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Fire Blight

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Fire blight is a disease that can infect apples, pears, and certain ornamental species including crabapples, cotoneaster, and mountain ash. Occasionally it may also appear on cherries, plums, Juneberry (also called Serviceberry or Saskatoon), and raspberry. This disease, caused by the bacteria Erwinia amylovora, can damage blossoms, fruit, leaves, shoots, and branches. If it is not controlled, fire blight may kill the entire tree or shrub. Infected tissue cannot be cured, but will need to be removed from the tree to prevent further spread.

Symptoms

The name "fire blight" describes the most obvious symptom of the disease: Leaves, shoots, and other affected plant parts appear scorched, as if burned by fire, turning brown or almost black (Figures 1-3). Infected blossoms appear discolored at first, before turning brown to black and shriveling (Figure 4). Infection of new vegetative shoots often produces a characteristic "shepherds crook," in which the branch tip curls down as the end of the branch dies (Figure 1). Fruit produced on diseased branches or spurs may be small and shriveled. Leaves that have been killed by the blight tend to stay on the plant rather than dropping off, sometimes well into the winter.

Spread of the fire blight pathogen into woody tissue can result in dead branches or trunks with obvious canker symptoms. Cankers appear as areas of sunken, discolored and often cracked bark (Figure 5). In moist weather, sticky ooze (Figure 6) may flow from the canker down the branch or trunk. If the bark is peeled away from the edge of a canker, reddish streaks underneath will indicate the presence of the bacteria (Figure 7). These streaks will sometimes extend a foot or more from the outer discoloration of the bark.

Disease Development and Spread

Cankers: The bacteria that cause fire blight overwinter in the margin of cankers formed during previous years' infections. Even before the tree leafs out in the spring, as temperatures warm above 55°F the bacteria multiply in the canker margins, producing a yellow to orange-colored ooze (Figure 6) which can contain billions of fire blight bacteria – the primary source of inoculum for new infections. A single canker can produce enough inoculum to infest a one-acre area during bloom.

Figure 1. Characteristic "shepherd's crook" of infected branches. *Photo credit: Rhoda Burrows*

Figure 2. A shoot may contain multiple infections from blossom "strikes". *Photo credit: Rhoda Burrows*

Bacteria are spread to new infection sites primarily by splashing rain and insects, including bees, aphids, leafhoppers, or flies. The bacterial ooze is quite sticky, forming droplets or strands, which can be spread by insects. During a rainstorm, water can dissolve the ooze, releasing "clouds" of bacteria, which are then carried by the wind. If these bacteria contact an open flower or a wound, infections can result. Wounding from insects, hail, wind or other factors is generally necessary for direct infection of shoots and fruits; in some cases the wounds may be microscopic and not readily apparent. Pruning also causes wounds, and pruning tools can carry the bacteria from one cut to the next.

As they continue to expand, cankers frequently enlarge to the point they encircle the branch, causing it to die back. The infection grows just underneath the bark, moving down the tree towards the trunk. Eventually, in susceptible trees, the bacteria move into major scaffold branches and the trunk, resulting in tree death.

Blossoms: Pollinating insects such as bees can spread the bacteria from blossom to blossom, a major site of infection as the bacteria can enter the plant tissue through the natural opening of the stigma of the flowers. (Once the blossoms are old enough to lose their petals, they are resistant to new infections.) The bacteria reproduce quickly under warm (75 to 90°F) temperatures, and there can be up to one million bacterial cells in one infected flower. These bacteria can then spread from the blossoms to their shoots (Figure 4). When the plant is infected at flowering, the result can be many separate shoot infections scattered across the tree. Young, rapidly growing tissue is more susceptible than older wood; in very young trees, infections can move through the whole tree in as little as three weeks. When many branch tips or limbs

Figure 3. Cotoneaster hedge with many branch tips dying back from fire blight. *Photo credit: Martin Draper*

Figure 4. Blossoms can easily become infected. *Photo credit: Michelle Grabowski, Univ. of Minn.*

Figure 5: Progressive fire blight cankers can serve as a source of inoculum for many years. They are a risk to the tree they occur on and nearby trees, as well. *Photo credit: David Graper*

Figure 6. Cankers on the bark leak a sticky ooze containing millions of the fire blight bacteria, which can be picked up and spread by insects. *Photo credit: David Schmitt, Rutgers*

become diseased, the tree or shrub can become very unsightly, and may eventually die.

