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BACTERIAL DISEASES OF ANTHURIUM, DIEFFENBACHIA, PHILODENDRON, AND SYNGONIUM

Species of *Anthurium, Dieffenbachia, Philodendron*, and *Syngonium* are popular foliage plants cultivated in interiorscapes of homes, offices, and malls throughout the world. These plants, which belong to the same plant family (Araceae) are tolerant to low humidity and can be easily grown in a potting medium that is light-textured, well-drained but moist, and rich. Anthuriums (tailflower) should receive at least 150 foot-candles (ft-c) of light in an interiorscape, but are produced under 1,500 to 2,500 ft-c. Dieffenbachias, under interiorscape conditions, do well at 100 ft-c for 12 hours per day, but are grown commercially under 1,500 to 2,000 ft-c; for propagation these plants are produced under as much as 4,000 ft-c. When grown indoors, many species of *Philodendron* tolerate 75 to 150 ft-c, but *P. selloum* requires more light than other species. Philodendrons are produced under 1,500 to 6,000 ft-c (or full sun for *P. selloum*). Nephthytis (*Syngonium podophyllum*) does well with light intensities of 75 to 150 ft-c and are produced under 1,500 to 3,000 ft-c of light.

Figure 1. Xanthomonas leafspot or blight of dieffenbachia.

Temperatures below 66° to 70° F (19° to 21°C) result in poor growth and rooting of all four types of plants.

BACTERIAL LEAF SPOTS OR BLIGHTS

Bacterial diseases caused by *Xanthomonas campestris* pv. *dieffenbachiae* (formerly called *X. dieffenbachiae*), *X. c.* pv. *syngonii, Pseudomonas cichorii, Erwinia carotovora* subsp. *carotovora* and *E. chrysanthemi* are all important pathogens of these foliage plants. These bacterial diseases may destroy leaves, petioles and stems rendering infected plants unsightly and unsalable.

Xanthomonas leaf spots or blights

Symptoms - Xanthomonas leaf spot or blight on dieffenbachias initially appears as yellowish, translucent or water-soaked specks usually first at the margins, later anywhere on the leaf blade except the midrib. The lesions enlarge to about half an inch (1.25 centimeters) and turn tan, yellow, orange-

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yellow, or reddish. The center is a dull watery-green, surrounded by an orange-brown border (Figure 1). Sometimes the roundish-to-elongate lesions are restricted to the leaf margins when infections occur through hydathodes. Older lesions are irregular and distinctly yellow with a reddish center. The lesions may coalesce to destroy the entire leaf.

When the air is very dry, the lesions remain as small, dry, reddish brown specks. Under moist air conditions (high relative humidity) the spots enlarge and merge to cover rather large irregular areas that soon turn yellow, wilt, and dry. If the lesions are numerous, affected leaves finally turn yellow, wilt, and die. Dead leaves are a dull tan to light brown and tough, but not brittle. All parts of the leaf blade except the midrib are susceptible.

A bacterial ooze usually appears on the lesions on the lower leaf surface. When the lesions are wet, the mounds of exudate are slimy; when dry, the exudate is thin, waxy, silvery-white, and easily peeled off the leaf.

Xanthomonas leaf spot on the heart-leaf philodendron (*Philodendron oxycardium* formerly *P. cordatum*) is called "red edge" due to the conspicuous coloration of most infections which are confined to the leaf margins (Figure 2). Under warm, moist conditions large areas of the leaf blade can become infected, but lesions are generally confined to interveinal areas.

