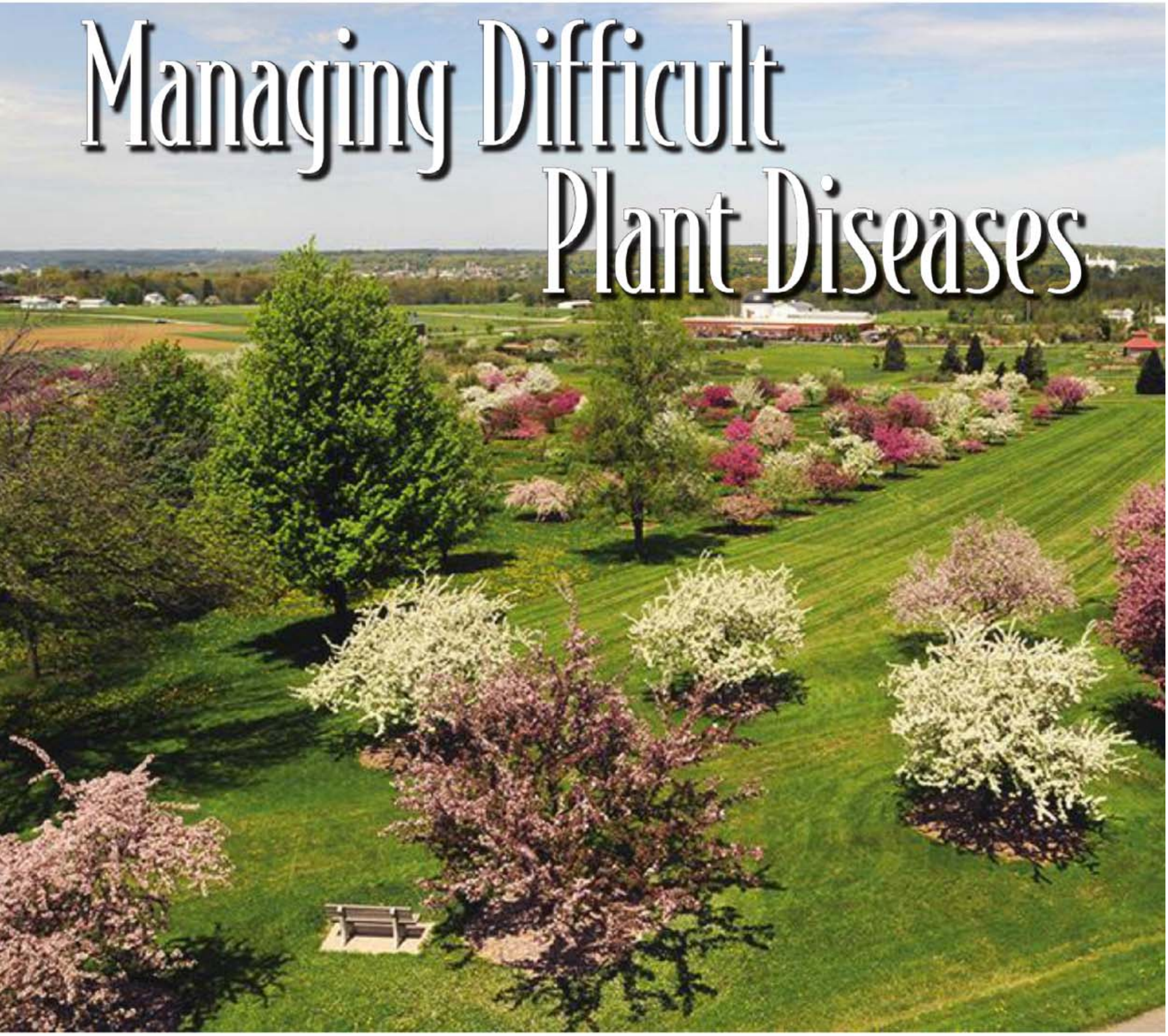
Managing Difficult Plant Diseases



By James Chatfield, Joe Boggs, and Erik Draper

Turf professionals often speak about why plant diseases are so difficult to manage. They generally note some key challenges, including how the inoculum of plant pathogens is microscopic and how they do not see the pathogen arrive on a plant, germinate, penetrate, and infect it. By the time visible symptoms develop, it is too late to prevent the invisible (to the naked eye) infection that has already occurred days, weeks, or months earlier.

Photo © Ken Chamberlain. Photo courtesy Ohio State University

Secondly, disease control is almost totally preventative, not reactive. For true prevention, turf managers should choose species or cultivars with genetic resistance to disease or planted into situations where disease is less likely to develop.

