

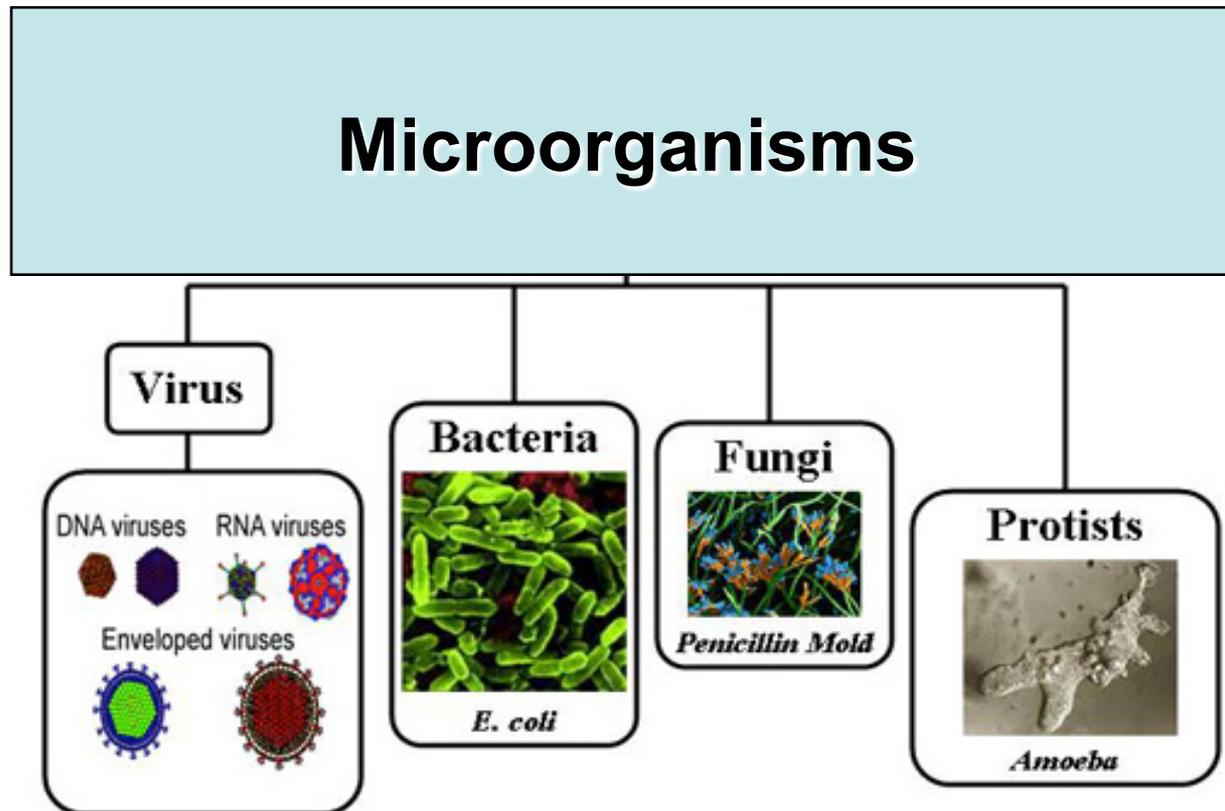
Introduction to fungi



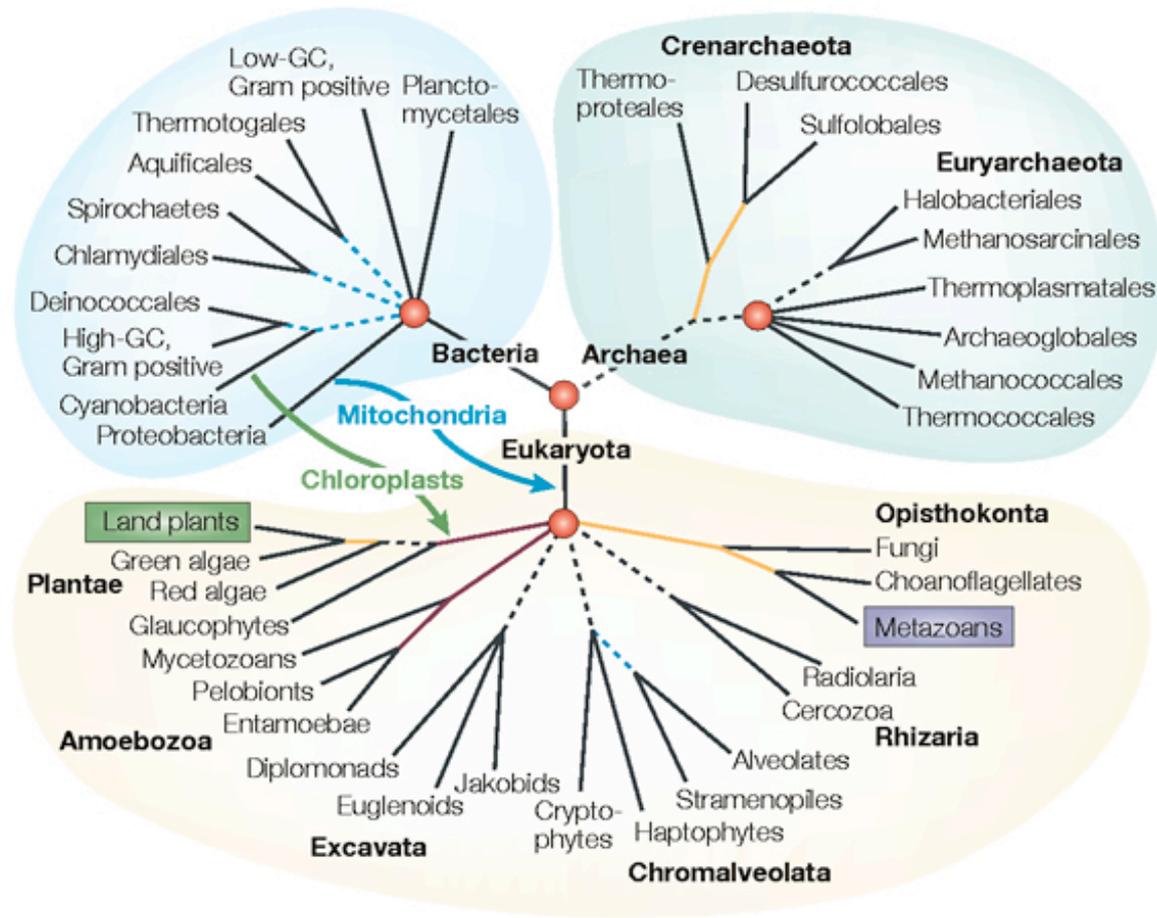
Photo: R. Hamelin

