

Propagation Pathology: The Basics[®]

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Control of disease in propagation begins with sanitation. A clean source of plant material and a clean growing area are both essential. Preventing leaf spots in stock plants will help to reduce diseases of cuttings during propagation. Fungal spores are the inoculum for most of the common diseases. Additional fungal structures, such as chlamydospores and sclerotia, are designed as survival structures and are difficult to eliminate from the greenhouse environment. Inspect cuttings before sticking, and eliminate any with suspicious symptoms. Avoid any practice that brings soil in from outdoors or moves it from the greenhouse floor up to crop level. A hose end dropped to the floor should be disinfested before use. Bench surfaces should be cleanable — smooth metal or plastic surfaces are best — wood can harbor pathogens, and cannot be adequately disinfested.

A propagation house should be kept separate from the rest of the nursery, and traffic through it should be minimal. A foot dip with daily-refreshed disinfectant is a good way to set a tone of high sanitation standards for all who enter. Any bins used for handling cuttings should be cleaned of grime after each use — fungal spores may linger in residual organic matter. To manage diseases culturally, design propagation areas so that there is no puddling to foster diseases such as those caused by *Pythium* and *Phytophthora*. Foliar diseases are also reduced by preventing excess moisture on the leaf surface.

Disinfectants are helpful for general greenhouse sanitation. Only steam treatment can adequately eliminate the resistant propagules of fungi in organic debris, so clean first, then disinfest. Materials include hydrogen dioxide (ZeroTol and OxiDate); quaternary ammonium compounds (GreenShield, Physan 20, and Triathlon), potassium peroxymonosulfate (Virkon, in Canada only), and chlorine dioxide (Selectocide).

The following will explain the basic differences among the main pathogens that you will deal with during plant propagation. Tips are provided to aid in preventing these diseases and responding to them appropriately, should they occur.

FUNGAL DISEASES

***Rhizoctonia solani*.** *Rhizoctonia solani* is one of the most common organisms in field soil. It has a wide host range, including woody as well as herbaceous plants. Although *Rhizoctonia* is not able to produce any spores, it does produce sticky hyphae that are easily moved along with soil particles. Handling plants or splashing media with irrigation water can easily spread *Rhizoctonia*. Ever-widening circles may appear in either seed or cutting propagation areas. On seedlings, *Rhizoctonia* causes post-emergence damping off. On individual cuttings, *Rhizoctonia* will attack at the soil line. The fungus will invade the stem base and form a brown canker, and will grow across the surface of the medium to attack other plants. On plants with dense canopies, under highly humid conditions, *Rhizoctonia* may also cause web blight. Also, large brown zonate leaf spots are sometimes formed. To manage this disease,

take cuttings from high on stock plants; avoid soil-splashed lower branches. Keep soil out of propagation areas. Use biocontrols preventively. Discard infected cuttings promptly, and drench the area with an appropriate fungicide. Materials used for *Rhizoctonia* control include Cleary 3336, OHP 6672, AllBan, Medallion, Heritage, Compass, Chipco 26019, Terraclor, Endorse, [Senator and Rovral in Canada], and combination products Banrot, Hurricane and 26/36.

Thielaviopsis basicola, the cause of the disease black root rot, is also well adapted to the propagation environment — it thrives in wet soils and is very persistent in a greenhouse. This fungus is well known as a pathogen of *Ilex* spp., especially Japanese holly, *I. helleri*, but it has recently emerged as a problem on herbaceous perennials. Heuchera, gaillardia, Shasta daisy, and rosemary are showing symptoms of black root rot. Plants with this disease are stunted, with chlorotic or purplish foliage. Below-ground, roots are stunted and sections are blackened. These areas show dark-pigmented chlamydospores under magnification. These structures are helpful for identifying the fungus, but are harmful because they are long-term survival structures. These chlamydospores will survive on the floor of the greenhouse or in organic debris on pots or flats. Re-using flats or pots without first power-washing and then soaking in a disinfectant such as GreenShield or ZeroTol will allow disease to cycle continuously. *Thielaviopsis* is sensitive to pH — because growing at a pH above 6.0 favors the pathogen, a lower pH is desirable. Fungicides used against *Thielaviopsis* include thiophanate methyl materials (e.g., 3336), as well as Medallion and Terraguard.

