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A NEW *AGLAONEMA* FOLIAR BLIGHT AND CROWN ROT

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Introduction

Several species and cultivars of *Aglaonema* have been grown in Hawaii for many decades. These species include *A. commutatum*, *A. nitidum*, *A. crispum*, *A. costatum*, *A. simplex*, *A. pictum*, *A. rotundum*, and *A. modestum*. 'Fransher', 'Pseudobracteatum', 'Maculatum', 'Elegans', and 'Treubii' have been popular commercial cultivars. More recently, 'Silver King' (from the cross *A. nitidum* 'Curtisii' × *A. pictum* 'Tricolor'), 'Emerald Beauty', 'Pewter', and 'Silver Queen' have been widely grown.

In Hawaii, *Aglaonema* is a favorite shade-tolerant landscape or garden plant that is also enjoyed indoors. During several decades of cultivation, few diseases have been observed on this plant group in Hawaii. Unfortunately, the importation of large numbers of aroids during the 1970s inadvertently introduced new bacterial and fungal pathogens. In the mid-1980s, a devastating crown rot was observed on cultivars of *A. commutatum* at commercial nurseries on the Big Island (Fig. 1). Similar specimens were received in 1987 from Oahu growers. Crop losses at various nurseries were large, and research into the etiology of this disease was begun.

Disease and Symptoms

Diseased *Aglaonema* plants have leaf and petiole (leaf stem) spots, sheath and stem (cane) rots, dead shoot tips, collar rots, and dead canes. On susceptible *A. commutatum* cultivars, leaf spots begin as faint, water-soaked tissue on the underside of leaves, about one to two weeks after artificial inoculation (Figs. 2 and 3). These spots expand and have dark centers with water-soaked edges. The top surface of the lesion is less distinct and slightly chlorotic. A week later, these spots are typically 10–30 mm in diameter, water-soaked with dark centers, and circular, elliptical, or irregular in shape (Figs. 2 and 3). On mature leaves, the spots have dark centers, large brown areas, and diffuse yellow borders (Fig. 4). On young unexpanded leaves, the spots develop rapidly into large spots without extensive yellowing. Petiole spots develop into extensive rots, causing the leaves to collapse (Fig. 5).

Stem or cane rots are dry, shriveled, and brown, gray-green, or greenish black (Fig. 6). Associated with these stem rots are wilting, yellow, or dying leaves attached to olive-green to yellow petioles. Internally, diseased canes are brown and spongy with darkened vascular elements. These darkened elements extend into the firm, healthier sections of the cane (Fig. 7). Fungal sporulation is common on diseased tissue and appears as white, crusty masses on dead tissue (Fig. 6).

On intact plants, young tissue is more susceptible to infection than older, mature tissue. Mature leaves are commonly infected at the leaf edge, and disease development is rapid once infection occurs. Wounds are not needed for fungal penetration, but wounded tissue is very susceptible.

Plants with leaf, petiole, and stem rots, but with little root rot, are characteristic of field-collected disease specimens. Repeated inoculations demonstrated that roots are relatively resistant to infection (Fig. 8). Small brown lesions or spots are formed on roots and expand slowly after inoculation of healthy plants. In contrast, large rotted sections of the root system are always associated with cane or collar rots.

Causal Organism and Spread

A *Fusarium* species subsequently identified as *F. subglutinans* was consistently associated with diseased *Aglaonema* plants collected at several nurseries. Pure cultures of the suspect pathogen were obtained from diseased plants, and representative cultures from four commercial nurseries were studied. Pathogenicity of *F. subglutinans* was confirmed by inoculations of healthy plants with spores of *F. subglutinans*.

Fig. 1. *Aglaonema* plant from a commercial nursery with dead and yellow lower leaves, stem rot, and collapsed canes.

Fig. 2. Early leaf symptom on *Aglaonema* caused by *Fusarium subglutinans*. Note the young water-soaked lesion and older lesion with a dark center. Lower surface of the leaf is pictured.

Fig. 3. Leaf spotting of *Aglaonema* caused by *Fusarium subglutinans*. Note the young chlorotic lesion and older lesions with dark centers and chlorosis. Top surface is pictured.