There is a wide variety of pathogens that can attack plants

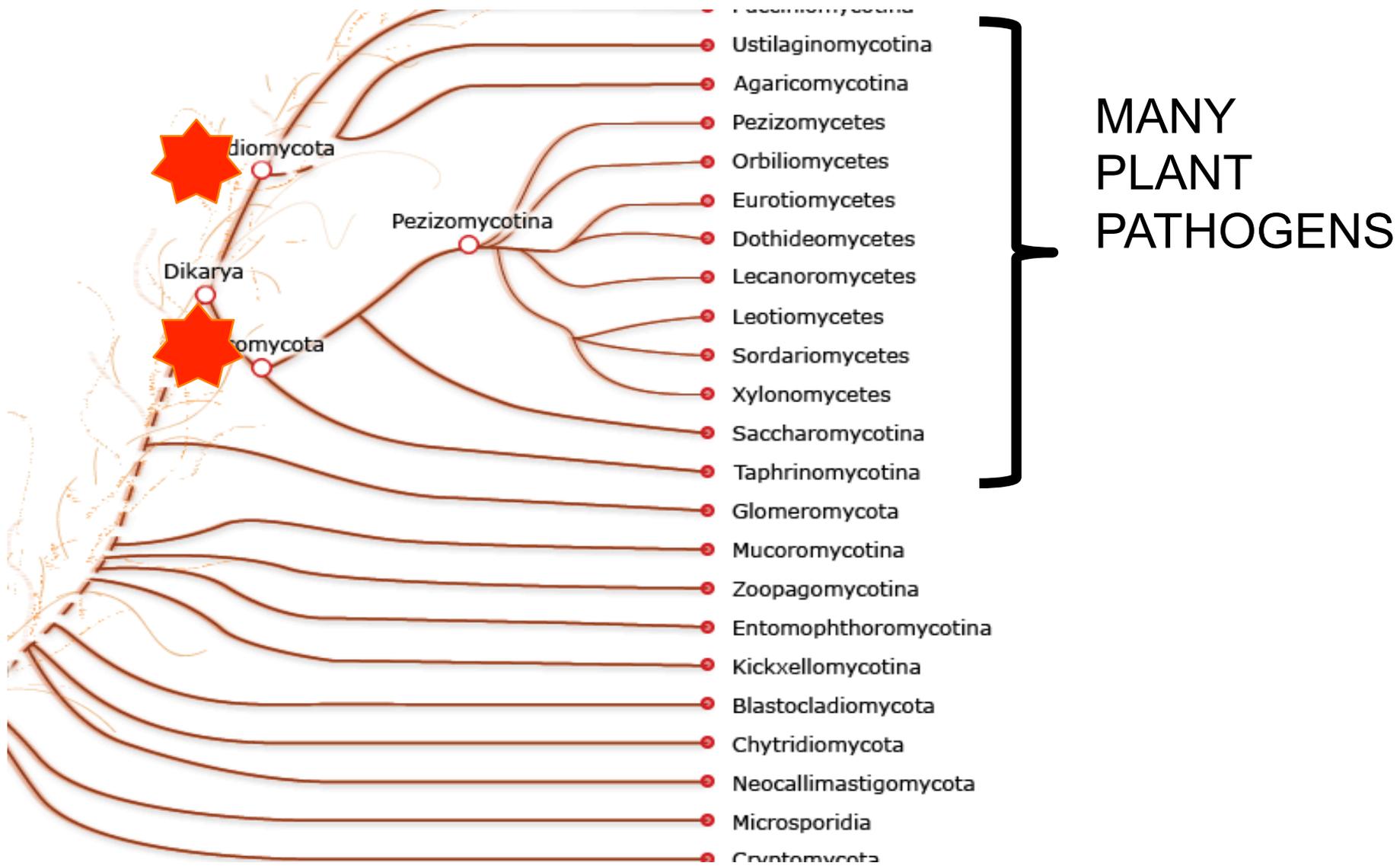
Fungi are the most important group of pathogens on trees



