

# Understanding Plant Fungal Leaf Diseases in Nurseries



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# Contents

- 1. Brief Introduction to Fungi.....3
- 2. Powdery Mildew
  - a. Causes and Description.....5
  - b. Environment and Infection Process.....6
  - c. Management Strategies.....7
- 3. Leaf Spot
  - a. Causes and Description.....8
  - b. Environment and Infection Process.....9
  - c. Management Strategies.....10
- 4. Leaf Rusts
  - a. Causes and Description.....11
  - b. Environment and Infection Process.....12
  - c. White Pine Blister Rust.....13
  - d. Management Strategies.....14
- 5. Generalized Management Strategy.....15
- 6. Vocabulary.....16
- 7. References.....17



*Powdery mildew*



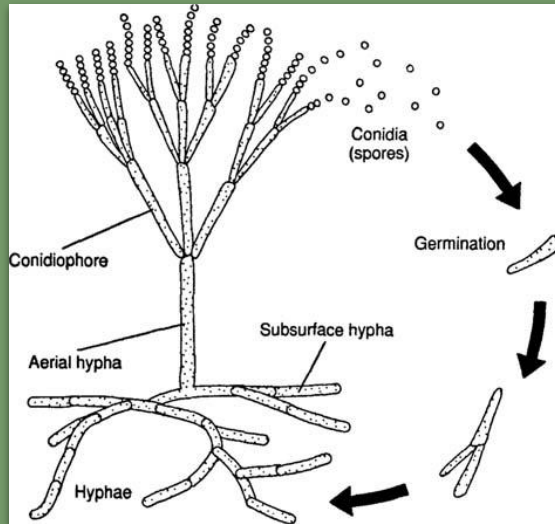
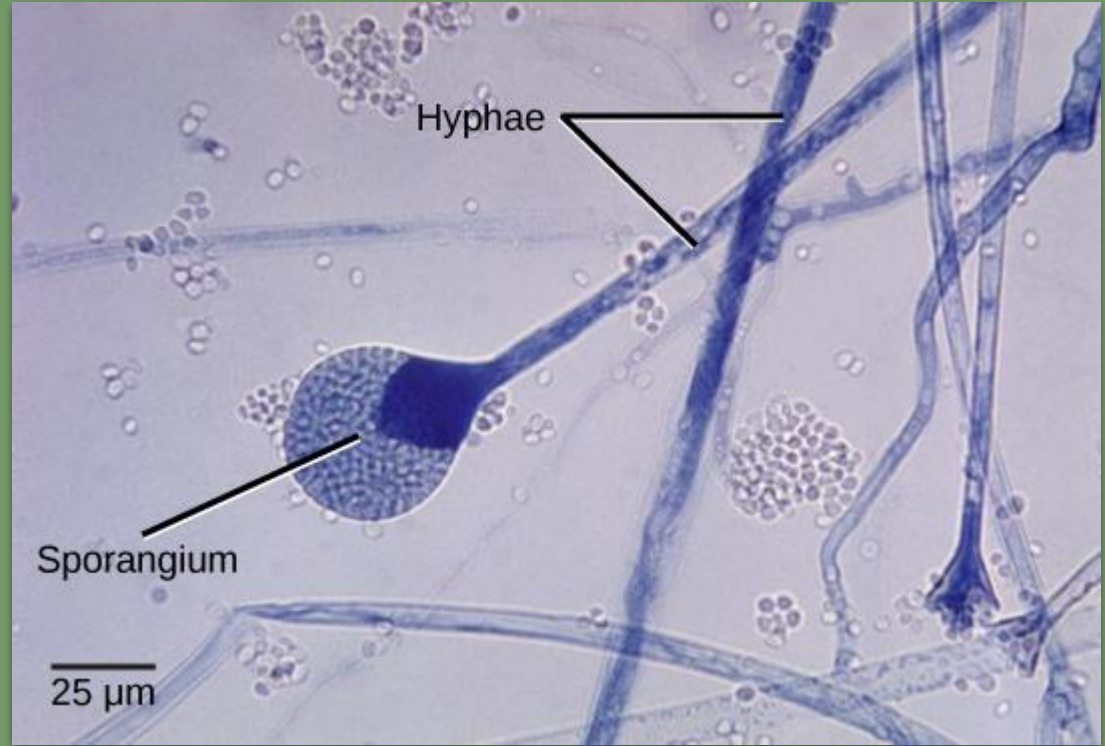
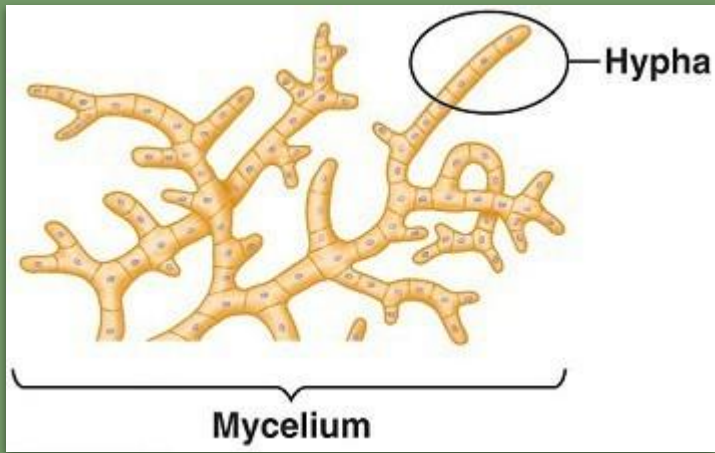
*Fungal rust on oregon oxalis*



