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# Bacterial leaf spot diseases are prevalent in wet greenhouses

Wet, humid, overcast conditions outside favors plant disease development inside greenhouses because plant foliage and soil remain wet for extended periods of time. Plant wetness and high humidity within warm greenhouses coupled with young, succulent seedlings and cuttings in production and poor sanitation issues and the introduction of propagation material fulfills all components of the Disease Triangle (host, pathogen, and environment interacting all at the same time). In several greenhouses I have visited, bacterial leaf spots and blighting were seen on Calibrachoa (Figure 3), Dieffenbachia (Figure 2), and geranium (Figures 5).

Bacterial leaf spot diseases on ornamental plants are usually caused by *Xanthomonas*, *Pseudomonas*, or *Acidovorax* species. Identification of which bacterium is causing the problem usually requires culturing on agar medium. However, there are certain symptoms that suggest bacterial infection such as brown to black, round to angular (when vein-delimited), greasy or oily-looking (water-soaked) leaf spots that may or may not have chlorotic halos (Figures 1, 2, 3, and 5).



**Figure 1:** Suspect bacterial leaf spots affecting Calibrachoa plugs. Leaf spots are dark, circular, and water-soaked (oily-looking). (Image by Jean Williams-Woodward)

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The best approach to dealing with bacterial plant diseases is to get a sample to a diagnostic lab for confirmation quickly. One fairly simple test to determine if bacteria may be causing the leaf spot is to slice through a leaf spot in a droplet of water on a glass microscope slide and viewing it for signs of bacterial streaming, which results from pooling of bacterial cells from the cut edges (Figure 4). Any time water sits on a bacterial spot, bacterial cells may ooze out of the tissue into the water droplet and be easily water-splashed to adjacent plants.

Bacterial pathogens are spread within greenhouses mostly by splashing water and water activity of handling wet plants. Overhead irrigation can easily spread the bacterium to adjacent plants on the same bench. Bacteria can also be spread on contaminated hands and tools. Bacterial leaf spot diseases are very difficult to control. Infected plants should be discarded. It is almost impossible to cure a plant of a bacterial disease. Copper-containing fungicide/bactericides can help protect plants from infection, but they will not stop the spread on already infected plants. Bacterial pathogens are often introduced with contaminated seed or seedlings; therefore, inspect all incoming plants for symptoms of infection. It is often a good idea to segregate incoming plants from different suppliers and monitor them for symptoms prior to transplanting. Handling of infected plants can contaminate worker's hands and tools, which can spread the bacterium as well. Always handle healthy plants first, and then suspect or infected plants to reduce spreading diseases through worker activity. Disinfecting hands and tools with 70% ethanol or isopropyl alcohol can reduce disease spread. Ready-to-use (RTU) Lysol® or Clorox® disinfectant aerosol



Figure 2: Bacterial leaf spots caused by *Xanthomonas* sp. affecting Zinnia. Leaf spots are often angular, dark, water-soaked with yellow halos. (Image by Jean Williams-Woodward)



Figure 3: Bacterial blighting on *Dieffenbachia* caused by *Xanthomonas* sp. Bacterial infection often occurs at the leaf margin and then progresses inward and is vein-delimited as it disintegrates leaf tissue. (Image by Jean Williams-Woodward)

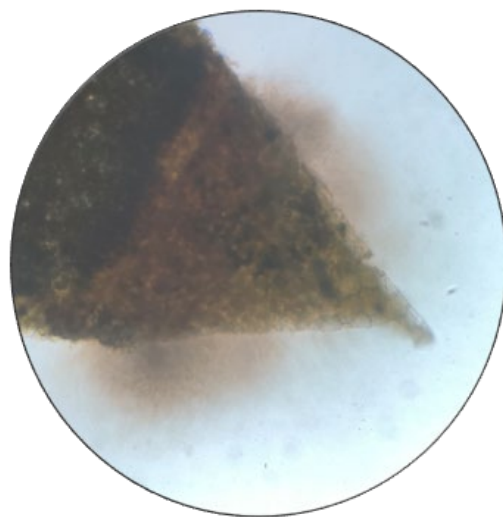


Figure 4: Bacterial cells ooze from the cut leaf spot edges on infected leaves when placed in water and viewed through a microscope. The bacterial cells appear as a cloudy ooze along the tissue's edge. (Image by Jean Williams-Woodward)

spray contains mostly ethyl alcohol, and can be used to disinfect tools and gloves. It is also a good idea to provide alcohol gel dispensers (Figure 6) throughout the greenhouse, especially when growing crops that are very susceptible to bacterial diseases.

### Bacterial leaf spot disease control summary:

- Inspect incoming plants for symptoms of infection. If planting from seed, use only certified disease-free seed.
- Discard infected plants.
- Keep plant foliage as dry as possible. If possible, avoid overhead irrigation to reduce water-splashing.
- Disinfect hands and tools after handling infected plants. Wash with soap and water or use alcohol gels to reduce carrying bacteria on worker hands. Disinfect tools with 70% ethyl or isopropyl alcohol or RTU aerosol sprays.
- Work from areas with healthy plants toward infected plants to reduce pathogen spread.
- Remove fallen plant debris to reduce bacterium survival.
- Copper-containing fungicides/bactericides (copper hydroxide, copper octanoate, copper sulfate pentahydrate, copper hydroxide + mancozeb) can reduce disease when used preventatively. Cease (*Bacillus subtilis* QST 713 strain) can also help reduce bacterial leaf spot disease.



**Figure 5:** The upper (top image) and lower side (bottom image) of Geranium leaves infected with *Pseudomonas* sp. The leaves were dried out upon receipt in the diagnostic lab; however, the circular, dark, oily leaf spots were still visible. Rapid submission of samples to diagnostic labs can quickly identify problems and help reduce the spread of disease within the greenhouse. (Image by Jean Williams-Woodward)



**Figure 6:** Hand-sanitizing alcohol gel can be used by workers to disinfect their hands after touching or working among bacterial leaf spot infected plants. (Image by Jean Williams-Woodward)

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