The tree of life shows that fungi are more closely related to animals than to plants



The kingdom fungi comprises many plant pathogens, most of them the dikarya



Fungi are diverse and abundant

- There are about **70,000** described species of fungi, and that is estimated to be only about 5% of the species that actually exist in the world
- The total number of species of fungi is estimated to be about **1.5 million**
- As a comparison there are only about 8000 species of birds in the world



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Fungi take many different forms, shapes and colors, yet we only see the tip of the iceberg!

Macrofungi - large sporocarps aka fruiting bodies



Microfungi - fruiting bodies small, visible with magnification



Famous Fungi

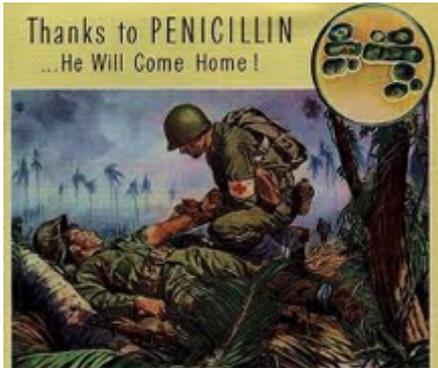
Tuber melanosporum



Saccharomyces cerevisiae- fermentation!



Penicillium



Amanita muscaria – toxic!



Ophiocordyceps unilateralis



Fungi play a multitude of roles in natural forests

Saprophytes

- Decomposition of cellulose and lignin
- Carbon, nutrient cycling

Symbionts

- Lichen, Mycorrhizae, Insects (bark beetles, wasps)

Food for wildlife, insects, human

Parasites

- Overcomes plant and tree defence to exploit resource

When the equilibrium is disturbed forest diseases can cause widespread damage

Nurseries provide conducive conditions for diseases and can introduce exotic invasive pathogens



Logging creates point of entry for pathogens



Courtesy Canadian Fire Research

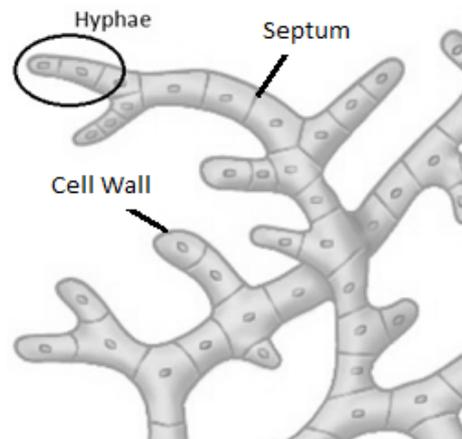
Fire management can create opportunities for pathogens

What are fungi?

