# Problems in Managing Fire Blight in High Density Orchards on M-9 and M-26 Rootstocks

**Paul W. Steiner**, Extension Fruit Pathologist
University of Maryland, College Park, MD

(Presented at the Annual Meeting of the Va./W.Va. State Horticultural Societies, Roanoke, Va., January 12, 1998)

## Introduction

Fire blight has been known in North America for over 200 years and throughout much of that history, its management has been difficult because we lacked essential details about the nature of the infection process. This knowledge gap is becoming even more critical now since changes in orchard management practices implemented over the last two decades have increased our vulnerability to devastating blight epidemics. Four factors contribute to this increased risk. First, instead of planting 100 to 200 trees per acre, we now routinely set between 500 and 1,000 trees per acre. Second, the only way to accomplish such high tree densities is to use size controlling rootstocks like M-9 and M-26 which are both widely used and very susceptible to fire blight. Third, fresh fruit market demands have encouraged widespread plantings of many new varieties such as Gala, Fuji, Braeburn, Granny Smith, Empire, Gingergold, and Jonagold which, along with older favorites like Rome, Ida Red and Jonathan are all very susceptible to fire blight. Finally, in adopting the tree training systems needed to make high density plantings more productive, the trees are pushed into bearing early and deliberately maintained with a minimum of vegetative structure so that some natural physiological mechanisms that resist the progress of infections may be reduced. The purpose of this report is to summarize developments over the last 10 years which have the potential to reduce the risks for damage in today's orchards.

## What is rootstock blight?

What makes fire blight a truly significant problem in high density orchards planted on either the M-26 or M-9 rootstock is a phenomena called "rootstock blight". While the blighting of these rootstocks has been observed for many years, it was thought that the primary avenue for infections by the bacterium, *Erwinia amylovora*, was fairly direct through root suckers, cracks in the bark or insect injuries below the graft union. Based on numerous observations over the last 10 years and research conducted at the University of Maryland in the early 1990s, we know now that the primary route of entry for the bacteria into the rootstock is internally, through otherwise healthy limbs and trunks from even a few blossom or shoot strikes on the scion variety. Once the bacteria reach a susceptible rootstock, they initiate the formation of new cankers that can completely girdle and kill the tree in one to a few months.

We have seen rootstock blight in the field and reproduced it in the greenhouse on other rootstocks such as M-7A and M-111, but the rootstock cankers that develop are never as aggressive as they are on M-26 and M-9 and rarely kill trees. We still lack key information on the physiological and environmental factors that determine if and when rootstock cankers

develop, because not all trees showing scion infections later succumb to rootstock blight. Nevertheless, our observations in Maryland and those of researchers in New York estimate that an average of between 5 and 15 percent of the trees in an orchard showing symptoms of scion infection (blossom, shoot or trauma blight) die each year once trees begin flowering. Keep in mind that this is an *average* loss, and that losses as high as 60 to 80 percent of the trees in a young orchard over a two year period have been observed more than once in several locations.

In this region, the gross symptoms of rootstock blight occur in four phases: 1) oozing of bacterial masses from the rootstock within 2 to 4 weeks after symptoms appear on the scion variety; 2) rapid death of the entire tree in late June to late July; 3) the development of early fall red color in late August to early September on the leaves of trees that are partially girdled but will die before winter; and, 4) early decline and death of the tree in the spring following infection, often showing the active development of a bark canker extending upwards into the scion trunk from the rootstock. Be aware, too, that where hail or high winds contribute to a trauma blight event, tree losses due to rootstock infections with M-26 and M-9 also can occur on normally resistant Delicious trees even though the scion strikes may not run very far.

In the future we hope to have a number of fire blight resistant rootstocks capable of producing a tree with all of the characteristics needed for high density orchards. Until these can be fully tested and made available, however, we have no direct methods for controlling the rootstock phase of infections. Our only alternative is to change the way in which we approach fire blight management using existing tactics; this is entirely possible.