Fig. 4. Expanding leaf spots of *Aglaonema* caused by *Fusarium subglutinans*.

Fig. 5. Petiole and leaf spots on *Aglaonema* caused by *Fusarium subglutinans*.

Fig. 6. Lower petiole, cane, and collar rot of *Aglaonema* caused by *Fusarium subglutinans*. Note the abundant fungal sporulation (white masses) on rotting tissue.

Fig. 7. Internal symptoms of *Aglaonema* cane rot caused by *Fusarium subglutinans*.

Fig. 8. Representative plant after root inoculation. Cane rots eventually develop, but only a few root lesions are formed two months after inoculation.

Fig. 9. Representative plants one month after collar and root drench inoculation with *Fusarium subglutinans*.

Fig. 10. Effects of contrasting inoculum levels. Top row: Plants sprayed with 100 spores/ml. Bottom row: Plants sprayed with 1,000,000 spores/ml. 5 ml = 1 teaspoon.

Fig. 11. Bacterial rot of *Aglaonema* leaves.

Fig. 12. *Aglaonema* 'Silver Queen' with limited lesion development on young leaves after inoculation.

Fig. 13. *Aglaonema* 'Silver Queen' with a blight of the spear leaf after inoculation.

reproduction of disease symptoms (Fig. 9), and re-isolation of the fungus.

Large numbers of conidia (asexual spores) of *F. subglutinans* are produced on diseased plant tissue. These spores are spread to healthy plant tissue by splashing water, indiscriminate handling of infected and clean plants, contaminated planting and trimming tools, and probably by insects or slugs.

The development of airborne sexual spores, or ascospores, is known to occur in F. *subglutinans* (= *Gibberella subglutinans*), and ascospores were observed in an early disease specimen. Ascospores have not been recovered in recent specimens and have not been seen in culture. Further studies on this disease phase are continuing. At present, conidia have been documented as the primary agent for pathogen spread.

Fusarium subglutinans (= *Fusarium moniliforme* var. *subglutinans*) has been recorded on pineapple and banana in Hawaii. This fungus causes severe diseases of pine, maize, and sorghum elsewhere in the United States. This is the first record of *F. subglutinans* as a pathogen of *Aglaonema* or any aroid. There are few records of *Fusarium* on the Araceae. *Fusarium solani* is a reported pathogen of *Dieffenbachia*, and a *Fusarium* species associated with *Aglaonema* has been recorded in Florida.

Control

Research on the control of this disease has recently begun, and until specific recommendations can be made, reliance on general disease control principles is necessary to reduce disease levels.

Sanitation. Prompt removal of diseased plants and new lesions on otherwise healthy plants will reduce the inoculum or spore level in the crop. A strong effort to reduce inoculum levels by removing diseased plants and plant parts should reduce disease significantly. Experimentally, plants sprayed with high spore levels were severely diseased and dying six to eight weeks after inoculation, while plants sprayed with low spore levels were rarely diseased (Fig. 10).

Diseased plants should be incinerated, buried in deep pits, or removed from the nursery site. Although experimental information is limited, it appears that conidia of *F. subglutinans* can be airborne, making early removal and destruction of diseased plant tissue imperative. *Fusarium* is able to survive many months in dead plant tissue, potting media, and bench and ground debris. The fungus will also survive in soil under benches or in areas receiving drainage water from contaminated crops. Fungal spores are also harbored on pots, trays, labels, shears, knives, gloves, and clothing.

Nonmetallic items, benches, and concrete walkways can be disinfested with a 10 percent solution of liquid household bleach or with quaternary ammonium compounds. Alcohol or heat can be used for metallic tools. Infested soil under and around contaminated benches can be drenched with a quaternary ammonium compound and covered with a layer of sand or gravel to reduce spread by splashing.

Ideally, *Aglaonema* should not be grown on benches previously contaminated by diseased *Aglaonema*. Using a nonsusceptible alternative crop interrupts the disease cycle, and remaining *Fusarium* spores eventually die.

