Fig. 1

Fire blight in the plant nursery

How did it arrive here, and what can be done?

BY KEN JOHNSON AND TIANNA DUPONT

FIRE BLIGHT IS A DISEASE that can kill apple and pear trees. It is especially dangerous in a nursery setting, for reasons we will explain.

The disease can result in the direct loss of plant material, which in turn can necessitate a costly and difficult clean-up. If infected planting stock is sent to customers, dissatisfaction is likely.

This article discusses recommendations for preventing fire blight from arriving in your nursery, and for cleaning up the disease, should infected plants be detected there.

Like all plant diseases, fire blight requires three ingredients: a susceptible host, a favorable environment, and of course, a pathogen. In this case, the pathogen is a tiny bacterium named *Erwinia amylovora*.

Of these ingredients, host susceptibility is the most difficult to manage because customers dictate the demand for cultivars. Currently, because of consumer and industry preferences for fruit quality and storability, most "in-demand" cultivars range from susceptible to extremely susceptible to this disease.

Cultivar susceptibility is exacerbated by the fact that all plants are young and frequently grown for optimal vegetative growth. This requires high inputs of nitrogen. These conditions — youth and high nitrogen fertility — greatly enhance susceptibility to the disease.

Where nurseries are vulnerable

A nursery environment also can promote fire blight to an extent beyond that observed in a typical orchard setting. This includes the use of overhead irrigation and tight plant spacing that creates the long periods of canopy wetness which are conducive for pathogen infection.

Flowers are a common and well-known site of infection for the fire blight pathogen, but flowers are typically absent in the nursery. Most plant-to-plant spread is via shoot infection, which occurs after the pathogen has been introduced to the very youngest cells near the tip of a growing shoot.

Fire blight in the plant nursery

Previous page: Figure 1. Shoot symptoms of fire blight. Frequently, an infection in the shoot leads to rapid wilting, which is described as a "shepherd's crook". Leaves on diseased shoots can show blackening along the midribs before becoming fully brown. PHOTO BY TIANNA DUPONT

Figure 2. On young plant material, shoots darken and appear water-soaked. Under the bark, the cambial layer will be streaked with brown to black discolorations both in and immediately below the visibly infected tissues. PHOTO BY DAVID SUGAR

Fig. 2

Overhead irrigation splashes the pathogen to the shoot tips from ooze droplets on infected plants. Wet conditions and whipping winds can be sufficient to create small (micro) wounds where the pathogen initiates a shoot infection.

Alternatively, an insect — perhaps a leafhopper, stink bug or earwig — might be attracted to the sweet odor of a bacterial ooze drop on a diseased plant. The insect may then transmit the pathogen when it moves to feed on a shoot tip of a healthy plant.

The pathogen can also enter through the wounds created by hard rains, hail, or where tender wind-whipped plant material rubs against wire and tie-offs. A single drop of ooze can contain a billion pathogen cells. Consequently, an overhead irrigation event has the potential to disperse a sufficient amount of pathogen cells to infest a large number of healthy plants.

If there is good news in any of this, it's that under dry conditions, pathogen cells splashed away from oozing cankers are viable for only a day or two. They do not multiply again unless they successfully infect those young tissues wounded by insects, wind, or hail.

How the pathogen arrives

For orchardists, fire blight management guidelines always recommend "pruning out the old cankers," which is where the fire blight pathogen overwinters.

Nurseries, in contrast, generally do not have enough old plants around for old cankers to be an issue, although mother trees used for scion wood or layering could be in this category.

Another bit of good news is that the fire blight pathogen does not survive well in soil, in water, or on plant surfaces. To continue its cycle, it must move quickly from an infected host to an infection site on a healthy plant.

Given these limitations, where does the fire blight pathogen come from? One potential source is unmanaged, backyard, orchard or ornamental apple and pear trees located near but off the nursery property.

Fire blight is indigenous to agricultural areas of the Pacific Northwest. While it might not seem common, especially west of the Cascades, it is known to persist at low levels on various rose family hosts, including *Malus, Crategus, Pyrus, Cydonia, Amelanchier and Sorbus.* An infection of any of these hosts can produce the ooze droplet that is brought to the nursery by an insect or wind-blown rain.

At a minimum, a nursery manager should be aware of rosaceous hosts growing nearby and manage the situation (to the degree possible) if fire blight is suspected or becomes an issue.

Likely more common, the fire blight pathogen comes to the nursery via infested scion wood collected from a tree that had fire blight earlier in the spring. The term "infested" is used because this scion wood will not show any fire blight symptoms.

In the mother tree from which the scion wood was collected, after infection, the pathogen produces a symptomatic canker that is literally loaded with trillions of bacterial cells. These cells of the pathogen are squeezed out of the canker as ooze drops, and they also begin to disperse (diffuse) internally within the tree.

Therefore, when the scion wood is collected in July from a tree previously diseased with fire blight in spring, it is potentially preloaded with the pathogen. Summer T-budding of this propagation stock then creates the wound that re-initiates disease. In a susceptible scion cultivar, such as Cripp's Pink or Bosc pear, numerous failed buds from a bud-stick unit is a potential symptom of scion wood infested with the fire blight pathogen.

Alternatively, a budded scion might transmit the pathogen to a susceptible rootstock (this occurs frequently in M.9 and its derivatives, and EMLA.26), which might cause fire blight in the current season (August or September) or perhaps not until the following spring.

