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FACT SHEET

Fire Blight Management at Bloom

Understanding Management from Disease Biology

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Fire blight, caused by the bacterial pathogen *Erwinia amylovora*, is an important and potentially devastating disease of apple and pear. Although the bark and healthy leaves provide protection from invasion by fire blight bacteria, flowers can be highly vulnerable. Thus, bloom time is a very important stage for fire blight infection because the natural openings in the hypanthium tissue of the apple flowers provide the fire blight bacteria an easy entry into apple trees (Figure 1).

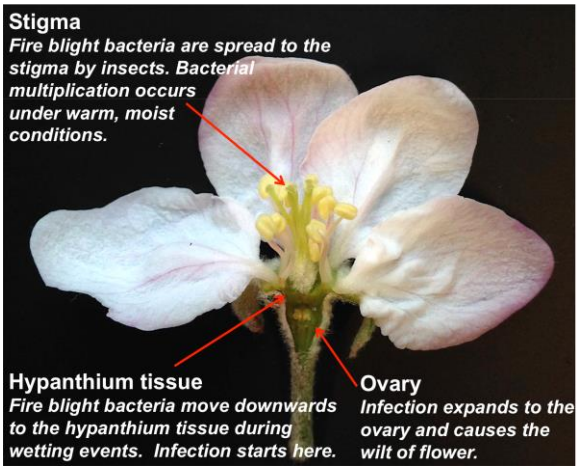

Figure 1. Illustration of parts of an apple flower that are targeted by the fire blight pathogen during infection. Photo taken at CAES in New Haven, CT.

In order to enter flowers, fire blight bacteria first need to be transported into the flowers. The bacterial inoculum comes from the overwintering fire blight cankers. In early spring (usually between half-inch green and pink), the overwintering bacteria exude from cankers onto the bark (bacterial ooze). Ooze contains billions of bacterial cells and is attractive to many insects such as flies and honeybees. These insects can spread the pathogens to the stigmas of apple flowers during their visits to the flowers. The bacteria can also be dispersed by rain or strong winds.

Notes for Management:

1. Winter pruning of fire blight cankers and copper sprays during green tip can significantly reduce fire blight inoculum in orchards, which subsequently reduces disease pressure for upcoming season. For more detailed information on winter pruning, please refer to my previous Fact Sheet (*Winter and Early Season Fire Blight Management*) available on the CAES website. http://www.ct.gov/caes/lib/caes/documents/publications/fact_sheets/plant_pathology_and_ecology/winter_and_early_season_fire_blight_management_02-18-15.pdf

Once on the stigmas, the fire blight bacteria can utilize nutrients from the apple stigma and start to multiply (Figure 1). As a high number of bacteria cells are required to cause infection, and the life span of an apple

flower is only about 3 days from full bloom to petal fall, bacterial multiplication must occur fast enough so that a large population can build during the 3-day window. During this process, weather conditions play a critical role, as warm (>60°F) and moist conditions from wetting events such as rainfall, heavy dew, or fungicide sprays can significantly facilitate bacterial multiplication, compared to cool, dry conditions. For instance, at 75°F with heavy dew, fire blight bacteria can double the size of its population within 30 minutes whereas under 50°F with dry conditions, the bacterial doubling time could be as long as one day. Because weather has such a critical role during blossom blight infection, multiple prediction models have been built to predict the fire blight risk levels based on weather. Degree Hour sum (DH) in CougarBlight as well as Epiphytic Infection Potential (EIP) in MaryBlyt are two commonly used indicators of fire blight risk levels.

Notes for Management:

1. Closely monitor weather conditions during bloom. Determine if the weather conditions are conducive for fire blight using either CougarBlight or MaryBlyt.
   CougarBlight: http://newa.cornell.edu
   MaryBlyt:
   http://www.caf.wvu.edu/kearneysville/Maryblyt/
2. Apply antibiotics or copper if the fire blight risk is indicated as "high" or "extremely high."
3. Fungicide spray during bloom could add a "wetting event" and facilitate bacterial multiplication. Thus, avoid applying fungicide without mixing with streptomycin when sprays are applied at bloom. Do not mix Regulaid with captan, as it may cause phytotoxicity. Use mancozeb instead.