Overall, fire blight occurs sporadically in South Dakota/ the Upper Midwest. It is influenced by a number of environmental factors, including weather, susceptibility of the host plant, and vectors (organisms which spread the bacteria, such as insects). Plentiful moisture with moderate to warm temperatures favors infection and disease development. Fire blight damage was extensive in western South Dakota the year following an early autumn snowstorm that damaged the majority of trees in the area, providing many openings for the bacteria.

Management

There are no cures for fire blight, only prevention. Sanitation is the best way to limit damage from fire blight. Begin by inspecting planting stock, whether fruit trees or ornamentals, to ensure that material is free from fire blight. Avoid selecting trees or shrubs with dead branches or discolored, damaged bark.

Pruning

Prune only in dry weather; remove dying, dead or cankered branches. This limits spread within an individual tree or shrub and reduces the number of fire blight bacteria available for new infections.

Growing season: Pruning is often recommended during the dormant season (i.e. winter) for woody plants; however, in case of fire blight damage, careful pruning during the growing season is a sound approach to limiting the spread of the disease.

When pruning infections in young (current or last season's growth) branches, cut at least 8- to 12-inches below the last sign of visible damage on the branch: in very susceptible cultivars the bacteria may be present up to 12 inches below a visible canker. Stripping back the bark below a canker can often reveal discoloration of the phloem (the actively growing tissue right beneath the bark) from a healthy green to a reddish brown (Figure 7), a sign of the bacteria. If this discoloration is present under the bark, cut the branch at least several inches below the lower edge of the discolored phloem, and usually back to a larger branch, to avoid leaving a stub.

A different practice is recommended when pruning older wood (2-years-old or more) during the growing season, when leaving a 4- to 6-inch stub may be preferable to removing the branch entirely. A cut made during the growing season may be re-infected before it has time to heal over, and the disease can then begin progress into the larger branch or trunk. Older wood is more resistant and can slow or stop infections; leaving a stub during the growing season gives the tree's natural resistance space to slow or stop any infection in the newly exposed tissue of the cut. The stub should then be removed the following winter during dormant pruning (you may want to mark the stub with bright paint or a ribbon so you can find it easily to remove during the dormant pruning).

Dormant season: During dormancy, make cuts at least 8- to 12-inches below the last sign of visible damage on an infected branch. Don't leave stubs during dormant-season pruning; instead, follow the usual recommended practice of removing the infected twig or branch entirely, leaving the collar at its base intact

Figure 7. Discoloration of phloem tissue caused by bacteria traveling under the bark.
Photo credit: Michelle Grabowski, Univ. of Minnesota.

Figure 8. A proper pruning cut leaves the branch "collar".
Photo credit: David Graper

(Figure 8). The cuts will heal over before it warms up enough for the bacteria to be active.

If major portions of a particular tree or shrub are infected, removal of the entire plant may be the best option. Often, with cotoneaster and other shrubs, major pruning of top growth is necessary to rejuvenate the planting as well as to remove fire blight inoculum.

Disinfecting Pruning Tools: During cold temperatures (under 40°F), it is not necessary to disinfect the pruning tools, as the bacteria will be inactive. If pruning during warmer temperatures, disinfect pruning tools between cuts to avoid spreading the bacteria from infected trees or branches to healthy ones. A 20% solution (1:5 dilution) of household bleach, undiluted Lysol concentrated disinfectant or Pine sol are suitable disinfectants. Rubbing alcohol is not sufficiently effective. Cutting tools should remain in contact with the disinfectant for 1 to 3 minutes for best efficacy. Alternating two pruning tools, with one always soaking in disinfectant is one way to allow sufficient time for disinfecting without slowing the pruning process. When finished with pruning and after a final disinfection of your tools, rinse and oil them to minimize rust that can occur from exposure to corrosive disinfectants such as bleach.

Researchers at Michigan State University have found that the prunings do not need to be removed from an orchard if the weather is conducive to quickly drying them out; once the bark no longer slips and the cambium is brown, the bacteria will not spread. Fresh prunings may be placed into a plastic bag to prevent inadvertent spread of the bacteria while moving them from the area.

Flowers

Remove flower buds before they open for the first two years after planting a fruit tree. This avoids blossom strikes, and should be done anyway to allow the tree to develop properly.

Fertility and Plant Vigor

Reducing fertility levels may be beneficial in some situations where persistent fire blight problems exist. The succulent grow that results from excess nitrogen is generally more susceptible to infection. More than about one foot of new growth on a standard (non-dwarf) sized apple tree with a fruit crop suggests an excess of nitrogen. Suckers and water sprouts are also very easily infected through natural openings in their leaves and should be removed.