*Fungal rust*

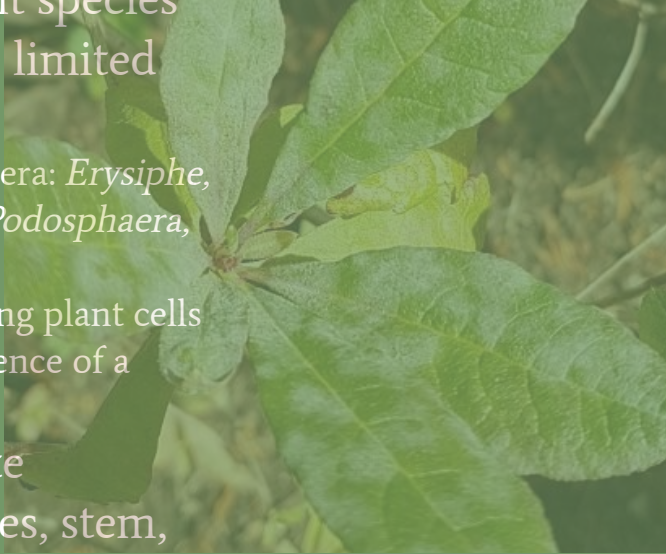
# Brief Introduction to Fungi

- Fungi are eukaryotic organisms that lack chlorophyll – making them taxonomically distinct from plants
- Fungi are heterotrophs – obtains nutrients from complex organic substances (as opposed to fixing their nutrients from the atmosphere as plants do)
  - they digest organic matter externally before absorbing it
- Fungi grow from tips of filaments (**hyphae**) that make up a complex, radically expanding network (**mycelia**) which is the body of the organism (**thallus**)
- Reproduction
  - Mycelium produces spores on hyphae
  - Spores are produced in sporangia (sac-like sporophores)
  - Asexually produced spores (**conidia**) are typically formed terminally on special, spore-producing hyphae (**conidiophores**)



# Powdery Mildew – Causes and Description

- Caused by multiple different species of fungi that generally have limited host ranges
  - Powdery mildew causing genera: *Erysiphe*, *Microsphaera*, *Phyllactinia*, *Podosphaera*, *Sphaerotheca*, and *Uncinula*
  - Biotrophic fungi: feed on living plant cells and barely survive in the absence of a living crop
- Appears as a powdery, white substance covering the leaves, stem, or fruit
  - This is actually a result of large numbers of microscopic **conidia**



# Powdery Mildew – Environment and Infection Process

- Thrives in humid conditions and stagnant air
  - Can be caused by plants growing too close together
  - High relative humidity promotes germination of spores, but inhibits spore production – overall effect is negligible
- Pathogen overwinters in plant debris and within buds of infected plants
- Conidia are the main means of dispersal (dispersed by wind)
  - In greenhouses, dispersal of spores over small distances mainly occurs through workers clothing
- Fungal spores germinate on leaf surfaces, where germ tubes grow and branch out
  - **Haustoria** are produced from which fungus penetrates plant cell and takes up nutrients from epidermal layer of plant cells
  - Doesn't require moisture for infection
- Powdery mildew is rarely fatal, but it causes stress and weakens plants
  - Stressed and weakened plants are much more susceptible to other diseases
  - Photosynthesis can be inhibited when the fungus covers leaf surfaces

# Powdery Mildew – Management Strategies

- Watering – deeply, in the morning when possible, avoid watering from overhead
  - NO overhead irrigation, keep foliage dry
- Remove infected plant material and destroy it
  - Continually remove dead leaves from soil to prevent an area for fungus to overwinter
- Neem oil – coats leaf surface and suffocates fungus
- Baking soda – 1 tsp in water, spray mixture onto affected leaves
  - pH level creates unsuitable environment for the fungus to reproduce and spread
- Do not provide excess nitrogen, since this promotes the disease
  - Remove affected plants from fertilizing regime
- Prevention
  - Extra silicon and/or calcium nutrition hardens the cell wall and makes it harder for fungi to enter the leaves

# Leaf Spot – Causes and Description

- Very common, caused by multiple species of fungi (some attack specific host plants and others will attack a wide range)
  - Leaf spot causing genera: *Cercospora*, *Alternaria*, *Anthracnose*, *Ascochyta*, *Corynespora*, *Cylindrocladium*, *Cylindrosporium*, *Didymella*, *Entyloma*, *Fabraea*, *Marssonina*, *Phyllosticta*, *Pleospora*, *Ramularia*, *Septoria*
- Spots are variable, but generally white to grayish-white and enclosed by reddish-brown, brownish, or yellowish margins
  - It is possible to see evidence of fungal pathogens (mycelium) at the center of some spots
- Spots first appear on adaxial surfaces, then become apparent on abaxial leaf surfaces