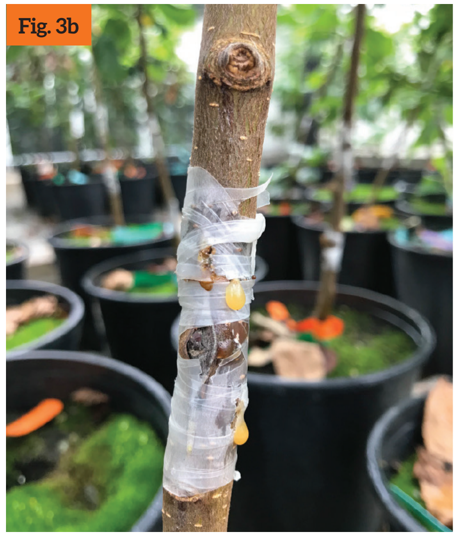
What to do after detection

In the event the fire blight pathogen is detected in a production nursery environment, a variety of control methods are available.

Cultural control. Restoring the nursery to a disease-free state is priority number one. Ooze drops of the pathogen are »

Fire blight in the plant nursery

Figure 3. Translucent to yellow to amber-colored drops of "ooze" of the fire blight pathogen may be present on bark both in and immediately below the visibly infected tissues. RIGHT PHOTO BY KEN JOHNSON, LEFT PHOTO BY TIANNA DUPONT



often present on infected trees before symptoms are easy to see. Frequent and intensive scouting — at least once a week — is required to remove these plants as soon as they can be detected.

With young plants (less than two years old), any material that has developed fire blight should be removed and destroyed. In layering beds, mother plants with fire blight should also be destroyed.

Secondary cultural priorities are to manage the canopy of infected beds to be as dry as possible. Reduce the frequency of overhead irrigation. Applications of water should be timed to take advantage of the drying power of the afternoon sun.

Reduce additional inputs of nitrogen, as this nutrient enhances susceptibility and encourages active shoot growth. In contrast, shoots with set terminals buds are resistant to infection. If any flowers appear (for example, Cripp's Pink likes to bloom anytime it's growing), remove them by hand.

In the fall, watch trees closely as the leaves begin to color. With apple, those trees with internal infections of fire blight often color earlier and the color is more toward red than yellow. Then inspect closely for cankers or ooze. Atypical early coloring is not sufficient reason by itself to destroy a tree. However, it's probably worth the effort to flag these trees for re-inspection in spring.

Chemical control. The antibiotic, streptomycin (FireWall, Agristrep 8 oz./100 gal.) is the most effective material (locally systemic) for fire blight suppression, but its effective period of protection is only four days. Copper-based bactericides, such as Cueva, CuPRO or Badge X2, are also effective but have the same problem of a short residual and are not systemic. Thus, with coppers, it is hard to protect a rapidly expanding shoot tip but the copper kills pathogen cells as they splash around during irrigations.

With both coppers and antibiotics, a treatment frequency that maintains a consistent residual provides more effective suppression than a higher rate with more infrequent application.

Actigard (2 oz./100 gal.) protects by inducing resistance in the tree. It is only partially effective at preventing fire blight infection, but provides a longer effective residual (7–10 days) than antibiotics or coppers.

Other antibiotics, oxytetracycline (FireWall, Mycoshield) and kasugamycin (Kasumin), are also available. They are not as effective as streptomycin and have similar short residual periods, but unlike streptomycin, the pathogen has not yet become resistant to them.

Streptomycin resistance in the fire blight pathogen occurs quickly when it is sprayed too often. Orchard districts of Washington State have greatly reduced levels of streptomycin resistance by making greater use of alternative materials.

Described below is a potential spray program that could be followed if a fire blight problem arises. It based on the idea that nurseries can afford relatively expensive mixtures of protective materials because the crop value is high and there is a relatively small area to be treated. Moreover, when combined with intensive scouting, this spray program should go for at least a month to provide a period of protection that overlaps the detection of infections that occurred before the control effort was initiated.

Spray program: Every five days, spray a mixture of an antibiotic, copper-based material, and Actigard. The specific copper material is less important than selecting the rate to be 0.16 to 0.21 lbs. of metallic copper per 100 gallons of water. For example, the amount of metallic copper in Cueva at 4 qt./100 gallons (a soluble copper material) and Badge X2 at 0.75 lb./100 gallons (a fixed copper material) is 0.16 and 0.21 lb. of metallic copper per 100 gallons of water, respectively.

For purposes of resistance management, antibiotic labels either limit (or are in process of limiting) the number of consecutive treatments of a specific material to two applications. For example, a clean-up program could begin with streptomycin on the first and second sprays, but needs to change to kasugamycin or oxytetracycline on the third treatment. In general, when there is active plant growth, it is better to have a spray on shortly before an irrigation (or rain) than after the wetting event.

At the end of a month, the program can be continued, slowed or stopped based on an assessment on whether the disease spread is still advancing. Cultural efforts should be ongoing.

Additional reading

https://articles.extension.org/pages/74505/organic-fire-blight-management-in-the-western-us

https://www.apsnet.org/edcenter/disandpath/prokaryote/pdlessons/Pages/FireBlight.aspx

http://treefruit.wsu.edu/crop-protection/disease-management/fire-blight/

Ken Johnson is a professor in the Department of Botany and Plant Pathology at Oregon State University in Corvallis, Oregon. He can be reached at johnsonk@science.oregonstate.edu. *Tianna DuPont is a tree fruit extension specialist with Washington State University's Tree Fruit Research & Extension Center in Wenatchee, Washington. She can be reached at* tianna.dupont@wsu.edu.