In years when fruit load is low due to spring frosts or an "off" year of a cultivar that tends to have heavy fruiting every other year, more overly-vigorous shoot growth can result. This tissue will be more susceptible to fire blight infection, so watch it carefully and prune out new infections as soon as they are discovered.

Avoid sprinkler irrigation during the time the tree has blossoms, as the added moisture can trigger infections.

Chemical treatment

Treating fire blight infection with chemical sprays generally is limited to commercial fruit orchards. Timing is critical; when sprays are properly timed at blossom, antibiotic sprays such as streptomycin or oxytetracycline can effectively reduce infection in apples and pears. Use of Streptomycin in certified organic orchards, however, is prohibited.

In drier parts of the U.S., a new organic product containing the yeast Aureobasidium pullulans (Blossom Protect™), has shown very good efficacy (approaching that of Streptomycin) in protecting blossoms against fire blight. When sprayed into the blossoms, the yeast colonizes the flowers, preventing the fire blight bacteria from becoming established. Under some conditions (check the label), it may cause fruit russeting on some cultivars; a subsequent copper spray may reduce this russeting. Blossom Protect is labelled in the U.S., but is not yet labelled for use in South Dakota. Other similar products containing beneficial bacteria are being tested; results thus far suggest they are more effective under drier weather conditions.

Copper fungicides have limited effectiveness but can be used as a delayed-dormant (just before budbreak, 2- to 4-weeks before bloom) spray. Some organic orchards in the Pacific Northwest have found it helpful to paint trunks with a mix of horticultural oil and copper in late winter.

There is some evidence that applications of a phosphite fungicide may also increase the tree's resistance to the bacteria; a recent study showed injections of the fungicide may hold promise in the future in preventing new infections, but this is still being tested. Phosphite salts can provide some

protection against blossom strikes, but not shoot infections.

Lime sulfur (2%) in combination with 2% fish oil was shown to decrease infections but is only partially effective. Lime sulfur does have the advantage of also helping to control apple scab, a common disease in South Dakota. Beware: Lime sulfur is also used at bloom time (at 30% and 70% bloom to thin flowers, so it must be applied very carefully. Never tank-mix these materials with biological controls such as Blossom Protect.

A different method of preventing shoot infections from progressing is to apply the growth regulator prohexadione-calcium (Apogee™ is one such product). The growth regulators hardens off the shoots, making them less susceptible to shoot blight. It appears that the substance thickens cell walls, so that the bacteria are unable to penetrate. The product is not effective to prevent blossom infection. Keep in mind it takes up to two weeks for the chemical to take effect, so sprays should be started at petal fall and sprayed every two weeks for 3 to 4 applications; do not apply within 45 days of harvest. Because it slows growth, this product should not be used on young trees where growth is desirable.

Always be sure to read and follow all pesticide label directions carefully.

Insect control

Control of insects before and after (not during) bloom can reduce wounding and bacterial inoculation. In addition to pollinating insects, there is some evidence potato leafhopper feeding may provide infection sites. NEVER apply insecticides during bloom as they can harm pollinating insects.

Mechanical injury

Limit mechanical injury to plants when possible. Remove rubbing branches during dormant season prunings. Avoid injury of the trunks with weed whips or lawnmowers. Protect trees from deer rubbing or chewing. Hail injury increases risk of fire blight, so watch carefully for new infections after storms.

Susceptibility/Resistance

Most apple varieties have some susceptibility to fire blight, but certain ones are more sensitive. Varieties that tend to have a long bloom period tend to have more blossom infections. Avoid planting very susceptible varieties such as Beacon, Honeygold, Wealthy, Prairie Spy, and Regent apples, or Hopa, Flame, Snowdrift, Whitney, Royalty and Zumi or Redbud crabapples, or else isolate them in plantings away from other fruit trees. Crabapple varieties Spring Snow and Red Splendor are intermediate in their resistance to fire blight, but in years that favor fire blight, damage can be severe on these varieties.

Most pear varieties are very susceptible to fire blight, so isolate pear plantings from apples.

Fire blight-resistant apples include Haralson, Hazen, Haralred, Mandan, Red Baron, Red Duchess, Sweet Sixteen, State Fair, Freedom, and Liberty. Resistant crabapple varieties are Adam, Centurion, Coralburst, Kelsey, Prairiefire, and Royal Raindrop. The dwarfing rootstock M26 is highly susceptible; M7 EMLA and B9 are moderately susceptible. New rootstocks are being developed that are more resistant; however, they do not confer resistance to the variety that is grafted onto them.

References

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