**Managing Fire Blight**

As our approach to growing apples has changed, so too must our philosophy about pest and disease management. Before looking at the specifics of an aggressive blight management program it may be useful to first look at what is meant by plant disease management. *Plant disease management is the knowledgeable selection and use of all appropriate technologies to suppress the damage caused by diseases below an acceptable economic threshold.* The words "management" and "control" are often used interchangeably when, indeed, they often imply different ideas that can influence how well a disease management program works. Some 20 years ago, J. Lawrence Apple summarized these differences. The word "control", for example, implies a degree of dominance by man that is simply impossible. It also implies a degree of finality of having controlled and, thereby, dispatched the problem through some specific action on the part of the grower. "Management", by contrast, implies a continuing effort or process addressing all phases of the disease and the crop rather than the application of some specific extrinsic factor. Management also implies that our primary goal is to reduce the harm caused by disease, not to kill pathogens. As semantic as it might seem, the significance of this difference in approach is clear when we look at the success we've had in dealing with fire blight.

As a perspective on why I recommend this approach, keep in mind just a few of the reasons why fire blight is such a formidable foe.

- Unlike apple scab where primary inoculum is dispersed just prior to infection, fire blight bacteria are dispersed widely for several weeks to a month or longer before actual inoculation and the first infections occur.
- The fire blight pathogen, *Erwinia amylovora*, is a competent epiphyte capable of colonizing and multiplying on the surfaces of plants. Furthermore, it makes little difference whether the plants colonized are susceptible or resistant to fire blight.
- At moderately warm temperatures in the 65-75$^{o}$F range, the bacterium has the potential to double every 20-30 minutes. One bacterium gives rise to 1 trillion cells with just 31 divisions which occur within just 2-3 days.
- Because blossom infections occur within minutes, even a single wetting event under the right conditions at bloom can increase the number of inoculum sources in an orchard from a few overwintering cankers to several hundred thousand blighted spurs very quickly. Indeed, when conditions are favorable, just spraying water at bloom can incite 100s of blossom infections per tree.
- Each new infection provides trillions of new bacteria available for dispersal by wind, water and insects contributing to secondary infection cycles and additional losses that often develop exponentially over time.
- Where hail or high winds strike a otherwise healthy orchard that has been colonized by the bacteria, fire blight infections can be initiated on nearly every tree, even on Delicious trees that generally exhibit strong resistance.
- In orchards where fire blight has occurred previously, primary inoculum arises from overwintering cankers, many of which are small and difficult to find\remove. This inoculum along with any subsequent inoculum contributed from infected blossoms fuels a continuing epidemic of shoot blight and can set the stage for the infection of mature tissues in a trauma blight situation.

The only way to manage fire blight under the high risk conditions present in our modern high density orchards planted to susceptible varieties on highly susceptible rootstocks is by implementing an aggressive fire blight management program. The program outlined here focuses on reducing the number and distribution of inoculum sources within an orchard on a continuing basis throughout the year, every year, regardless of how much blight occurs.

Without question and before any other steps are taken, it is mandatory that all visibly infected spurs, shoots and limbs be removed during the dormant pruning period. A complete coverage copper spray is recommended at green tip and should be applied using a total spray volume that ensures thorough wetting of all bark and bud surfaces on ALL trees in a given orchard block, not just on susceptible varieties. The purpose of this treatment is to reduce the efficacy of primary inoculum in colonizing these surfaces during the prebloom period. Copper is NOT effective in killing the bacteria harbored within cankers or in preventing that inoculum from being extruded onto the bark surface.