- Fungi are **heterotrophs**: they can't make their own food
 - They lack chlorophyll and must find carbon source
- Fungi live in their food
 - They absorb nutrients from their food as a result of secreting enzymes: they are **osmotrophic**
- Fungi are **eukaryotic** organisms
 - They possess nuclei and mitochondria
- The cell walls of fungi comprise **chitin**
 - Long chain polymer, made of a glucose derivative

The hyphae are the basic fungal units

- A **hypha** (plural hyphae) is a long tubular structure with rigid cell walls that contains the cytoplasm including the nuclei; it is the main mode of vegetative growth of a fungus
- Hyphae absorb nutrients from the environment and transport them to other parts of the thallus (fungus body)
- **Mycelium** refers to several hyphal strands: mass of branching hyphae

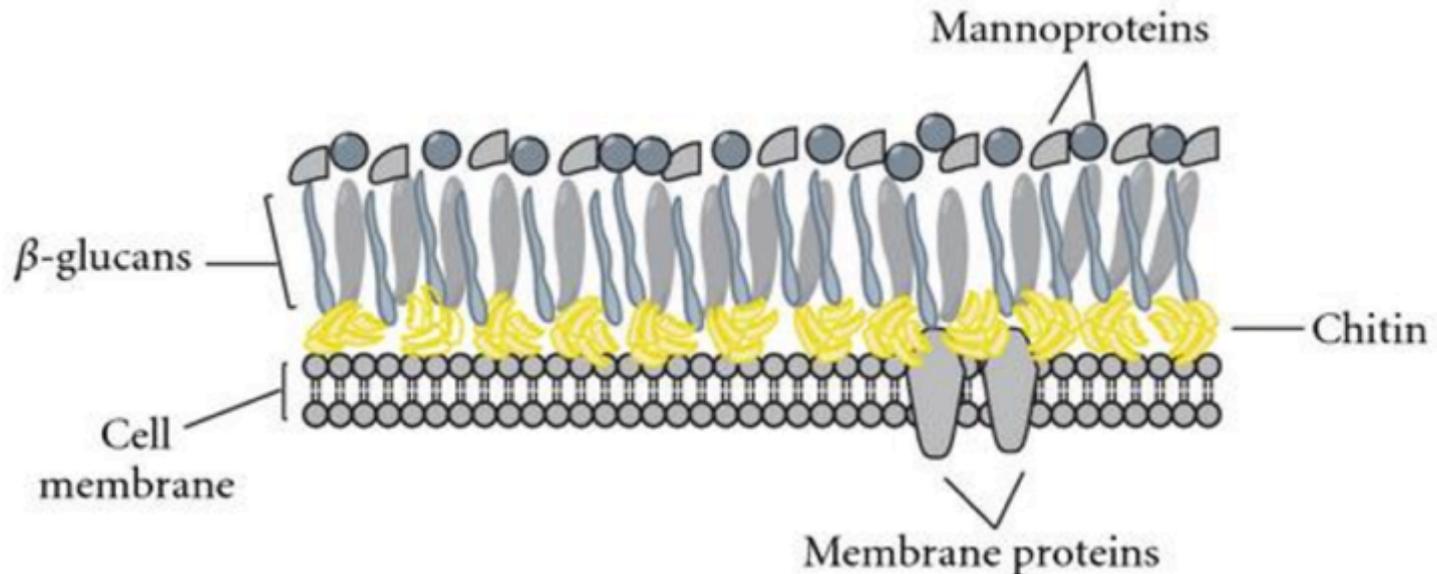


Mycelium



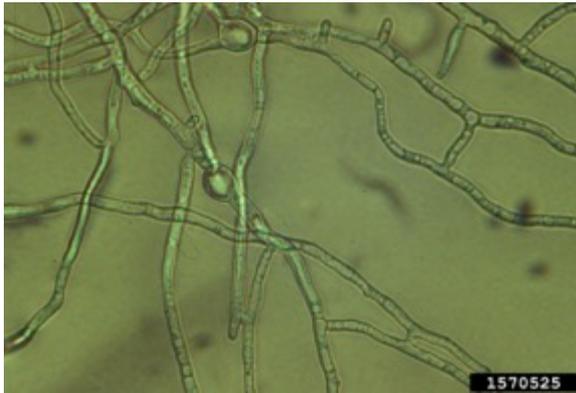
The fungal cell wall is a matrix of three components

- The **chitin** layer is the 'skeleton' and provides the walls with strength and rigidity
- Chains of **glucans** (glucose polymers) that cross link to chitin and form a matrix that maintain the integrity of the cell wall
- **Proteins** (enzymes) that serve in cell wall synthesis and lysis (breakdown)



How do fungi grow and feed?