Under conditions of low fire blight risk, bacterial multiplication on apple stigmas is slow and the infection is unlikely to happen. However, under conditions of high or extremely high levels of fire blight risk, application of antibiotic or copper on flowers is necessary to prevent the buildup of bacterial population on stigmas. Without any control, bacterial populations could reach to as high as 10^6 cells per stigma under fire blight-conducive weather conditions. With the help of wetting events, bacteria can move from the stigma downwards to the hypanthium tissue and infect the ovary (Figure 1). Once established in the flower, fire blight bacteria can move internally to other parts of the tree, causing shoot blight and canker blight. At this point, surface applications of antibiotics will no longer work, since the fire blight bacteria are now inside the tree. Young (<5 years old) trees are more susceptible to fire blight than older trees. Vigorously growing tissue is more susceptible than tissues that have hardened up.

Notes for Management:

1. Under conditions of high risk, every open blossom needs to receive antibiotic spray at least once. Since flowers do not open all at once, multiple sprays may be necessary to cover all the blossoms, especially if weather conditions are favorable for disease. However, applying more than 4 sprays in one orchard per year may increase the risk of inducing antibiotic resistance in the bacterial population and is not suggested. If more than 3 sprays of streptomycin are applied during bloom, reduce the dosage of Regulaid to half in the 2nd and 3rd spray to reduce the phytotoxicity of Regulaid.
2. Antibiotics can be degraded by sunlight and washed off by rainfall. A study by

Dr. H. Scherm from GA showed that the antibiotic oxytetracycline is stable for 2-3 days under cloudy weather but only stable for 1-2 days under sunny weather. Application of antibiotics in late afternoon helps to reduce degradation by sunlight. Since a heavy rainfall can wash off the majority of antibiotics, re-application is needed in those cases.

3. Streptomycin (Agri-mycin17) remains the first choice for blossom blight control in New England due to its higher control efficacy and lower cost compared to other products. Streptomycin resistance has not been reported in fire blight bacteria in New England, but has been reported in several other areas of the U.S., including New York, Michigan, and Washington. I am conducting a survey to scout for streptomycin-resistant bacterial isolates in New England this year.
4. Kasugamycin (Kasumin) works as well as streptomycin, but costs almost 3 times more than streptomycin. It is mainly used in regions (Michigan mostly) where streptomycin is no longer effective in fire blight control.
5. Oxytetracycline (Mycoshield) inhibits bacterial growth but does not kill the bacteria, so it does not work as well as streptomycin. Research studying the combination of oxytetracycline with biocontrol methods is ongoing on the West Coast.
6. Antibiotics can no longer be used for fire blight control in organic fruit production after 2014. A combination of Cueva, a copper product, (2qts/A) mixed with Double Nickel, a biocontrol product, (1qt/A) is suggested for organic growers in substitution of antibiotics in PA by Dr. K. Peter. However, fruit russeting may occur due to the usage of copper.
7. Biological controls such as Serenade, Double Nickle, Bloom Time, and Blossom Protect provide about 40-50% control compared to 80-90% control by streptomycin in eastern United States. These products could be used when the fire blight risk is low (e.g., DH in CougarBlight is below 250 or EIP in MaryBlyt is below 150%). However, these biological controls cannot provide effective control under high fire blight risk conditions (e.g., DH is greater than 300 or EIP is greater than 200%).
8. Prioritize sprays to protect newly planted young trees. However, under extreme high disease pressure, even older trees and resistant cultivars can be infected.
9. Apogee (plant growth regulator, prohexadione calcium) can be applied at petal fall to control shoot blight by facilitating the hardening up process. Early timing is critical (best timing is when king flower is at petal fall according to Dr. D. Rosenberger) for the best effect. Multiple low-rate applications are better than a single high-rate application. Do not apply Apogee to Empire or Winesap.

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If you observe fire blight in your orchard, please contact me (Dr. Quan Zeng) at the Connecticut Agricultural Experiment Station. I would like to come and collect samples from your orchard to determine the susceptibility of the isolates to streptomycin. With your help, I believe we can keep the fire blight under control this year!

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