

DISEASES COMMONLY FOUND IN GREENHOUSES



Your GOAL: disease-free plants with IPM



Powdery Mildew



Phlox seedlings damaged by powdery mildew.



Close-up of a kalanchoe leaf heavily infected with powdery mildew.

POWDERY MILDEW

Damage symptoms

Usually seen on the upper leaf surfaces although some powdery mildews may infect lower surfaces. Older leaves may be more symptomatic than younger ones. The fungus typically grows on the surface of the leaf where it produces whitish spores in abundance. This gives the leaf a powdery appearance as the name implies.

Host plants

Most floral and foliage plants found in greenhouses are susceptible to attack.

Disease characteristics

Spores and mycelium are produced on leaf surfaces. Spores are released into the air for short-range dispersal when temperatures are moderate, air is moving or there is a rapid drop in relative humidity coupled with drying. Each of these factors renders the plant surfaces, where the pathogen grows, unfavorable for its survival. Airborne spores landing on host plant tissue germinate, penetrate the plant tissue, and grow internally. Eventually the fungus will proliferate on the surface of the leaf and again produce conidia for dispersal within the greenhouse.

Management

The severity of powdery mildew infections depends upon several environmental factors in the greenhouse. If these factors can be either eliminated or altered, the pathogen can be managed.

Consider the following factors:

- ✓ Infection often starts at doors or cracks in the greenhouse. Eliminate drafts in your greenhouse.
- ✓ Adjust temperatures. In general host plants can tolerate higher temperatures than powdery mildew. Temperatures above 86°F will kill or retard growth of most powdery mildews.
- ✓ Although some powdery mildews germinate in dry conditions, most germinate best in a saturated or near saturated, humid environment. Adjust the level of moisture in your greenhouse to limit relative humidity.
- ✓ Strong sunlight accompanied by high temperatures promote dry leaves. Dry leaves are not favorable for powdery mildew development.
- ✓ Fungicides are available for use.



*Geranium plants showing severe symptoms of Botrytis blight.
Notice the grey mold on the leaf indicated by arrow.*



Leaf with signs of leaf spotting caused by Botrytis.

BOTRYTIS

Damage symptoms

The most common symptoms include blight, leaf spot, damping-off, and stem cankers. If humidity reaches 85% or more, a fluffy, grayish to brown fungal growth may appear on infected plant parts. Symptoms of “Gray Mold” depend on the host and environmental conditions of your greenhouse. Optimum conditions for symptom occurrence are 64-82°F and high humidity.

Host plants

Botrytis is present in all greenhouses and attacks most herbaceous ornamentals grown in the Northeast. It causes significant loss during storage and shipment of flowers and cuttings.

Disease characteristics

Botrytis prefers to invade immature, senescent and wounded plant parts or flower petals. This disease can spread to healthy plants if infected plant material or organic matter comes in contact with disease-free plant tissue. Initial infections are not easily detected. As time passes and conditions in the greenhouse become favorable for the pathogen, symptoms will appear, sometimes in less than 24 hours. Botrytis spores are small, dry, easily dispersed in the air or with water, and carried from plant to plant by insects. Free moisture is needed for germination and infection. This fungus can overwinter in dead plant material or survive in soil as sclerotia.

Management

Control is difficult because the pathogen can infect any part of the plant at any stage of development and attacks a wide variety of species.

- ✓ Reduce humidity and increase temperature and airflow.
- ✓ Turn up the heat and vent for 2-3 cycles at dusk.
- ✓ Use disease-free stock.
- ✓ Clean up and sterilize your equipment, including tools.
- ✓ Space plants on benches so they don't touch and allow for good air flow.
- ✓ Avoid wetting foliage when watering, particularly later in the day.
- ✓ Inspect incoming material.
- ✓ Before introducing a new crop, destroy weeds and old plants, and remove all plant debris.
- ✓ Fungicides are available for use.



Hollyhock rust, upper leaf surface with typical yellow spots (left); lower surface with brownish ruptured pustules (right).



Snapdragon rust.



Geranium rust, underside of leaf with circular rust pustules; single pustule enlarged (insert).

RUSTS

Damage symptoms

Infected areas may appear with chlorotic or necrotic spots. The rust fungi most often produce spores that are rust colored. Severe infection may limit growth, cause extensive defoliation and even kill the plant. Lower leaves are usually infected first. Stems or flowers may also be affected.

Host plants

Ageratum, hollyhock, windflower, snapdragon, chrysanthemum, carnation, impatiens, fuchsia, rose and many more.

Disease characteristics

Many rusts have two different life cycles and may produce 5 distinct spore types. Most greenhouse rusts however, produce 1 to 4 different spore types and have life cycles similar to other common leaf-spotting fungi. Two hosts, often a woody ornamental and a herbaceous annual may be infected with a single rust species but have different host phases. Each spore type or stage has a definite role in the life cycle of the pathogen. The most common spore stage on greenhouse crops is the uredospore. Uredospores are responsible for spreading infection in the same host plants in the greenhouse. The teliospores are not common on floral crops. Spores are spread by wind or water splash. Cankers may form from stem infections.