Another challenge involves anticipating how bad rose black spot or apple scab, for example, will be in a given year, depending on how well turf professionals can predict the weather.

Further complicating matters is that pathogens change. This means while horticulturists busily go about breeding for genetic resistance to a particular disease, nature works 24/7 via mutations and natural selection. The resulting new strains of the pathogen, such as the *Venturia inaequalis* apple scab fungus in Ohio that overcomes the genetic resistance of 'Prairifire' crabapple, can be difficult to predict.

A final challenge is dealing with numerous host plants, which is especially difficult for the green industry since there are hundreds of genera of ornamental plants, each with their own particular set of diseases.

All pathogens are not created equal

Plant pathogens—such as certain fungi, bacteria, phytoplasmas, nematodes, and viruses—by definition are parasites, infecting living plant cells. However, there is quite a range from obligate parasites (which only survive on living cells) to opportunistic pathogens (which mostly live on already dead cells as saprophytes, but also make a living as parasites on dying or stressed plant cells).

A good example of a pathogen thriving both as saprophyte and parasite is the *Botrytis* grey mould fungus, which infects many plants from herbaceous geraniums to woody plants in propagation situations. Imagine a world where a perfectly healthy

Sycamore anthracnose occurs only on sycamores and London plane trees and is favoured by infections during cool, wet weather as new leaves emerge in spring.

geranium plant has a part that is dying, such as flower blossoms that senesce and die with age. As this living blossom tissue dies, *Botrytis* colonizes it by feeding on these dead and dying cells. The pathogen rapidly multiplies, especially in cool and moist conditions, and then those infested geranium florets fall on healthy leaf tissue in great numbers with moisture, blocking the sun where they fall. Those healthy leaves then develop *Botrytis* blight.

Inoculum is microscopic

Inoculum is the structure or part of the pathogen that initiates disease. Microscopic, it can take the form of:

- spores or threadlike mycelia of fungi;
- bacterial cells;
- parasitic eelworms known as plant parasitic nematodes; or
- submicroscopic particles of viruses or phytoplasmas—so small even regular light microscopes cannot detect them.

One of the reasons infectious plant diseases were mysterious for so long, and why disease management is complicated, is the inoculum of the pathogen is invisible to the naked eye when it arrives at the plant, where it then penetrates and infects the plant tissue. Green industry professionals consider insects and mites to be small and hard to see, but they are gargantuan compared to virulent plant

Rose black spot disease occurs only on genetically susceptible roses when there are periods of leaf wetness long enough for infection to take place.

Apple scab disease on crabapple occurs only on certain crabapple types. Though it does not kill the plant, it may make them unsightly with considerable leaf drop.

pathogens that cause infectious plant disease, along with the other two components of the disease triangle—'the susceptible host' and the 'environment conducive to disease.'

Inoculation, infection, and symptoms separated in time

The inoculum that arrives at the plant via wind, splashing rain, or a vector cannot be seen. Then, a spore germinates and penetrates into plant tissue, a nematode inserts its stylus into the plant, or a vector inserts the pathogen into plant tissue, and the pathogen is still not seen. It spreads through the plant and establishes a host-parasite relationship with plant cells.

Turf professionals have no idea the pathogen is there until symptoms develop on the plant (*e.g.* leaf blighting and discolouration along the veins of a sycamore due to an infection from the sycamore anthracnose pathogen). Symptoms can develop days, weeks, or sometimes even months or years after inoculation, penetration, and infection. Green industry professionals are effectively in the dark all that time. Among other things, this makes effective timing and use of disease-controlling pesticides such as fungicides difficult. Symptom development and damage to the plant may be inevitable even when the infected plant looks fine.

Bacterial fireblight only occurs on certain plants in the rose family, such as Callery pear (pictured), crabapple, mountain ash, pyracantha, and cotoneaster.

Even though a florist's geranium may be healthy, bloom tissue does senesce and die, providing just the sort of plant tissue susceptible to the *Botrytis* grey mould fungus.

Disease control is preventative, not reactive

Since green industry professionals cannot see inoculation and infections occur, they must act proactively with regard to plant diseases. In many cases, this means they need to use fungicide applications to prevent the germinated fungal spore from getting into plant tissue in the first place (though there are systemic fungicides that sometimes help).

A better, more sustainable approach is to employ their knowledge of genetic disease resistance, plant health, and plant stress management to optimal effect. Green industry professionals need to recognize Sargent and Adirondack crabapple have excellent resistance to apple scab, compared to thunderchild and hopa. If they know there is a site with the *Verticillium* fungus well-established in the soil, which they can know from previous *Verticillium* wilt diagnoses, then they should not plant highly-susceptible species such as Japanese maples (*Acer palmatum*).