# Leaf Spot – Environment and Infection Process

- Infection process requires water on the leaves or a prolonged period of high humidity
  - Prolonged period could be 12 - 24 hours
  - Leaf spots often mature in 1 - 2 weeks
- Spores are dispersed by splashing rain, wind, personnel working with infected, wet plant material, insects, or mites
- Spores can germinate in water or in the natural leaf openings
  - Hydathodes, lenticels, stomata
- The cycle of spore production and infection can repeat any time weather conditions are favorable
- Pathogen can survive winter in infected leaf debris
- Favorable conditions include humidity and after a rainfall (or overhead watering)
- The pathogen can cause leaves to drop prematurely, however it is generally considered an aesthetic concern
- Leaf spot can turn into a blight in which case tissue death can progress until the entire lamina is dead
- Blight or continual defoliating should be indications of a more concerning infection



# Leaf Spot – Management Strategies

- Avoid overhead watering and keep the foliage as dry as possible
  - Apply irrigation only to roots and potting material
  - Water early in the day, if possible
- Prune dead leaves and stems **AND** remove dead plant material from the soil of pots as well
- Reduce stress on plants
  - Plants already experiencing stress are more likely to be susceptible to the pathogen and more likely to experience worse symptoms
- Avoid fertilizing infected plants



# Rust – Causes and Description

- Rust fungi are obligate parasites, meaning they can only grow on a living host
- Rust pathogens have the most complex life cycles of all fungal plant pathogens with up to five different spore stages that occur over at least two different host species
- Spores are identifiable as powdery pustules that initially appear on the abaxial side of a leaf
  - Spore are yellow to orange-red and brown



# Rust – Environment and Infection Process

- Rust pathogens thrive in cool and damp conditions
  - Germination and infection requires water on the leaf surface for several hours
- Rust spores germinate on leaf surfaces and enter through the stomata or form a special organ to penetrate the cuticle and epidermis
  - Pathogen will penetrate plant cells and use a **haustorium** to absorb nutrients
- Rust spores are wind, rain, and splash dispersed during multiple stages
  - Some spores will remain close to the plant in fallen debris or dead material to overwinter
- A heavy rust infection can cause leaves to fall prematurely, which will prevent natural hardening of shoots and buds, resulting in lower outplanting success
- The fungus will destroy leaf tissue, reducing plant photosynthetic capacity and in some cases plants may be killed

# White Pine Blister Rust

- Cause: *Cronartium rubicola* – a fungus introduced to North America in the 1900s
- Hosts: all North American white pines/five-needle pines
- Alternate Hosts: currants and gooseberries (*Ribes*) and occasionally *Pedicularis* and *Castilleja* species
- Impact: Affects trees of all ages and sizes, can effectively eliminate white pines from certain ecosystems
  - Branch and stem cankers eventually lead to entire tree death
  - Premature defoliation occurs on *Ribes* but otherwise there is little damage
- Concern: High



# Rust – Management Strategies

- Regularly check plants, especially in Spring, paying close attention to the underside of leaves
- Avoid overhead watering and keep the foliage as dry as possible
  - Apply irrigation only to roots and potting material
  - Water early in the day, if possible
- Prune dead leaves and stems **AND** remove dead plant material from the soil of pots as well
- Reduce stress on plants
  - Plants already experiencing stress are more likely to be susceptible to the pathogen and more likely to experience worse symptoms
- Potentially beneficial to begin fungicide application at the first appearance of rust
- Considerations for terminating a plant if infection cannot be managed?

# Generalized Management Strategy

- Regular check plants for signs of infection
- Always avoid overhead irrigation and try to avoid splashing or wetting foliage
- Prioritize spacing of plants to promote quick drying and air circulation
- Prune dead leaves and stems **AND** remove dead plant material from the soil of pots as well
- Practice sanitary handling techniques – wash hands in between touching infected plants, take caution when watering and handling wet plants
- Reduce stress on plants
  - Plants already experiencing stress are more likely to be susceptible to the pathogen and more likely to experience worse symptoms
- Avoid fertilizing infected plants
- Monitor and assess damage from fungal infection before deciding to use chemical control (neem oil or a fungicide)

# Vocabulary

- Abaxial = the bottom side of the leaf
- Abscission = “programmed self-pruning”
- Adaxial = the side of the leaf towards the sun, top side of the leaf
- Chlorosis = yellowing of leaf tissue due to a lack of chlorophyll
- Conidia = a spore produced asexually by various fungi
- Haustoria = a slender projection from the hyphae of a parasitic fungus, enabling parasite to penetrate tissue of its host and absorb nutrients
- Lamina = refers to the entire flat and extended section of the leaf, i.e. the leaf blade



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