Management

- ✓ Remove plant debris infected by rust.
- ✓ In early stages of infection, remove diseased leaves.
- ✓ When watering, avoid wetting the foliage.
- ✓ Avoid excess condensation on leaves.
- ✓ Provide sufficient air circulation and do not place plants close together on benches.
- ✓ Several fungicides are effective for rust.
- ✓ Use resistant varieties when they are available.

Management of viruses

Like other plant diseases, viruses should be managed by prevention.

- ✓ Grow plants from virus-free stock.
- ✓ Space plants apart on benches so they don't touch. Rubbing facilitates wounding which serves as an entry point for virus and encourages movement of thrips from plant to plant.
- ✓ Control the insect vector, especially thrips, to reduce virus spread.
- ✓ Grow indicator plants to detect viruses early. Remove them if they become infected.
- ✓ Carefully prepare greenhouses before plants are growing.
- ✓ Consider installing thrips-proof screening to reduce the chance of thrips entering from outside.
- ✓ Remove weeds from greenhouses as they serve as a reservoir for thrips and viruses.
- ✓ Check symptomatic plants for virus infection by sending samples to a diagnostic laboratory or testing tissue with test kits.



*Characteristic symptoms of tospovirus infection.
Note: stunting (red arrow)*



Western flower thrips adult, a primary vector of tospoviruses.



Tospovirus on impatiens.



Tospovirus on cineraria.

VIRUSES

General Information

Characteristic symptoms of viruses include ringspots, mosaic patterns, yellowing, streaking, deformed growth, stunting, necrotic lesions and veination. Symptoms may be masked during warmer temperatures. However, once a plant is infected, there is no cure. Viruses can be transmitted by insects, nematodes and cultural practices. Most plant species are susceptible to at least one virus, and some plants are susceptible to many.

Tospovirus (Impatiens Necrotic Spot Virus INSV, Tobacco Spotted Wilt Virus TSWV and others)

One of the most widespread viruses found in greenhouses is Impatiens Necrotic Spot Virus (INSV). Tomato Spotted Wilt Virus and INSV were once thought to be two strains of the same virus. They are now recognized as two distinct viruses. Both are only transmitted by thrips.

Damage symptoms

Infected plants often have a localized necrotic brown, yellow or red spot surrounding the point where the virus entered the plant. These lesions may be found on leaves, stems and flowers and may gradually enlarge as the virus spreads. Blackened stems are also characteristic on infected impatiens plants. Other symptoms that have been reported on flower crops include: vein necrosis, vein clearing, wilt, ringspots, stem cankers, white necrotic spots, chlorotic mottle, leaf-base necrosis, necrotic or chlorotic line patterns, leaf bronzing and stunting. Some of these symptoms are also common for other ornamental diseases. Some infected plants, such as Christmas cactus, are symptomless.

Host plants

Over 300 plant species are listed as susceptible to tospoviruses, including: ageratum, calendula, cyclamen, dahlia, gerbera, gladiolus, impatiens and others. Many weed species are also susceptible, though they may not show symptoms.

Disease characteristics

Tospoviruses enter plants via small wounds in plant cells caused by thrips feeding. Once the virus invades the cells, it begins to multiply and spread within the plant. The exact tospovirus species can only be determined by diagnostic testing. The occurrence of tospoviruses in greenhouses increases as the population of its primary vector, western flower thrips increases (see page 16-17).



Healthy poinsettia plant.



Poinsettias with symptoms of root rot.



A root system with pythium root rot. The outer cortex of the root will slough off, leaving the central stele of the root. (see arrow)

ROOT ROTS

Damage symptoms

Plants can become infected at any stage of growth. The first indication of a problem may be nutrient deficiency-like symptoms followed by growth reduction, wilt, and possibly plant death. Roots appear brown to black. Normal root growth is greatly reduced, thus the root ball will appear smaller than normal. Often roots infected with either *Pythium* or *Phytophthora* become so rotten that when you pull on them, the outer portions slip off, leaving the hardened root core.

Host plants

Most plants grown in the greenhouse are subject to root rot.

Disease characteristics

Root rots may be caused by noninfectious or infectious factors. Noninfectious factors include overwatering, excess use of fertilizer, drought, extremely high temperatures, salt buildup in potting media and toxic chemical buildup in soil. The infectious agents are soil-borne fungi or bacteria. Fungi include *Pythium*, *Rhizoctonia*, *Phytophthora*, *Thielaviopsis*, and *Fusarium*, which also cause other symptoms, i.e., damping-off and blights. The plant must be removed from the pot, and the agent viewed under magnification to positively identify the pathogen. All infectious root rot pathogens can exist in growing media. Most of these microbes are confined to soil and can only affect roots. Root rot pathogens kill the cells they invade. Host root exudates stimulate fungal spore germination and provide food for the pathogen. The spread of infection in the greenhouse is usually via soil particles or water.

Management

Prevention is the best management for root rot pathogens.

- ✓ Use soilless potting mixes and sterilize them before use.
- ✓ Treat soil with heat, steam, chemical drenching or fumigation before use.
- ✓ Make sure the sanitization process eliminates the pathogens; a few spores can flourish quickly in the relatively sterile medium.
- ✓ Clean tools, hoses, walkways and boots regularly.
- ✓ Apply preventative biological soil treatment at planting.
- ✓ Use chemical fungicides if necessary.
- ✓ Avoid high EC levels. EC is a measure of soil salinity. High EC levels may injure roots, making them susceptible to root rots.