Botrytis cinerea. *Botrytis cinerea* attacks flowers most readily, but it will also attack leaves on some species, particularly when foliage sits wet for long periods. Wounded tissue is also more vulnerable. Reducing leaf wetness interval through environmental controls is key. Some of the fungicides used against *Botrytis* include Decree, Daconil, PathGuard, Chipco 26019, 26/36, coppers, mancozeb, and the bio-fungicide Rhapsody [in addition to Rovral, Botran, and Captan in Canada].

Downy Mildew. Downy mildew is a disease caused by a relative of *Pythium* and *Phytophthora*. It ordinarily appears in early spring, when humidity is high and temperatures cool. Woody plants are not generally affected during propagation, but certain herbaceous perennials and annuals should be protected against downy mildew. Some especially vulnerable crops are rudbeckia, veronica, geum, coreopsis, and coleus. Fungicides used include the contacts mancozeb and copper, and the more systemic materials Stature DM, Aliette, Alude, Compass, Heritage, Insignia, and FenStop.

Leaf Spots and Anthracnose Diseases. These affect a number of woody plants, and these may thrive in the warm, wet conditions in the propagation environment. One example in this category is the anthracnose on lupine, which is seedborne and thus may appear in plug trays as well as in older plants. Spots are round and tan, and petiole droop and leaf twisting are often seen. Many fungicides offer fairly broad-spectrum leaf spot control: mancozeb (including Protect, Dithane, and Junction), thiophanate methyl (AllBan, 3336, 6672, Zyban [and Senator in Canada], plus chlorothalonils Daconil, PathGuard, and Spectro and demethylation inhibitors (DMIs) such as Eagle [and Nova in Canada]. For bacterial leaf spots, coppers and Rhapsody are the options.

Pythium. *Pythium* is a water mold pathogen that is often active in peat-based media. Unlike *Phytophthora*, *Pythium* attack is focused purely below-ground, on the roots. On seedlings, *Pythium* may cause a pre-emergence damping off, or may attack young roots and cause stunting and death. Root systems affected by *Pythium* develop a softened, discolored outer cortex, leaving the stele at the center of the root intact. This can create a rat-tail effect, seen when a *Pythium*-infected plant is pulled from the soil. *Pythium*'s swimming zoospores are attracted to the root tips, especially those of stressed plants (injured by high soluble salts or drought, for example). Good cultural practices and greenhouse sanitation are the primary protections against pythium root rot. *Pythium* may be introduced on cuttings or by fungus gnats, which are a common pest in propagation houses.

Phytophthora. *Phytophthora* is a close relative of *Pythium*. It produces zoospores within sporangia under flooded soil conditions and attacks stem bases and roots of woody plants. It thrives in propagation conditions. On rhododendrons, *Phytophthora* may cause a tip blight and thus inoculum may easily be brought into the greenhouse on cuttings. Various *Phytophthora* species are also common on lavender and hederas as well as daphne, juniper, forsythia, and many other species.

Treatments for *Pythium* and *Phytophthora* include SubdueMAXX (although note that insensitivity to this active ingredient, nefenoxam, is well documented in the greenhouse floriculture industry) and Hurricane, a new combination of mefenoxam with fludioxonil (also found in Medallion). Other materials include Aliette, Alude, Vital, Biophos, Truban, Terrazole, and Banrot. For foliar *Phytophthora* diseases, sprays with Daconil, Stature DM, or FenStop may help. Avoid overfertilizing or overwatering.

BACTERIAL DISEASE

The bacterial disease most often noted in propagation is crown gall, caused by *Agrobacterium tumefaciens*. It is recognized by the swollen galls visible on the roots or at the soil line (the root crown). This disease has a huge host range, including many dicots; grasses are not susceptible.

VIRUS DISEASES

Viruses may be accidentally propagated along with the plants. Become familiar with the general symptoms caused by viruses, which include ring spots, mosaic, line patterns, and leaf distortion. The most common viral problems in greenhouses today are impatiens necrotic spot (INSV), tomato spotted wilt (TSWV), hosta virus X (HVX), and tobacco rattle virus (TRV). The INSV and TSWV are spread by thrips, HVX is spread by handling, and TRV is spread by nematodes. All, however, are spread by propagation: cuttings from a diseased plant remain diseased, so discarding plants with virus-like symptoms before and during propagation is very important.

Note: Mention of disease management products is for information purposes only, and is not intended as endorsement; neither is criticism implied of materials not mentioned. Follow instructions on the product labels, and be aware that registrations vary by nationality, state, and region.