Phylum: Oomycota

Order: Peronosporales

Characteristics

1- The Peronosporales are obligately biotrophic pathogens of a few groups of higher plants
2- They are responsible for diseases mainly of aerial plant organs known collectively as **downy mildews**
3- The order currently comprises three families:
    a. Peronosporaceae (*Peronospora, Plasmopara, Bremia*)
    b. Albuginaceae (*Albugo*)
    c. Sclerosporaceae (*Sclerospora*)
4- The mycelium in the host tissues is coenocytic and intercellular (between cells), with haustoria of various types penetrating the cell walls.

    Appressoria (to press against): a flattened, hyphal, pressing organ from which a minute infection peg grows and enters the epidermal cell of the host.

    Haustoria: they are specialized food absorbing organs, knob-like, elongated, or branched-like, formed after the penetration of intercellular hyphae of parasitic fungi into plant tissue then after the fungus sinks into the plant host cells through a minute pore punctured in the cell wall. They basically outgrowths of somatic hyphae.
5- Parasitize on a narrow range of angiosperm families, usually dicotyledons
6- The tendency of their sporangia to germinate directly, rather than by releasing zoospores. Their sporangia being functional 'conidia' which are disseminated by wind
7- The sporangiophores are well-differentiated, showing determinate growth and branching patterns which provide **characteristic features for identification**.
8- The life cycle of Peronosporales is similar to that of *Phytophthora*

Family: peronosporaceae - Genera of peronosporaceae

***Peronospora* spp.**

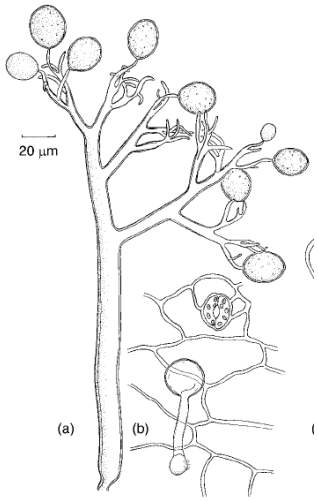
The sporangiophores emerge singly or in groups from stomata. There is a stout (firm) main axis which branches dichotomously to bear egg-shaped sporangia at the tips of incurved branches. Members of the genus attack plants such as onion, sugar beet and brassicaceae causing downy mildew on them. The following are some of them:

Peronospora destructor downy mildew on onion

P. farinosa causes downy mildew of sugar beet, beetroot and spinach

Peronospora tabacina causes blue mould of tobacco

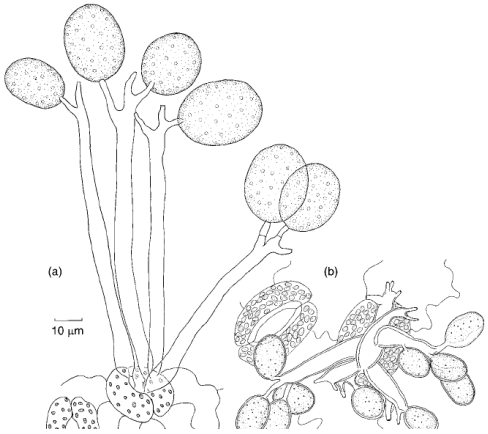
Peronospora parasitica attacks members of the Brassicaceae (Turnips, cauliflower, and Brussels sprouts)



Plasmopara

The sporangiophores are branched monopodially and the sporangia are hyaline. The branches bearing sporangia tend to be right angled. *Plasmopara* is potentially a very destructive pathogen causing downy mildew on many plants. Two types of sporangial germination have been reported. In *P. pygmaea* there are no zoospores but the entire sporangium detaches and later produces a germ-tube. In other species the sporangia germinate by means of zoospores

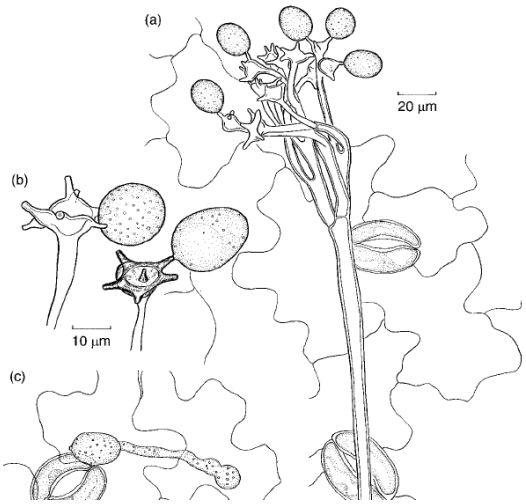
which encyst and penetrate the host stomata. Oospore germination in *P. viticola* is also by means of zoospores.