Streptomycin antibiotic is the only material available that has the potential to fully protect the highly susceptible apple and pear flowers, but for maximum effect it must be applied the day of or the day before an infection event occurs. The *MARYBLYT* forecasting program works very well in the mid-Atlantic region for identifying periods of high risk for infections and in identifying specific infection events when they occur. Missing that critical window of

effectiveness by even 24 hours can result in only 80-90% control and those infections that do arise can provide significant amounts of inoculum for later infections and a continuing epidemic

The *MARYBLYT* program can also help in timing orchard monitoring efforts to locate new infections because it accurately predicts what kind of symptoms are likely to be found and when. Here, symptoms of both blossom blight and canker blight are important. In years when blossom blight is well controlled or when no blossom infection events occur, the importance of locating and thoroughly removing all sources of canker blight early cannot be under stated. Even a few active cankers in an orchard can supply the initial inoculum needed to place the whole orchard at risk from the ravages of shoot and trauma blight.

Keep in mind that, because of the inoculum potential and the ability of new inoculum to be repeatedly dispersed throughout an orchard by wind, splashing rain and insects, ***there is no such thing as a "little bit" of fire blight!!*** An aggressive fire blight management program requires that all infections, regardless of their apparent insignificance in location on a tree or time of year, be removed quickly as soon as symptoms develop. Note that I say "as soon as symptoms develop" and not "as soon as you find it" or "as soon as the number of new strikes seems to slow down". This is because the advantage of reducing inoculum potential and having an effect on this year's epidemic passes quickly. The late removal of blighted shoots and limbs is, in effect, little more than revenge because the bacteria they release have already be redispersed many times in the orchard.

As a general rule, I suggest that if you can remove all of the blight showing within two days after it begins to appear, do it. If it will require much longer, it may be best to let nature take its course and concentrate your efforts on cutting for salvage where infections threaten to enter the main tree stem or occur in the tops of trees. The cutting effort also goes much faster if additional time for tool sterilization between cuts is not needed. In our work, we have found the bacteria in the internal bark tissues of limbs 3 to 9 feet ahead of any visible symptom. Note, too, that even where pruning tools and the bark surfaces where cuts are to be made are *both* thoroughly sterilized, small cankers still develop around the cutting wound in a large number of cases. Where removal cuts are made in the traditional fashion of pruning back to the next healthy branch union, many small cankers will be missed during the dormant pruning effort and will provide inoculum for the next year=s epidemic.

All cutting to remove fire blight should be done following the "ugly stub" procedure. Here, blighted shoots and limbs are cut 8 to 12 inches or more below any visible symptoms (same as in traditional recommendations), but leaving a naked stub in wood that is at least 2 years old and approximately 4 to 5 inches short of the next branch union or spur. The inevitable cankers that will form on many of these cuts are then in a position so that they can be easily removed during the dormant period when it is too cold for the bacteria to produce a new canker. Finding such "ugly stubs" in the winter is made easier if, at the time of cutting, the stubs are spray painted with bright orange paint. This two-step cutting procedure is designed to eliminate cankers from the orchard and, thus, reducing the inoculum potential and the risks for early orchard colonization in the following season. Remember that, in years when fire blight is not severe and only a few trees are involved, you can afford to be more severe in your cutting operations. This means that whole

limbs or trees can be removed without having a significant effect on the current season's crop while having a major impact on how much inoculum might be available in subsequent seasons.

**The Payoff with Good Management**

Fire blight is a "new world" disease. The bacterium, *Erwinia amylovora*, was already in North America when the first colonists arrived and probably caused infections on native species of crab apple, hawthorn and mountain ash. Since the late 1950s, fire blight has marched through all of Europe, the Middle East and into Asia. None of the often drastic measures tried by more than one government to eradicate the pathogen from early sites of infection have been successful. Since the introduction of *MARYBLYT* and emphasis on the adoption of an aggressive fire blight management program in Maryland over the last 10 years, we have observed not only an overall improvement in the level of control, but a reduction in the amount of spraying required and, most significantly, the ability to withstand severe hail events with only minor secondary losses due to fire blight where, previously, such incidents would have resulted in serious tree losses.