

Fire Blight in Apples and Pears—Paul W. Steiner¹

Fire blight is one of the most destructive and difficult to control diseases of apples and pears in the mid-Atlantic region. It also appears to be becoming more common and causing more significant tree losses in young apple orchards planted at high densities using clonal rootstocks in combination with susceptible cultivars. The disease develops in several phases, not all of which occur every year in every orchard or with equal intensity. ***Managing fire blight well requires an aggressive approach aimed at limiting the number and distribution of inoculum sources before and during the growing season and in preventing primary infections.***

The fire blight bacterium, *Erwinia amylovora*, overwinters in the healthy bark tissue surrounding limb and twig cankers established the previous season. In the spring, as the daily average temperature increases and early bud development begins mobilizing stored carbohydrates, the overwintering bacteria multiply and initiate new infections in bark tissues at about 90- 96 cumulative degree days above 55°F after green tip (approx. tight cluster to open cluster stage of spur bud development). Symptoms of these first infections won't be apparent until several weeks after bloom, but this early activity produces many bacteria which are then extruded onto bark surfaces as ooze in the weeks before flowering begins. These exposed bacteria continue to multiply and are dispersed again and again throughout the orchard by rain and insects. Thus, unlike apple scab where inoculum dispersal occurs immediately prior to infection, ***the fire blight pathogen can be dispersed widely to bark and bud tissues for several weeks to a month before flowering begins and the first blossom infections occur.***

Once flowering begins, honey bees serve as very effective vectors in carrying the bacteria to nearly all open flowers in and around the orchard site. The rate at which flowers are colonized by the pathogen and, hence, at risk for infection if rain or dew occurs increases exponentially at temperatures above 64°F. If no rain or dew occurs during bloom, few if any blossom infections occur. If rain or dew does occur when the average daily temperature is 60°F or higher, infections can occur within minutes in flowers already colonized by the bacteria. Thus, the early dispersal of bacteria, their colonization of flowers in advance of any wetting that triggers an infection event and the very short time required to establish infections all help explain why blossom blight epidemics develop so explosively in some years. ***The minimum requirements for blossom infection and the order in which they must occur are: 1) flowers must be open with petals intact (flowers in petal fall are resistant); 2) an accumulation of at least 198 degree hours above 65°F; 3) a wetting event as dew or rain; and, 4) an average daily temperature of 60°F. The more any one or more of these minimum requirements is exceeded (e.g., many open flowers, more than 200 cumulative degree hours, extended rains and average temperatures above 65°F) the more severe the epidemic will be.***

In addition to the direct loss of infected spurs resulting from blossom blight, the sudden availability of thousands of new sources of inoculum greatly increases the chances for many shoot infections, which can lead to additional limb and tree losses. Regardless of whether blossom blight occurs or whether large numbers of shoot blight symptoms develop, the presence of active cankers within or near an orchard can provide enough bacteria to support colonization of apple and pear foliage in an orchard by early to midsummer. Under normal conditions this epiphytic colonization poses no problem. However, should hail or wind storms damage the foliage, widespread and often severe trauma blight symptoms affecting all tissues can occur.

High density apple orchards where either the M-26 or M-9 clonal rootstock is used with any of the highly susceptible cultivars (Gala, Fuji, Braeburn, Rome, Jonathan, Ida Red, Ginger Gold, Jonagold, etc.) are at high risk for significant tree losses from fire blight when cankers develop on the rootstock. Even a few blossom or shoot blight strikes on the scion variety provide sufficient bacteria that then move rapidly through the healthy tree stem (i.e., without causing visible damage or symptoms) into the root where they initiate cankers that expand quickly, killing the entire trees within one to several months. rootstock infections can also occur where Red Delicious, a normal blight resistant scion, develops trauma blight symptoms following hail or wind damage. Some rootstock infections also occur with the M-7A rootstock, but these are never as aggressive as those on M-26 and M-9 and seldom completely girdle and kill trees.

While it is impossible to totally eradicate fire blight to the extent that it no longer occurs, there are a number of tactics that, if followed rigorously, can reduce the frequency of serious outbreaks and provide more consistent and cost-effective control. Because fire blight develops in different phases, the strategies and tactics needed for control also are different (see Table 11).

Streptomycin treatments and resistance. The antibiotic, streptomycin, works best in limiting the multiplication of bacteria, not in killing large populations. Also, only those blossoms open at the time of the application are

protected against infection. Thus, it is most effective when it is applied as a thorough coverage spray (either low volume or high volume when coverage is adequate throughout the tree) just before an anticipated infection event. The addition of an activator-type surfactant (Regulaid, Ortho X-77, Widespread, LI-700, etc.) will improve coverage and penetration of the flower structure, especially the nectaries where most infections occur. Once treated, an open blossom is protected until petal fall when it becomes naturally resistant. Sprays applied too late are not effective in stopping infections already in progress, and those applied too early afford no protection for new flowers opening after treatment. Because thorough coverage is required, these treatments should not be made on an alternate row middle basis as is commonly done for other diseases and insect pests. Streptomycin is not effective in preventing shoot blight and should not be used for that purpose.

Resistance to streptomycin has been reported from many locations in the U.S.. In nearly all cases, however, such resistance has developed only where six or more sprays are used per year. Where growers have routinely limited the number of sprays to four or less, the product appears to remain effective even after 20-30 years use. Because of the manner in which streptomycin resistance develops in a population, it should not be used repeatedly after symptoms first appear, since this is more likely to encourage the selection of resistant strains.