The following species are common:
Plasmopara viticola cause downy mildew of grapevine
P. nivea cause downy mildew of carrot and parsnip

Bremia

The fungus is characterised by the sporangiophores that emerge singly or in small groups through the stomata and branch dichotomously. The tip of each branch expands to form a cup-shaped disc bearing short cylindrical sterigmata at the margin and occasionally in the centre, and from these the hyaline sporangia arise. *Bremia lactucae* causes downy mildew of lettuce (*Lactuca sativa*) and strains of it can be found on 36 genera of the Asteraceae.
Basidiophora:



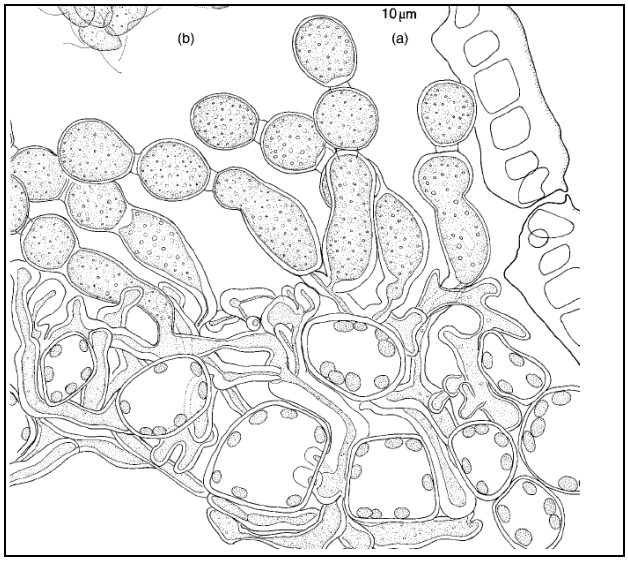
Family: Albuginaceae

This family has only a single genus, *Albugo*, with about 40-50 species of biotrophic parasites of flowering plants which cause diseases known as white blisters or white rusts.

Albugo candida

Causes white blisters of crucifers such as cabbage, turnip, swede, horseradish, etc. It is particularly frequent on shepherd's purse (*Capsella bursapastoris*).

The intercellular mycelium aggregates beneath the host epidermis to form a palisade (strong fence) of cylindrical or skittle-shaped (bottle-shaped) sporangiophores which give rise to chains of spherical sporangia in basipetal succession i.e. new sporangia are formed at the base of the chain. The pressure of the developing chains of sporangia raises the host epidermis and finally ruptures it.