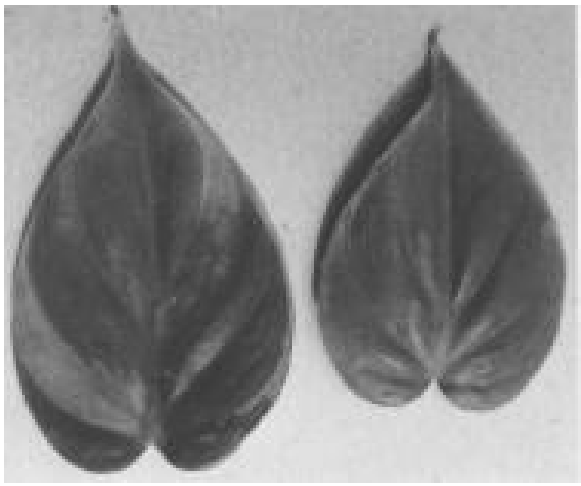

Figure 2. Red edge of heartleaf philodendron caused by Xanthomonas campestris pv dieffenbachiae. (Courtesy A.R. Chase)

On anthuriums small, irregular, water-soaked, translucent spots are first seen at the leaf margins following infections through hydathodes. Lesions resulting from foliar infections are usually restricted to the leaf margins although large areas may be involved. Mature lesions are brownish black with a bright yellow border; adjacent tissue is chlorotic. The bacterium can become systemic in anthuriums causing a general chlorosis of older leaves. The petioles often break off revealing a tan to brown discoloration of the vascular system. Systemic infections can also result in leaf spots which form anywhere on the leaf blades.

Figure 3. Syngonium blight on Syngonium podophyllum 'White Butterfly'.

On *Syngonium* species and cultivars, especially *S. podophyllum* 'White Butterfly', *Xanthomonas campestris* pv. *syngonii* causes a widespread and devastating blight. Irregular areas between the leaf veins are water-soaked during the early morning hours before frequently disappearing by noon. After 2 to 14 days, the diseased tissue becomes severely chlorotic and dies within 2 days (Figure 3). When allowed to dry, blighted tissue develops a papery appearance. Root infections result in foliar symptoms and occasionally individual lower leaves turn chlorotic, wilt (droop), and wither. When a new leaf unfolds water-soaking of the entire leaf occurs within 7 to 10 days. Within 20 days (from the onset of water-soaking) such leaves become chlorotic, then wilt, and dry.

Disease Cycle - The *Xanthomonas* bacteria enter a leaf through hydathodes on the leaf margins, stomates on the lower surface, or wounds. Symptoms appear 7 to 18 days after infection. The newly developing leaves on an infected plant do not necessarily become infected, since the bacteria are rather slow-growing and are favored by warm (70° to 90°F or 21° to 32°C), moist conditions. The organisms are easily spread from leaf to leaf and plant to plant by splashing water, contaminated tools, insects, handling infected plants, and by propagating infected plants. The bacteria can even be in tissue-cultured plants.

Other ornamental plants infected by *Xanthomonas campestris* pv. *dieffenbachiae* include Chinese evergreen, Silver Queen and other *Aglaonema* species, fancy-leaved caladiums (*Caladium* spp.), and cocoyam (*Xanthosoma caracu*).

PSEUDOMONAS LEAF SPOTS AND BLIGHTS

Symptoms - *Pseudomonas cichorii* infects a very wide range of foliage and flowering ornamental plants as well as vegetables. Symptoms of Pseudomonas leaf spot and blight differ somewhat on different hosts. On most foliage plants the lesions are first minute and water-soaked but rapidly enlarge (up to over an inch in diameter or 3 centimeters) and turn dark brown or black, often with concentric light and dark rings and sometimes surrounded by a bright yellow halo. Most lesions are roughly circular to irregular and are rarely confined to interveinal areas. The centers of lesions are tan and brittle if allowed to dry. Lesions form anywhere on the leaf blade but are more common at the leaf margins. Under very damp conditions infected leaves may drop off.

Disease Cycle - The *Pseudomonas* bacterium enters a leaf primarily through hydathodes and wounds. Severe symptoms can appear in as little as 3 days after infection, particularly if plants are misted before infection occurs. The number of lesions increases linearly as the misting period increases. Wounding is unnecessary for infection to occur on most hosts when moisture levels are high (such as misting). Disease severity is enhanced at 82° to 85°F (28° to 29°C) with little disease developing above 90° F (32°C). The organism is easily spread from leaf to leaf and plant to plant by splashing water, contaminated tools, insects, and by handling infected plants.

