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Fire blight, its biology and management

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Fire blight is a destructive disease of apple, pear and woody ornamentals. The disease is caused by a bacterium that is named *Erwinia amylovora*. Fire blight is native to North America. It was first reported in 1780 on pear and quince in the Hudson Valley of New York. The name 'fire blight' was derived from the characteristic blackening of vegetative tissue caused by the disease, often making trees appear as if they were burnt.

DISEASE BIOLOGY

E. amylovora most commonly over-winters in fire blight cankers (infected woody tissue from the previous season). In spring, bacteria multiply at the margin between infected and healthy tissue. Usually only a small proportion of the cankers in an orchard will produce inoculum. Although active cankers will often produce liquid ooze on their surface, fire blight bacteria can be isolated from active cankers in the absence of ooze. In addition to cankers, bacteria have been reported to over-winter in dormant buds and in internal healthy plant tissue. Although contaminated planting material is important in the introduction of the pathogen to new areas, infested buds and internal bacteria are not considered important sources of primary inoculum in orchards with a prior history of fire blight.

During bloom, bacteria can be transferred from active cankers to blossoms by water (rain, irrigation, or dilute chemical sprays) or by insects (ants and flies). Bees are important in spreading bacteria among blossoms. In blossoms, fire blight bacteria can multiply on the surface of the stigma without causing disease. Large populations of bacteria can develop on the surface of blossoms when warm temperatures occur during bloom, enhancing the likelihood of blossom infection. Blossom infection usually occurs when bacteria are washed by rain from the stigma to nectaries located in floral cup, although other flower parts can also be invaded.

Much less is known about the process by which shoots become infected. Shoot infection can occur following injury caused by hail or high winds if fire blight bacteria are present in the orchard due to blossom infections or active cankers. The bacteria can also move within the plant from blossoms infections to nearby shoots to initiate infection. Internal fire blight bacteria can also be found in more distant, symptomless shoots, however, the role of internal bacteria in initiating new shoot infections is poorly understood. In addition, it is thought that insect feeding in the presence of bacteria can result in shoot infection. However, although almost 100 different insects have been reported to be associated with the dissemination of fire blight, there is a lack of information demonstrating the importance of specific insects in the shoot blight phase of the disease.

Recently, fire blight of apple rootstocks has become a serious economic problem in high-density orchards. Most apple growing regions have adopted the use of high-density orchard systems that depend on dwarfing rootstocks to control tree size. The commonly used dwarfing rootstocks, Malling (M.) 9 and M.26, are highly susceptible to fire blight, and infection usually kills trees by girdling the rootstock. Several avenues of rootstock infection have been demonstrated, including infection of rootstock suckers (vegetative shoots developing from the rootstock), internal spread of internal bacteria, or direct infection of the rootstock through discontinuities in the bark caused by growth or various injuries, including boring insects.

Several terms are used to refer to the various phases of fire blight. Blossom, shoot and rootstock infections are referred to as 'blossom blight', 'shoot blight' and 'rootstock blight', respectively. 'Trauma blight' describes fire blight infections due to wounding by hail, high wind or freezing injury. 'Canker blight' refers to the renewed activity of over-wintering cankers that can result in oozing from bark and infection of new shoot growth.

DISEASE MANAGEMENT

Despite the destructive potential of fire blight, it is sporadic in its occurrence. The disease can cause little damage in an area for several years but then be followed by severe epidemics once environmental conditions are favorable. Effective management of fire blight requires the integration of several practices aimed at reducing the amount of initial inoculum, imposing barriers to successful establishment of the pathogen, and reducing host susceptibility to infection.

Removal of cankers during winter pruning is a critical component of fire blight management. Management strategies also include the application of early season copper sprays to reduce primary inoculum in the orchard and pruning out early season infections after bloom to reduce inoculum available for shoot infection.

Preventing blossom infection is also a critical component of fire blight management. Streptomycin (17WP ½ lb/100 gallons) is effective in preventing blossom infection but must be applied precisely to coincide with fire blight infection periods. Several models, such as Maryblyt^{TM} and Cougar Blight, can predict the occurrence of blossom infection periods. In general, antibiotic applications are recommended during bloom when weather has been relatively warm, and there is a high probability of rain and temperatures greater than 65^{o} F in the next 24 hours. Although blossom blight control has relied heavily on antibiotic sprays, significant progress has been made in the biological control of blossom infection and commercial products are currently available. In general, biological control agents should be applied during early bloom so that they can become established prior to the occurrence of infection periods. Antibiotics are not recommended for the control of shoot infection due to their limited efficacy and to reduce the chance of the fire blight bacteria developing resistance to the antibiotic. However, antibiotic application is recommended following a hailstorm in orchards with fire blight infections.

Management practices that minimize excessive vegetative growth will reduce plant susceptibility to fire blight infection. Prune orchards frequently to avoid having to make larger cuts that encourage the development of many highly susceptible suckers. Growth regulators, such as Apogee (BASF), that reduce shoot growth also reduce fire blight intensity. Excessive applications of nitrogen, including barnyard manure, should be avoided. Serious fire blight damage can usually be avoided by planting scion varieties and rootstocks with resistance. Unfortunately, current markets and production economics are encouraging the fruit industry to move in exactly the opposite direction.

CONCLUSION

After more than a century of research, a great deal is known about fire blight and its causal agent, yet the disease remains a serious threat to the pome fruit industry. The ability of the bacteria to infect different host tissues and the limited number of effective management practices available make it difficult to stop or slow the progress of the disease. In addition, the sporadic nature of the disease encourages growers to become lax in implementing costly control practices after long periods without serious fire blight outbreaks.

Due to the widespread use of streptomycin to control fire blight, streptomycin-resistant *E. amylovora* strains are now common in several regions of the U.S. Finding alternative control agents to replace, or supplement, streptomycin is an important goal for future research. Currently, no effective cultural practices or chemical

treatments are available to control the rootstock phase of fire blight. Development of apple rootstocks that combine desirable pomological characteristics with resistance to fire blight, such as B.9 and G.16, has the potential of providing practical control for rootstock blight in the future.

NOTES

Mention of trade names or commercial products in this report is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

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