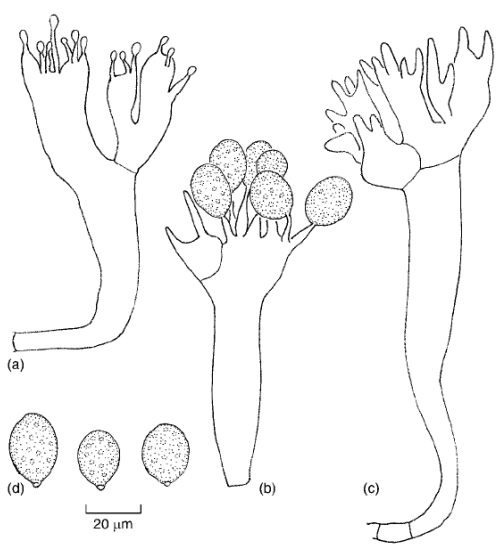
Family: Sclerosporaceae

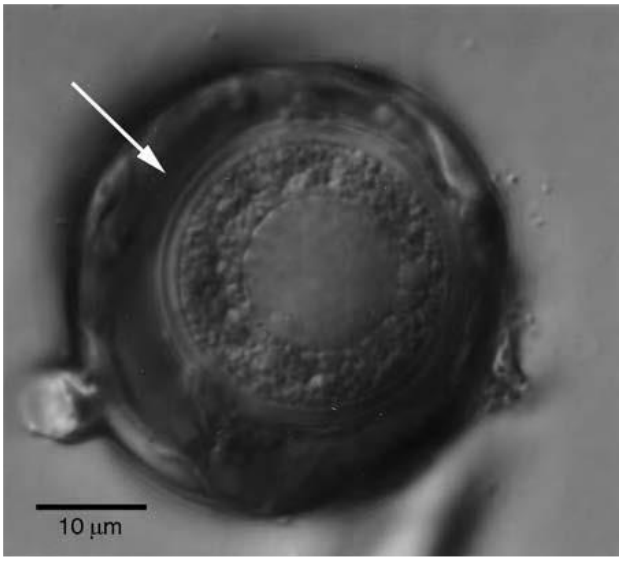
Characteristics

1- This family comprises the downy mildews of grasses and cereals.
2- recent ribosomal DNA-based studies placing its members among the Peronosporales
3- includes genera such as *Sclerospora*, with sporangia capable of germinating by releasing zoospores, and *Peronosclerospora*, whose sporangia show direct germination by germ tubes and are thus, functionally speaking, 'conidia'.
4- Sporangia or conidia are produced on repeatedly branching aerial structures which resemble those of *Peronospora* spp.
5- Oospores of Sclerosporaceae are distinctive in being surrounded by a thickened oogonial wall. The thick-walled oospores can survive on plant debris and in the soil for up to 10 years

Peronosclerospora

the conidiophore project through stomata of the host and branch at their apices to produce up to 20 finger-like tapering extensions which expand to form conidia. The conidia are oval and hyaline.



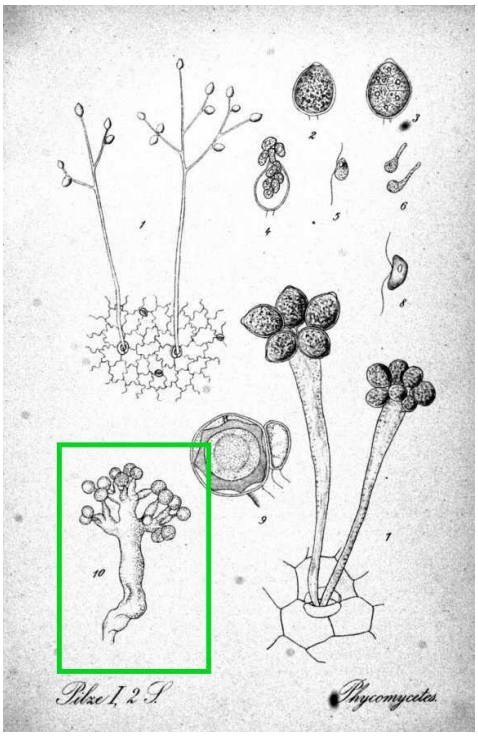


The most important species is *Peronosclerospora sorghi* pathogenic on sorghum and maize.

Sclerospora

The species *Sclerospora graminicola* infecting pearl millet (Pennisetum americanum).

Sporangiophores are short, stout, hyaline , branch irregularly to produce sterigmata bearing the sporangia The sporangia are hyaline, thin walled and elliptical, bear prominent papilla Non-septate hyphae are intercellular in the parenchymatous tissue, sending branched haustoria into the host cells.



Possible questions of this section

- What are the main characters of order peronosporales?
- Why fungi belong to order peronosporales cannot be grown on synthetic culture?
- What is the name of the disease caused by peronosporaceae?
- Why sporangiophores and branching patterns are important in peronosporaceae?

- What are the characters of: Peronospora, Plasmopara, Bremia
- What is basipetal succession in albuginaceae?
- What is the name of the disease caused by albuginaceae?