- Hypha grows at the tip, which can be very strong and penetrate between and within plant and wood cells
- The hyphal tip releases substances, such as enzymes, that soften or even dissolve material in its path
- All fungi produce extracellular enzymes but each fungus produces its own battery of enzymes which defines the substrate it will feed on
- All fungi require carbon-containing substances such as sugars as sources of energy and all need nitrogen-containing substances to build proteins and other essential components.

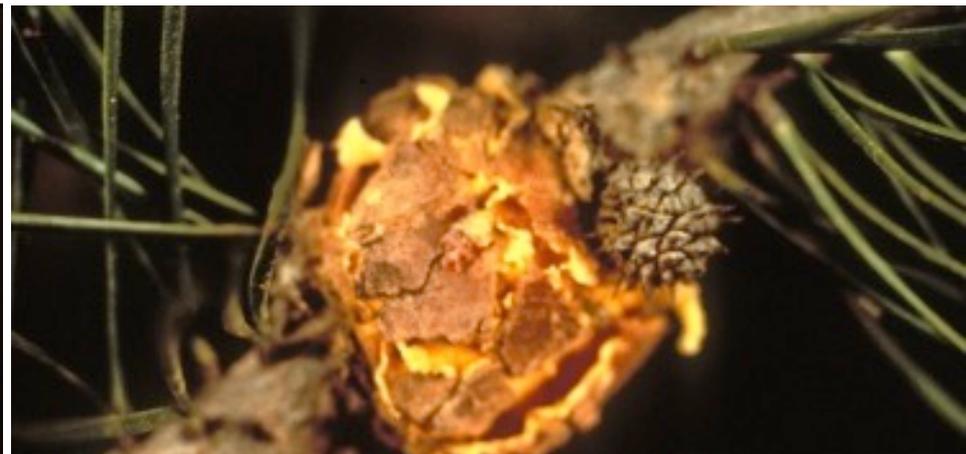


How do fungi reproduce?

- Fungi reproduce either sexually or asexually,
- The majority of fungi produce spores (microscopic seeds)
- Spores can be produced in specialized fruiting bodies or directly on specialized hypha

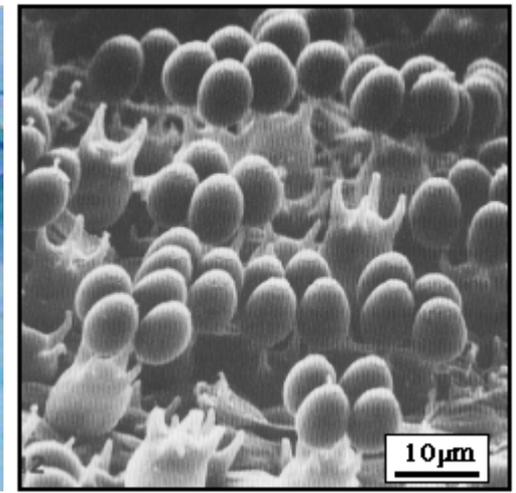
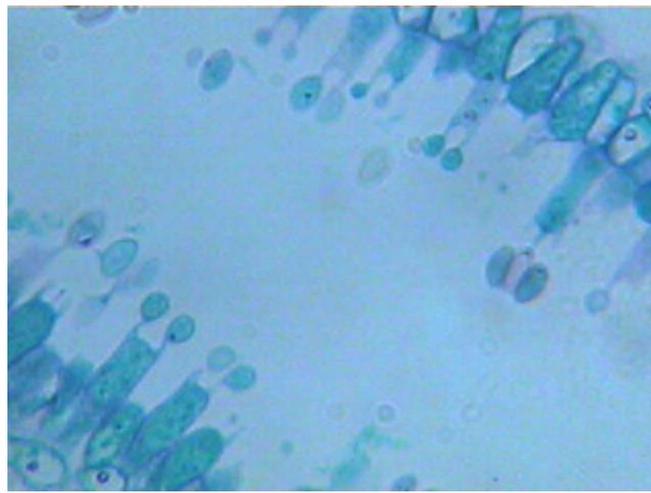
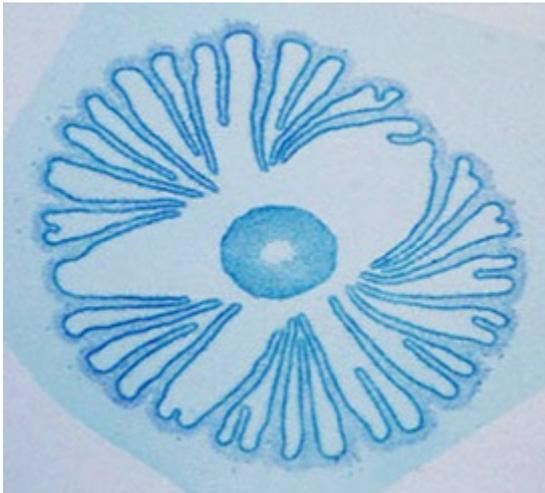