Other foliage plants infected by *Pseudomonas cichorii* include Chinese evergreen, Silver Queen and other *Aglaonema* species, umbrella tree or schefflera (*Brassaia actinophylla*), *Caladium* spp., false aralia (*Dizygotheca elegantissima*), fiddle-leaf fig (*Ficus lyrat*a), pothos (*Epipremnum aureum*), tree ivy (*x Fathshedera lizei*), Japanese fatsia or aralia (*Fatsia japonica*), English ivy (*Hedera helix*), *Monstera* spp., staghorn fern (*Spathiphyllum* spp.). Vegetables that are hosts of the pathogen include cabbage, celery, chicory, endive, escarole, lettuce, and tomato.

Erwinia leaf spot, blight, stem rot, and soft rot

Symptoms - The most common bacterial pathogens of these four foliage plants are *Erwinia carotovora* subsp. *carotovora* and subspecies of *E. chrysanthemi*. Both organisms cause soft rots or leaf spots and blight. The first symptom is usually soft, mushy, watersoaked areas at the base of the stem at or below the soil line (Figure 4). These lesions are gray to tan or pale brown, irregular

Figure 4. Erwinia stem rot on a cultivar of Dieffenbachia maculata. (Courtesy A.R. Chase)

in shape, with a distinct line separating diseased and healthy tissue. Stem and cane lesions below the soil surface usually go unnoticed until infection causes severe decay. Diseased plants commonly produce terminal leaves that are pale yellow and small. Under warm, moist conditions the stem lesions develop rapidly, causing the lower leaves to turn yellow, become soft and mushy, collapse, and die prematurely. Stem rot of cuttings is common; the lower leaves wilt and turn yellow and an entire cutting may turn into a rotted mass. The stem rot phase may develop so rapidly that entire plants or cuttings die before the bacterium has advanced into the leaves. Diseased tissue commonly has a foul, dead fish odor due to secondary microorganisms colonizing dead tissue.

Figure 5. Erwinia leaf blight on Philodendron selloum. (Courtesy A.R. Chase)

Leaf infections start as pinpoint spots that are water-soaked and yellow to pale brown. The lesions are sometimes surrounded by a diffused yellow halo. When the humidity is high and temperatures are warm to hot, the spots expand rapidly, becoming slimy, irregular, and sunken with light tan centers, darker brown borders, diffused yellow margins, and may involve the entire leaf in a few days. An invasion of the midrib and larger veins (Figure 5) by the casual bacterium often results in advancement into the petiole and stem. The result is yellowing and total collapse of the leaf. Large, watery blisters may form on the lower leaf surface when conditions are humid. When the air is dry and temperatures are low, the leaf lesions continue to enlarge, become papery, brittle, yellow to tan, and commonly tear away. Some strains of both species of bacteria can produce a severe root rot of dieffenbachias causing collapse and wilting of the entire plant. Laboratory culturing of the casual organism is required to separate this from root rots caused by various pathogenic fungi. The detection of the disease is difficult since infected plants may show no visible symptoms, especially under cool and dry conditions.

Disease Cycle - The two *Erwinia* species, like the *Xanthomonas* and *Pseudomonas* leaf spot and blight organism, enter primarily through hydathodes and wounds. Disease development is favored by the presence of moisture and temperatures of 71° to 93°F (22° to 34°C). The bacteria are transmitted from an infected to a healthy plant by splashing water, insects, and by contaminated knives, tools, gloves, and carrying trays. The bacteria may invade the vascular (xylem) system and become systemic, causing the leaves and stems to turn soft and rot (Figure 5). Plants of all ages are susceptible to infection, with young leaves being more susceptible than older ones.

Erwinia chrysanthemi can survive in greenhouse potting media with or without a host plant for a year or more and in the leaves of host or nonhost plants in a greenhouse for 5 to 6 months. The same bacteria have been associated with bacterial soft rot diseases of a majority of foliage plants and numerous flowering plants (Table 1). Many fleshy vegetables are also susceptible.