Using Apogee to manage shoot blight. The plant growth regulator, Apogee (prohexadione-calcium), is a new tool for management of shoot blight that may reduce the threat of development of resistance to streptomycin. Apogee causes shoots to start hardening off beginning about 10 days after application, resulting in reduced susceptibility to shoot tip infection. For shoot blight suppression, Apogee should be applied at late bloom when active shoot growth is 1-3 inches long. Recent studies at Winchester indicate that Apogee may be safely tank-mixed with Agri-Mycin and Regulaid, allowing Apogee to take effect while there is residual protection from streptomycin. Registered rates for Apogee are 6-12 oz/ 100 gal dilute or 24-48 oz/acre. To reduce interference from naturally occurring calcium in the water used for spraying, ammonium sulfate should be added to the tank before Apogee, at the same rate per 100 gal of spray mix as for Apogee. Based on research at Winchester, the combination of 6 oz of Apogee plus 6 oz of ammonium sulfate per 100 gal is suggested for moderately vigorous trees. An adjuvant such as Regulaid should be included to increase systemic uptake of Apogee. (Further testing may indicate the suitability of other water conditioners). Vigorous trees might be more responsive to the 12 oz Apogee rate than to the 6 oz rate.

Because shoot blight suppression is related to early hardening off and continued suppression of shoot tip growth, vigorous trees might benefit from additional Apogee applications if shoot growth is resumed in mid-season. Studies in WV showed that Apogee reduced shoot blight infections that occurred with hail injury in June. Apogee should not be expected to provide a satisfactory growth response in time to be beneficial when applied after hail injury has occurred. However, it might be possible to predict its usefulness for shoot blight suppression if the year is marked by frequent Maryblyt™ infection periods during bloom and the potential threat of severe shoot tip infection under high secondary inoculum conditions. Apogee is not to be considered a replacement for streptomycin sprays for blossom blight control. Other situations in which Apogee should be most beneficial include vigorous trees and susceptible varieties. Apogee treatment for shoot blight suppression would be most strongly suggested for vigorous young trees that have nearly filled their tree space. Apogee must be further tested to determine whether its application will reduce the progression of fire blight bacteria into the rootstock.

Cutting out active fire blight strikes. Cutting out fire blight strikes while an epidemic is in progress is often controversial. Where symptoms of fire blight are severe and widespread, extensive cutting should not be done except as a salvage effort to limit the invasion of the central tree structure. Where outbreaks of fire blight are light to moderate or are limited to isolated areas within a larger orchard, however, the prompt removal of all blighted tissues can be beneficial. Recent research on both apples and pears indicates that sterilizing pruning tools prior to each cut is not useful because the bacteria often are present internally in mature bark well in advance of symptom margins. Cutting shoots or limbs to remove symptoms appears to breach the natural defense mechanisms active in mature tissues so that a small canker then develops around the cut stub. For this reason, if cuts are made back to the next healthy branch union, as is usually recommended, the small canker that forms will remain in place and provide inoculum for the following season. By making the cut into at least 2-year-old wood and leaving a 3- to 4-inch, naked, "ugly stub", however, the stub and its small tip canker can then be removed safely and completely during the dormant pruning operation so that cankers are not left in the trees.

Forecasting fire blight. MARYBLYT™ is an easy to use computer program that uses daily temperature and rainfall to define the risks, predict fire blight infection events, predict symptom appearance and to prompt treatment decisions. This program was developed and validated with cooperation from fruit pathologists in the mid-Atlantic region and throughout the U.S.

Table 11. Aggressive Fire Blight Management

| Timing | Tactics and basis for treatment |
|---------------------------|---|
| Dormant season | Thorough pruning to remove all blighted limbs and shoots every year reduces the number and distribution of canker sites available the following spring. Complete removal of severely damaged trees and replanting may be more cost-effective than retraining and allowing potential inoculum sources to remain. |
| Pre-bloom period | Include a copper formulation with the oil at green tip; later copper applications may damage foliage and fruit. Treat entire orchard blocks, not just susceptible varieties. The purpose of this treatment is to prevent or reduce the colonization of tree surfaces by the bacteria before bloom. Full block treatments are necessary since the bacteria also colonize resistant varieties from which the bacteria then can be dispersed to susceptible varieties during bloom. |
| Bloom period | Apply streptomycin (plus surfactant) just before an anticipated infection event when infection risk is moderate to high. Treat again in 4 days if high risk conditions persist. Do not exceed four antibiotics sprays per year. Make blossom treatments strictly on whether an infection event is expected or has occurred, not on how severe that event might be. The fire blight forecasting program, MARYBLYT™ can aid in these decisions. Consider applying Apogee to reduce the threat of shoot blight on vigorous trees of susceptible varieties that have nearly filled their tree space. The ideal timing of application for this purpose is at late bloom when active shoot growth is 1-3 inches long. |
| Postbloom through bud set | Control sucking insect pests to reduce the incidence of shoot blight. Monitor orchards closely for early blight symptoms and remove these promptly before extensive necrosis develops. Use the “ugly stub” method for blight removal. Several cutting tours may be needed to limit the number and distribution of inoculum sources for shoot blight and subsequent canker formation. Do not use streptomycin after symptoms develop or to control shoot blight since it is not effective and increases the risk for developing resistance. Avoid extensive cutting that may stimulate vegetative replacement growth and lengthen the period of shoot blight susceptibility. Shoot blight susceptibility of vigorous trees may be reduced by additional Apogee applications if shoot growth resumes in mid-season. |
| Late season | Although the risk for infection during the late season is relatively low, severe weather storms can still trigger a trauma blight incident, especially if blight has occurred earlier in the season. Late-season shoot blight seldom causes severe damage and is often ignored. These strikes, however, should be cut out promptly. |

¹ Excerpted from *2007 Spray Guide for Commercial Tree Fruit Growers*, Virginia, West Virginia, and Maryland Cooperative Extension Publication 456-419, pp. 82-84.

Figure 1. Comparison of conventional and ugly stub pruning methods for fireblight control