Basidiomycetes comprises important tree pathogens: root pathogens, decay, rusts

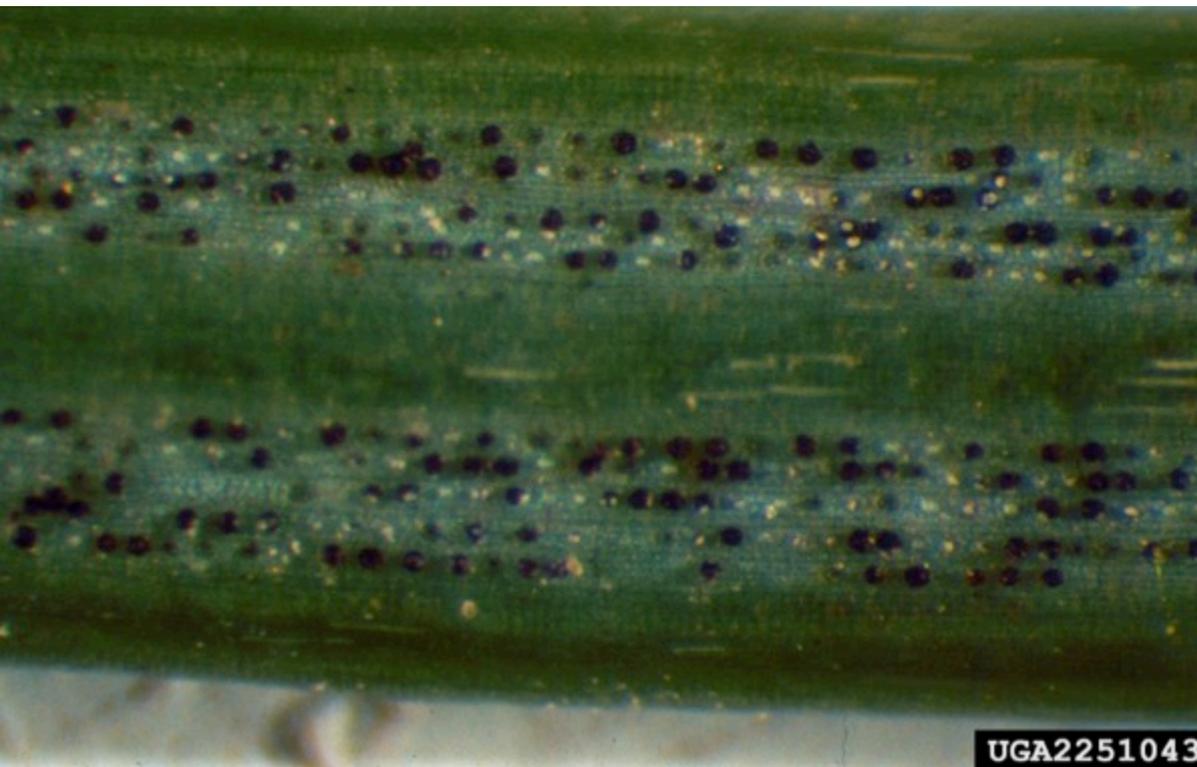


Characteristics of basidiomycetes

- The most diagnostic feature is the production of **basidia**
- Cells in which meiosis occurs and where spores called **basidiospores** are produced
- Four basidiospores per basidium



Ascomycetes comprises important tree pathogens: foliar, vascular, cankers



Characteristics of ascomycetes

- The most diagnostic feature is the production of **asci** (from the greek sac)
- **Ascospores** are sexual spores produced in asci; each ascus contains 8 ascospores