Control of Bacterial Diseases

1. When possible, start with culture-indexed, pathogen-free plants from a reputable commercial propagator. Plant immediately into a sterilized growing medium.

2. Water only the soil surface. Avoid overhead irrigation and splashing water on the leaves. Water early in the day to promote rapid drying of the foliage.

3. Avoid crowding plants, heavy shade, poor air circulation, over-watering, mechanical injuries to plants, and high humidity. These factors all favor disease development.

4. Separate infected plants from apparently healthy plants when disease is first noticed.

5. Carefully remove and destroy seriously infected plants and plant parts. Handle these plants with throw-away plastic gloves to avoid contaminating other plants.

6. Sterilize contaminated pruning knives, tools, carrying trays, and the like between plants by dipping or swabbing in a solution of 70 percent rubbing alcohol, liquid household bleach (1 part bleach in 4 parts water), or 38 to 40 percent formaldehyde solution.

7. Where feasible, lower the temperature at which plants are grown to 70°F (21°C). This will slow down multiplication and spread of the causal bacteria.

8. For bacterial leaf spots and blights apply several sprays of a streptomycin formulation (such as Agri-mycin) at 200 parts per million of active ingredient, 4 to 7 days apart during damp weather, starting when disease first appears. There is always the potential of getting resistance to streptomycin compounds if they are used repeatedly. Copper materials provide moderate control of Xanthomonas and Pseudomonas leaf spots and blights. When applying any spray, carefully follow all the manufacturer's directions and precautions on the container label.

9. For bacterial soft rot or stem rot, dip cuttings in a streptomycin formulation (200 parts per million) for 20 minutes. Carefully follow the manufacturer's directions. Immerse dieffenbachia cane pieces in a hot-water bath held at exactly 120°F (49°C) for 40 to 60 minutes, depending on the cane diameter (40 minutes for canes 1 inch in diameter and 60 minutes for canes of 1 ½ inches).

   Extreme care is required in handling the cuttings and cane peices after treatment to avoid recontamination. Treated plant materials should always be planted into a sterilized potting medium. Use only disinfected trays, tools, gloves, and soil mix. Wash hands with soap and hot running water before and after contacting suspected diseased plants.

10. Control insects and mites following recommendations of University of Illinois Extension Entomologists.

Table 1. Some other foliage and flowering host plants of *Erwinia carotovora* subsp. *carotovora* and/or *E. chrysanthemi*

Scientific name	Common name
Aechmea spp.	Bromeliads
Aglaonema spp.	Chinese evergreen, Silver Queen, and others
Aphelandra squarrosa	Zebra plant
Asplenium nidus	bird's-nest fern
Begonia spp.	Begonias
Brassaia actinophylla	Umbrella tree or schefflera
Caladium spp.	Caladiums
Calla spp.	Callas
Chrysanthemum moriflorum	Florist's chrysanthemum
Cordyline spp.	Ti plant
Cyclamen persicum	Cyclamen
Dahlia spp.	Dahlias
Delphinium spp.	Delphiniums and larkspurs
Dianthus spp.	Carnation, garden pinks
Dracaena spp.	Dracaenas
Epipremnum aureum	Pothos
Euphorbia pulcherrima	Poinsettia
Ficus elastica	India-rubber plant
Fittonia spp.	Nerve plant
Hoya carnos	Wax plant
Hyacinthus orientalis	Hyacinth
Iris spp.	Irises
Lilium spp.	Lilies
Lithops spp.	Lithops
Maranta spp.	Prayer plant
Monstera deliciosa	Swiss cheese plant
Pelargonium hortorum	Florist's geranium
Peperomia spp.	Peperomias
Saintpaulia ionantha	African violet
Sansevieria spp.	Sansevierias
Schlumbergera truncata	Thanksgiving cactus
Zantedeschia spp.	Calla lilies