Getting the upper hand on fire blight

Kari Peter, Ph.D.
Penn State Fruit Research and Extension Center
Biglerville, PA 17307
kap22@psu.edu Twitter: @drtreefruit

Ask any apple grower and they will tell you the most feared disease is fire blight. Caused by the bacteria *Erwinia amylovora*, fire blight has the ability to devastate an otherwise healthy orchard in one season. The last couple of years have been especially challenging fire blight years in the East, and it is important to understand the disease in order to manage it effectively. The following talk will describe the who, what, why, when, where, how and how much of everything you need to know about fire blight and its management in preparation for the coming season.

Fire blights hosts: obvious and less obvious

Everyone is aware apple, pear, and quince are targets for the fire blight bacteria. Don't underestimate the hosts that linger in the orchard (crabapple), surrounding woods (hawthorn), and in the landscape (cotoneaster, fire thorn, mountain ash, Bradford pear). The host range of the bacteria includes 130 species in 40 genera. These hosts are most likely not being controlled for the disease and can provide additional sources of bacteria to wreak havoc in your orchards if these plants are nearby. In addition, not all apple cultivars and rootstocks are created equal when it comes to susceptibility to the disease. Remember: resistance does not mean immune. If disease pressure is very high even traditionally tolerant cultivars, such as Red Delicious, can become infected.

Where do the bacteria overwinter?

The bacteria overwinter in living tissue surrounding cankers formed at the base of spurs or shoots killed the previous season. Cankers also will form where cuts were made to remove infected shoots during the growing season. Bacterial populations are influenced by temperature and can grow in a range of 50°F to 90°F. Bacteria will begin to multiply at canker margins early spring, typically between tight cluster and early pink, and begin to ooze, and the ooze contains trillions of bacteria. This is important because this is when the bacteria are first available for dispersal in the orchard.

Bacteria dispersal and colonization

Insects (mostly flies) are attracted to the sweet, sappy bacterial goo oozing from canker sites. These insects will begin to unknowingly disperse the bacteria from tree to tree by leaving colonies of bacteria wherever they walk. Bacteria are capable of surviving and multiplying on plant surfaces several weeks before flowering begins. In addition, the bacteria can also be dispersed by rain (directly or as aerosols), or carried on even modest winds.

Once the first early opening flowers are colonized by bacteria, further dispersal is not only rapid, but specifically directed at open flowers through the activities of honey bees and other pollinators. The five stigmas in the center and top of each blossom have a moist, nutrient rich surface that supports their colonization of the bacteria to high levels even though infection has not yet occurred. One day at 88°F is enough to build a very high bacterial population. As

pollinators arrive to collect pollen, the bacteria are picked up on their body hairs and are then subsequently moved to other flowers in the orchard.

Blossom blight phase

Warm weather builds the bacteria population; water/moisture triggers the infection event. Both bacteria and water must be present in the bloom for blossom infection to occur. If rain or dew does not occur during bloom, the pollinated flowers will go ahead and set healthy fruit despite the presence of the bacteria. Unfortunately, bacteria have flexible legs call flagella, which make them very efficient swimmers, and if rain or dew does occur during flowering, the water will move the bacteria from the stigmas to the open nectaries, where over 90% of blossom infections occur. Once inside the plant, the bacteria will move systemically via the plant's vascular system. The younger the tree, the faster the bacteria will move inside the tree. Above 60°F, colonization and infection of the nectaries appear to occur within minutes. Once a blossom infection event does occur, symptom development (black and wilted tissue) can range from 5-6 days under warm conditions to 30 days or more under cool conditions.

Canker blight phase

Canker blight is often a head scratcher and, consequently, grossly underestimated for its ability to cause damage in the orchard. Canker blight develops due to renewed activity by the bacteria at the margins of overwintering cankers from the previous season and occurs regularly every year where the disease is established. In other words, if cankers are left in your trees, you can count on canker blight. The bacteria move systemically from the canker into nearby growing, succulent vegetative tissue. Often times, water sprouts close to active canker sites will develop a distinct yellow to orange color and begin to wilt. Another distinct feature is canker blight "shoot blight" will appear as if the infection is starting from the base of the shoot, as opposed to the shoot tip, which is characteristic of typical shoot blight. In years when blossom infection events do not occur or have been well controlled, active canker sites serve as the primary source of bacteria for a continuing epidemic of secondary shoot blight infections that can lead to major limb, fruit and tree losses.

Shoot blight phase

Shoot tip infections are incited on the youngest 2-3 tender, un-expanded leaves at the tips of vegetative shoots. The significance of these infections are twofold: 1) they tend to progress downward rapidly, often invading and destroying larger supporting limbs; and 2) as bacteria becomes abundant in the orchard, leaf surfaces are colonized by the bacteria (arriving from earlier blossom infections, active cankers or young shoots systemically invaded by bacteria from nearby cankers), but cause no harm so long as they remain on the surface and there is no injury. Unfortunately, injury can easily occur. When potato leafhoppers feed on shoot tips, they will cause damage, thereby creating an entry for the bacteria to enter the plant. A more likely factor for injury is wind, and it does not necessarily need to be high winds associated with storms.

