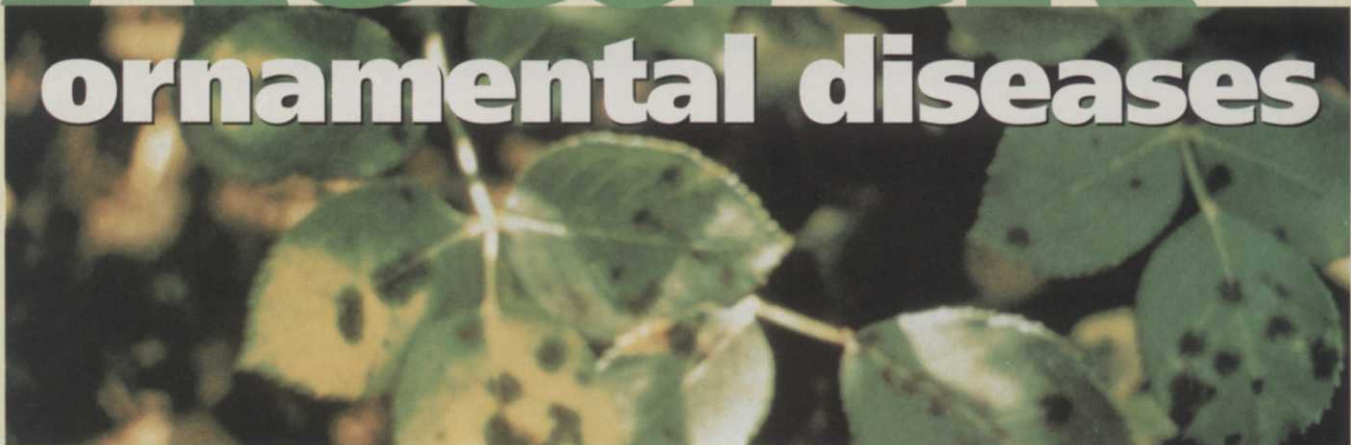


Attack

ornamental diseases



Use the “disease triangle” to help you protect valuable ornamentals

By JAMES A. CHATFIELD

A key concept in understanding infectious diseases (those involving pathogens such as fungi, bacteria and viruses) is the disease triangle. This concept is simple, yet powerful. It includes:

- ▶ a host plant susceptible to a particular disease
- ▶ a virulent disease-causing organism (pathogen)
- ▶ an environment conducive to that disease.

Without all three components, infectious disease will not occur. For example:

- For many fungal diseases, the number of hours of leaf wetness is the key environmental condition necessary for infection. Imagine the pathogen involved in black spot of rose (*Diplocarpon rosae*) present on

last year's leaves, which remain on the ground, where black-spot susceptible roses are grown. Two components of the disease triangle are present. However, if the weather is dry for two months, irrigation water is kept off the foliage and good air movement is provided by pruning and proper plant siting, black spot will not be severe, because the key environmental element — leaf wetness — is absent.

• If apple scab fungus is abundant, it is a very moist spring and there is a susceptible crabapple such as *Malus* 'Radiant,' all three components of the disease triangle are present and significant scab disease will occur. However, if the cultivar is *M.* 'Prairifire,' with excellent genetic resistance, scab will not generally occur. The susceptible host is the missing component of the triangle.

All three components of the disease triangle must be present for disease to occur.

▲ rose black spot

Using the disease triangle to highlight different control strategies in these cases, would involve using:

- ▶ resistant varieties
- ▶ quarantines to exclude the pathogen
- ▶ cultural practices to modify the environment.

The disease triangle concept is a powerful tool, not only to understand disease, but to think about multiple ways to control diseases.

Case study: Rose black spot

As an example, here are some disease management strategies for rose black spot disease, caused by *Diplocarpon rosae*.

Black spot is the most important infectious disease of roses. It occurs only on roses (*Rosa spp.*), and is widespread among most rose species and cultivars. Many hybrid tea roses are very susceptible. Lists of black spot-resistant roses



often are variable due to localized races of the pathogen.

The round to irregular black splotches with fringed margins occur mostly on upper leaf surfaces, and defoliation of infected leaves is common. Repeated defoliation weakens plants, leading to poorer blooming and greater sensitivity to other stresses.

