds of 20 percent copper-lime or 50 pounds of 10 percent copper-lime dust per acre. Apply at least 3 times as outlined above. Recently, growers have used Coposil dust applied by plane with satisfactory results. Copper sprays sometimes cause russeting of fruits, especially Anjou pears.

2. If fire blight has been present or a problem the previous year:

a. Apply the first spray at about 10 percent bloom.

b. At 40-50 percent bloom.

c. At full bloom.

d. Two weeks later (sooner in case of heavy rains).

e. Two weeks later.

Streptomycin Sprays

If fire blight has not been a serious problem in previous years, apply streptomycin sprays at full bloom and at 7-day intervals as long as flowers continue to develop.

When fire blight has been a problem previously, control may require streptomycin sprays spaced at 3 to 4-day intervals starting with early bloom.

Research information from the University of Illinois may make it possible for orchardists to predict when fire blight bacteria are infectious and make better use of streptomycin sprays. Prediction is based upon **degree days** during bloom period.

At approximately the pink bud stage, when bacterial ooze develops on the surfaces of cankers, a freeze will destroy a high percentage of the bacteria. The remaining viable bacterial cells are inactive. The Illinois studies indicate that 30 **degree days** are required for the bacteria again to reach a potentially dangerous inoculum level after each freeze.

These **degree days** are computed from a base of 65°F. For example, 2 days of maximum temperatures of 80°F, or 3 days of 75°F, or 6 days of 70°F following a freeze will supply adequate heat units for the bacteria to present a serious fire blight infection threat.

When 30 degree days have occurred and blossoms are still present (including secondary bloom), apply the first streptomycin spray. Repeat the spray at 4-day intervals for the duration of the bloom period. At temperatures above 86°F, bacteria will not develop. Therefore, chemical applications are not necessary when temperatures average below 65° or above 86°.

Table 2. Application rates of chemicals to control fire blight.

Material	Rate per 100 gallons water	Rate per gallon of water
Bordeaux mixture*	½-½-100	Follow manufacturer's recommendation
Fixed coppers**	½ lb.	
Streptomycin 17%***	4.8 oz.	½ tsp.

*Bordeaux ½-½-100 means a Bordeaux mixture of ½ lb. of copper sulfate plus ½ lb. of lime in 100 gallons of spray. In any Bordeaux formula, the ingredients are always given in the same order with pounds of copper sulfate first, then pounds of lime, and gallons of water.

**Fixed copper is manufactured under several trade names. If the copper content of the available material differs from 53%, follow the manufacturer's recommendations.

***Streptomycin may cause russeting of fruits, especially Anjou pear. Do not apply streptomycin closer than 30 days before harvest. Researchers in California have reported the development of a strain of the bacterium resistant to streptomycin.

How temperature and moisture conditions affect fire blight

	Temperature	Moisture
For blossom infection	a. At least 30 degree days between latest freeze and early bloom plus	a. Adequate rainfall during prebloom period plus
	b. Maximum temperature of 70-80°F during early bloom	b. Very light rain and high humidity during early bloom
For no blossom infection	a. Freeze close to bloom and less than 30 degree days between latest freeze and early bloom, or	a. Drought preceding and during bloom, or
	b. Maximum temperature lower than 65°F or higher than 85°F during early bloom	b. Excessive moisture during early bloom
For twig blight infection	a. Temperatures preferably between 70°F and 80°F	a. Sufficient rain for succulent growth and
		b. Periods of 100% humidity for at least 24 hours

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