Trauma blight phase

The incidence of severe fire blight associated with damage caused by hail and high wind is well known by experience. Much like shoot blight, leaf surfaces already colonized by the bacteria are severely injured during hail and wind storms so that the bacteria have ready access to internal leaf tissues and the vascular system. When such trauma-inducing events occur, the

amount of fire blight that follows appears to be directly related to the amount of foliar colonization by the bacteria in the orchard, being heaviest near good sources of bacteria such as active blossom, canker or shoot blight symptoms or active cankers not previously removed.

Rootstock blight phase

Rootstock blight can be especially damaging where M.26 and M.9 apple rootstocks are used for high density plantings. Bacteria from a single shoot infection can move rapidly down through the otherwise healthy superstructure of branches, limbs and trunk into the rootstock where the bacteria initiate a canker that quickly expands to girdle the tree causing the death of the whole tree. Early fall red coloration of trees in late summer to early autumn is indicative of girdling. Additional trees may show symptoms of decline and die in the early spring.

The How-To Guide to Manage Fire Blight

What to do during dormancy

Dormant pruning of blighted limbs, shoots and cankers must be done every year to reduce the number and distribution of bacterial sources in and around the orchard before the bacteria can be dispersed in the early spring. In addition, remove wild or neglected fruit trees and other susceptible host plants from fencerows and areas nearby.

What to do during green tip/pre-bloom

Be mindful about fertility since excessive amounts of nitrogen make trees more susceptible. A vigorously growing tree will have the nutrients and water (and bacteria if the tree is infected) pumping fast in the vascular system to grow the tree. Also avoid tree stressors, such as poor nutrition, inadequate drainage and nematodes since tree stress results in a tree less capable of resisting the progress of infection. Apply early copper sprays, which will reduce bacteria colonizing bark and bud surfaces. Aim to apply 2 lbs/A of metallic copper at green tip.

What to do during bloom

Blossom sprays protect only flowers that are open and only protect blossoms prior the infection event. Since blossoms do not open all at once, it is necessary to apply several sprays when infection conditions are frequent during bloom. It is important to be vigilant in monitoring weather conditions: average temperatures >60°F and wetting events (rain, heavy dew).

Options available to protect blossoms and considerations to keep in mind:

- Apply antibiotics as complete sprays and add an adjuvant or surfactant. Antibiotic sprays are most effective when they are applied the day before or the day after an infection event (within 24 hrs!).
- **Streptomycin** is still the best option since it kills the bacteria and has partial systemic activity. Note: the systemic activity does not persist like fungicides and you have about a 48 hour window. Best used when an adjuvant is tank mixed.
- **Kasugamycin** is new to the market in 2015. It is different from streptomycin in that it reduces bacterial growth and reproduction, rather than killing it directly.
- **Oxytetracycline** is an antibiotic that functions similarly to kasugamycin in reducing bacterial growth.

- There is a 4 spray maximum when applying antibiotics and do not apply antibiotics after bloom. This is necessary for resistance management. Please do not think that just because 3 antibiotics are available you are able to apply 12 antibiotic sprays.
- **Blossom Protect** is a live yeast product that colonizes the flower and prevents the bad fire blight bacteria from entering the nectaries. Research on the West Coast indicates this is a very successful product for controlling fire blight. However, this product is not as effective for our conditions on the East Coast at the present time. (Registered in MA, MI, NY, NC, PA,VA.)
- Although applying copper at bloom will kill bacteria, copper can cause fruit russetting and should be used with caution.
- Be mindful of rattail bloom. All blossoms are susceptible to infection if the bacteria and conditions are present.

What to do during post bloom through terminal bud set

As mentioned previously, do not spray antibiotics post petal fall. A hail event is the exception. When making the decision to apply an antibiotic spray after a hail event, take cultivar susceptibility, fire blight history, PHI, and the ability to spray within 24 hrs into consideration if the crop value justifies the cost. Shoot blight will be limited by applying the plant growth regulator, Apogee. The effect of Apogee occurs 10 -14 days after application and can be tank mixed with streptomycin. It is not a streptomycin replacement. Apply during late bloom when active shoot growth is 1 - 3 inches. Apogee will harden off shoots, which will make the shoots not susceptible to shoot blight. Monitor your orchard regularly for infections if there were blossom blight conditions and prune as necessary: symptoms manifest 5 - 30 days post infection and shoot blight infection risk continues until shoot growth ceases. Since insects can cause wounds, which are entry points for the bacteria, be sure to control piercing-sucking insects, such as aphids, leafhoppers, and pear psylla.

Important considerations for cutting out infections

- Do not cut out infections during wet weather since bacteria move via water.
- Cut out active infections early - before necrosis develops (limits the spread of bacteria).
- Pruning is most effective when incidence is low.
- Focus on salvaging tree structure and young high density plantings when incidence is high.
- Avoid excessive cutting since this stimulates secondary shoot growth.
- Bacteria can invade healthy tissue up to ~3 feet in advance of visible symptoms, which makes tool sterilization not effective
- Practice the ugly stub method: cut 6 -12 inches below the margin of visible infection and remove later during winter pruning.
- Bacteria can live very well outside the plant and, to be certain you are getting rid of all sources of bacteria, it best to burn infected tissue that has been removed from the tree.