The fungus overwinters on fallen leaves and diseased canes. Microscopic spores are then splashed to newly emerged leaf and stem tissue in the spring. Under ideal conditions of leaf wetness, humidity and temperature, the spores can germinate and infect in one day, cause symptoms in four to five days, and produce spores that can infect additional leaf, flower and cane tissue within 10 to 11 days. Spores can easily spread to new locations by air currents.

• **Strategy 1: Keep foliage dry.** Plant roses in sunny locations to encourage drying. Avoid sites with dense surrounding vegetation. Avoid overhead irrigation, especially late in the day. Black spot is most severe with sustained rainy periods.

• **Strategy 2. Keep it neat.** Remove all black spotted leaves from and around plants, throughout the season. Before winter or before leaves emerge in the spring, remove and clean up all diseased leaves and remove diseased canes where possible.

• **Strategy 3. Select for resistance.** In spite of localized races of the fungus, lists of disease-resistant varieties should always be a part of plant selection decisions. For these lists, check references such as "Pest Resistant Ornamental Plants," by D.C. Smith-Fiola of Rutgers Cooperative Extension.

• **Strategy 4: Use preventive fungicide sprays.** Fungicide controls are not successful if you don't follow cultural and sanitation practices. Make applications preventively, providing a protective fungicide barrier to kill germinating fungal spores landed on plant tissue. If conditions for infection are present and a high level of control is desired, start preventive spray programs as soon as rose foliage emerges in the spring and continue throughout the summer at frequent intervals (as frequently as every 7-10 days in wet weather).

Case Study: Apple scab.

It might be tempting to look at the disease triangle and ask, "Why not just use disease-resistant hosts — then you need not worry about anything else?" First, there is no such thing as a completely disease-resistant plant. Second, even with a single disease, there may be no readily available cultivars with good resistance (like *Botrytis* gray mold on geranium). Third, disease resistance is not the only consideration when selecting a particular cultivar.

At Secrest Arboretum in Wooster, OH, we looked at 47 crabapple selections for the past six years. We have a replicated, randomized plot rate them on a scale of 0 to 5, with 0 being no scab and 5 being extreme scab, defoliation complete or near complete. We came up with a list of eight crabapples with no scab.

We also rated the crabapples monthly for overall aesthetics, with 1 being an exceptionally ornamental crabapple (flower, foliage, fruit or form at time of rating) to 5 as an ornamentally unacceptable crabapple.

The monthly ratings were averaged, and the top eight crabapples listed. Apple scab, with its obvious effects on foliage, fruit and overall aesthetics, was a factor in these overall ratings.

Many of the overall, top-rated crabapples did get some scab over the years and only one of the top eight had no scab. Most of the crabapples with no scab were not the best in terms of overall ratings, most being rated as less attractive than many of the nonscab-resistant crabapples. For example, 'Dolgo' was one of the worst in the entire plot; no scab but large, messy fruits which severely restrict its use as an ornamental. Obviously, ratings for a particular disease are only part of the story.

The disease triangle is central, not only to understanding how disease occurs but also in how to limit its occurrence. Like a three-legged table, the removal of one side of the disease triangle will reduce the occurrence and severity of a disease. But, as always, the best way to do that is to consider these factors *before* installation of the plant in the landscape.

apple scab ▼

TOP AESTHETICALLY RATED CRABAPPLES WITH THEIR SCAB RATINGS

Crabapple	Aesthetics	Scab
M. 'Molten Lava'	1.8	1.3
M. 'Mary Potter'	2.2	1.3
M. 'Red Jade'	2.2	1.2
M. 'Prairifire'	2.3	0.0
M. 'Strawberry Parfait'	2.3	0.1
M. 'Sugar Tyme'	2.4	0.7
M. 'Donald Wyman'	2.4	1.3

SCAB-FREE CRABAPPLES WITH THEIR AESTHETIC RATINGS

Crabapple	Aesthetics	Scab
M. <i>baccata</i> 'Jackii'	2.8	0.0
M. 'Beverly'	3.5	0.0
M. 'Bob White'	2.9	0.0
M. 'Dolgo'	3.9	0.0
M. 'Prairifire'	2.3	0.0
M. <i>sargentii</i>	2.8	0.0
M. 'Silver Moon'	3.0	0.0
M. 'White Angel'	3.2	0.0

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