Selecting the right plant for the right site is the greatest preventive maintenance practice tree professionals can use, not only for infectious disease management, but also for overall plant health. Eastern redbuds planted in open sun on unirrigated sites are more likely to become moisture-stressed and are more likely to have *Verticillium* wilt problems as well as *Botryosphaeria* canker disease—the two most common infectious disease problems of Eastern redbuds that

Pictured is a healthy Pelargonium bloom (*i.e.* florist's geranium), which will soon senesce.

cause stem dieback and eventual plant death. Preventing these diseases from the very beginning can occur by not planting redbuds in those sites.

Weather is unpredictable

The environmental component of the disease triangle is crucial for plant diseases. Plant pathologists talk about infection periods for specific plant diseases and whether these periods occur depend on such things as the number of hours of leaf wetness and relative humidity. Of course, this in turn is influenced by temperature. All this plays into the overall weather, which can be difficult to predict over the short term, to say nothing of an entire growing season.

Temperature and moisture, for example, play a big role in development of fireblight disease. Bad years for fireblight on callery pear or crabapple usually relate to how warm and wet it is during bloom. The years where there are massive blossom infections—the greatest occurrence is during wet weather during extended periods over 16.7 C (62 F)—are those where fireblight is worse. So, it depends on whether these conditions occurred during the bloom of a particular callery pear or crabapple in a particular part of the province or region.

Anthracnose diseases on oak, sycamore, and ash depend greatly on cool, wet conditions during leaf emergence on these trees. Oak anthracnose is very noticeable on the lower canopy (less air movement) only once in a while—the years where that oak (mostly in the white oak group) have leaves emerging during extended cool, wet weather. Bad years for rose black spot depend on the number of times there are a certain number of hours of leaf wetness (exact number of hours needed depends on the temperature variable) for the pathogen spores to germinate.

Pelargonium blooms infested with *Botrytis* fall on healthy leaves. The result is *Botrytis* blight on leaves.

Polyporuis squamosus (*i.e.* Dryad's saddle) bracket fungus, like many fungi, is both a saprophyte and a parasite.

For the most part, tree professionals cannot use phenological calendars for infectious tree diseases. Using phenology—the relationship of environmental factors such as temperature to physiological events such as flowering of plants or emergence and development of insects—for insect control timing is fairly straightforward since it involves simply the temperature variable (heat units and degree days). With plant diseases, it is more complex because of the role of moisture in addition to temperature.

Pathogens change

The reality is all green industry professionals are proud when they notice genetic resistance in plants to infectious diseases. In fact, sometimes they go to considerable lengths and time with plant-breeding to develop plants to provide both desired arboricultural characteristics and resistance to certain diseases. However, they have to remember nature has its own breeding experiments 24/7. Over time, pathogens mutate, overcome resistance, and parasitize plants that once truly had good genetic resistance relative to a particular disease. However, disease resistance is not necessarily forever, so green industry professionals must keep studying, learning, and adapting.

Numerous host plants

Green industry professionals deal with hundreds of different host plants, different species of maples (*Acer*) and oaks (*Quercus*), and different genera from *Acer* to *Zelkova*, from *Quercus* to *Xanthophyllum*.

Each of these plants has their own set of diseases and other problems. Industry professionals need to remember the multiplicity of host plants creates an extra layer of information for them to keep track of: apple scab does not occur on roses, Dutch elm disease does not occur on oak, black knot does not occur on pears, and sycamore anthracnose does not occur on oak. Each host not only has its own set of horticultural best practices, but also its own set of disease weaknesses.

Infectious plant disease management is challenging, requiring an approach of "the prevention is better than a cure, and in fact is typically necessary." It also needs careful attention paid to the unique profile of each disease. Nevertheless, it is a key ingredient in good groundskeeping and healthy plant management.

James Chatfield is an associate professor and an extension specialist with Ohio State University (OSU) Extension in the Departments of Plant Pathology and Horticulture and Crop Science. He has more than three decades with the green industry and educational institutions as a grower, plant problem diagnostician, plant pathologist, and horticulturist. Chatfield can be reached via e-mail at chatfield.1@osu.edu.

Joe Boggs is an assistant professor and an extension specialist with OSU Extension in the Department of Entomology in Hamilton County, Ohio. He has more than three decades of experience with the green industry, public and educational institutions as a grounds manager, plant problem diagnostician, and entomologist. Boggs can be contacted at herms.2@osu.edu.

Erik Draper is an assistant professor and county director with OSU Extension in Geauga County, Ohio. He has more than three decades of experience with the green industry as a grower, landscaper, and with educational institutions in the area of horticulture, plant evaluations, and plant problem diagnostics. Draper can be reached at draper.15@osu.edu.