Moisture control. The growth and reproduction of *Fusarium* species is favored by high moisture. Increasing the humidity in the *Aglaonema* growing environment will increase the rate of infection, disease development, and fungal sporulation.

Large numbers of spores are produced on almost all lesions more than 20 mm in diameter. Fungal sporulation is especially high on diseased canes and petioles. These spores splash onto healthy tissue on the same leaf or adjacent leaves, germinate, penetrate the host, and cause new lesions.

In Hawaii, tropical conditions are ideal for commercial aroid production but, unfortunately, are also ideal for disease development by many fungal and bacterial pathogens (Fig. 11). Although *Aglaonema* thrives in high humidity, reduced humidity levels need to be maintained until disease levels are lowered or the fungus is eradicated. Drip irrigation will reduce disease spread by eliminating the splashing effect of overhead irrigation and shortening the leaf-wetness period.

Saran houses provide no protection from frequent and prolonged rains. Solid-covered greenhouses are highly recommended, especially for new, expensive cultivars or cultivars that are very susceptible to fungal and bacterial diseases. In a dry environment, spores do not germinate and eventually desiccate and die.

Maintaining disease-free stock. New stock should be started from disease-free plants obtained from a clean nursery or by growing tissue-cultured plants. If these are unavailable, a small group of clean stock plants should be established. A clean *Aglaonema* stock can be started from diseased plants by (1) taking tip or cane cuttings from the least contaminated or diseased plants (healthy *Aglaonema* canes are completely white internally; light brown to dark streaks in the cane indicate disease), (2) peeling or trimming all leaves and sheath material, (3) thoroughly washing all plant surfaces in running tap water, (4) drenching with a surface disinfestant (e.g., a 20 percent solution of household bleach), (5) air drying for 12–48 hours in a clean area, (6) planting individual canes in separate pots using clean media, (7) growing plants in a glasshouse or under solid cover, (8) irrigating new plants by drip methods or hand-watering to avoid wetting the cane or foliage, and (9) closely monitoring new cuttings, with immediate removal and destruction of all plants with symptoms of any disease. Repeating this procedure with canes taken from plants established by this method will further improve the purity of the stock plants. Disease-free stock plants of *Dieffenbachia* were successfully established by similar methods.

Propagation from severely diseased stock plants is a poor practice and will only perpetuate the existing problem. If this is unavoidable, e.g., to save rare cultivars, the following remedial procedure is suggested: (1) move plants to a dry environment where moisture is controlled, (2) remove all severely diseased or dry tissue (when green leaves with lesions are cut off, the sheath material should be carefully peeled away *after* natural abscission of the sheath has occurred within a few weeks; fresh wounds on the cane, caused by the removal of leaf sheaths before the sheaths are dry, provide an entryway for the fungus), (3) make two or three applications of a fungicide such as mancozeb to reduce the number of viable spores on the external plant surface, (4) avoid wetting the foliage, and (5) in

one to three months, if there are no new leaf or cane infections, take cuttings and treat as described earlier.

Use of resistant cultivars. In preliminary studies, 'Silver Queen' and 'Emerald Beauty' showed significant tolerance to *F. subglutinans.* Mature leaves were very resistant, even to inoculations with high spore levels. Small, brown leaf spots about 1–3 mm in diameter developed on some young expanding leaves of 'Silver Queen', but these spots failed to enlarge (Fig. 12). The unexpanded spear or new leaf was occasionally blighted after inoculation, but these lesions rarely expanded as the leaf matured (Fig. 13).

Minor infections on resistant or highly tolerant cultivars should be recognized and removed from the plant. Additionally, tolerant crops should not be grown adjacent to susceptible cultivars, because minor lesions on 'Silver Queen', for example, may provide the inoculum to start epidemics on susceptible cultivars of *A. commutatum.* Accurate diagnosis and identification of the pathogens involved are crucial to implementing cost-effective control measures, including production of the most suitable cultivars. By combining crop tolerance, nursery sanitation, pathogen eradication, and moisture control, effective control of *Aglaonema* foliar blight and crown rot can be obtained and high quality plants can be produced.

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