

# Oomycote-Pythiales

## Order: Pythiales

- 1- The order Pythiales includes two families, the Pythiaceae and Pythiogetonaceae. The Pythiogetonaceae are a small group of aquatic saprotrophs while Pythiaceae is a large family includes over 200 species in approximately 10 genera, of which 2 are of outstanding significance: *Pythium* and *Phytophthora*.
- 2- *Phytophthora* species are primarily pathogenic to plants from which they can be isolated and grown in pure culture. The genus *Pythium* is best known for its saprotrophic soil-inhabiting members, many of which are opportunistic pathogens especially in young plants. There are also obligately pathogenic *Pythium* spp.
- 3- Asexual reproduction in *Pythium* and *Phytophthora* is by means of sporangia which vary in shape from swollen hyphae or globose structures (*Pythium*) to lemon-shaped (*Phytophthora*). Sporangia are borne on more or less undifferentiated hyphae. In most cases, sporangia germinate to produce zoospores which are of the principal (kidney-shaped) type.
- 4- In many *Pythium* spp., the final stages of zoospore differentiation take place outside the sporangium in a walled vesicle, followed by breakdown of the soft wall and release of the zoospores. In *Phytophthora*, in contrast, zoospores differentiate within the sporangium and are released directly or via a very short-lived vesicle which is surrounded only by a membrane.
- 5- Sexual reproduction is oogamous.

- 6- Most members of the Pythiaceae are homothallic, although heterothallism and relative sexuality have been reported, e.g. for *Phytophthora infestans* and *Pythium sylvaticum*.

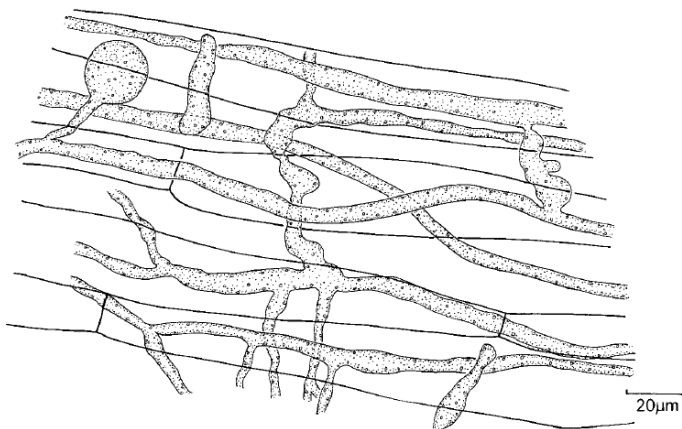
## **Pythium**

### **Life cycle**

Species of *Pythium* grow in water and soil as saprotrophs, but under suitable conditions, e.g. where seedlings are grown crowded together in poorly drained soil, they can become parasitic, causing diseases such as pre-emergence killing, damping off and foot rot.

### **Fungal body**

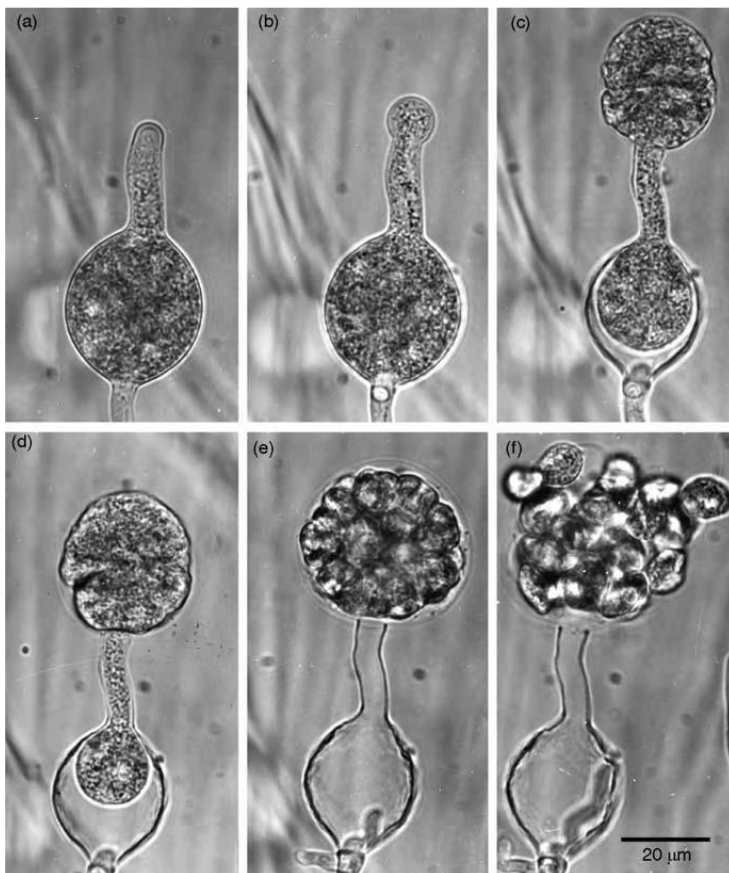
The mycelium is coarse and coenocytic, with typically granular cytoplasmic contents. At first there are no septa, but later cross walls may cut off empty portions of hyphae. Thick-walled chlamydospores may also be formed. There are no haustoria.



Pythium mycelium in the rotting tissue of a cress seedling hypocotyl. Note the spherical sporangium initial and the absence of haustoria.

## Asexual reproduction

The mycelium within the host tissue or in culture usually produces sporangia, but their form varies. Discharge of the sporangium occurs by the formation of a thin-walled vesicle at the tip of the papilla from the fibrillar material of the apical cap, and the partially differentiated zoospore mass is extruded (to push with force) into it.



*Pythium middletonii*. Stages in zoospore discharge. (a) Sporangium shortly before discharge. Note the thickened tip of the papilla which consists of a cap of cell wall material. (b) Inflation of the vesicle begins. (c,d) Protoplasm is retreating from the sporangium. Note the shrinkage in sporangium diameter as compared with (a). (e) Zoospores have differentiated within the vesicle, with flagella visible between the vesicle wall and the zoospores. (f) Zoospores escape following the rupture of the vesicle wall. The whole process of discharge takes about 20min.

## The zoospore

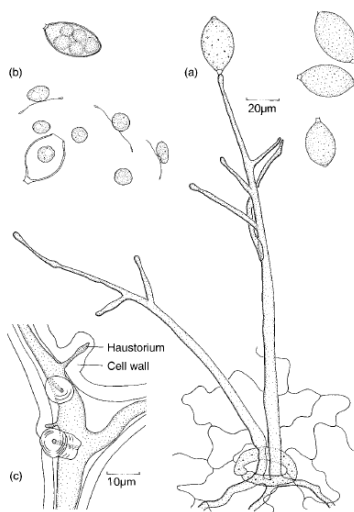
Zoospores of *Pythium* spp. are always of the principal type. They can swim for several hours in a readily recognizable manner of helical forward movement.

## Sexual reproduction

Most species of *Pythium* are homothallic, i.e. oogonia and antheridia are readily formed in cultures derived from single zoospores.

## *Phytophthora*

The name *Phytophthora* (Gr.: 'plant destroyer') is apt, most species being highly destructive plant pathogens. *Phytophthora* is closely related to *Pythium* and there are transitional species which may need to be re-assigned as more DNA sequences and other data become available. In general, the two genera can be distinguished morphologically in that the sporangia of *Phytophthora* spp. are typically pear- or lemon-shaped with an apical papilla (Figure), and ecologically by the predominantly saprotrophic existence of *Pythium* and the predominantly parasitic mode-of-life of *Phytophthora*.



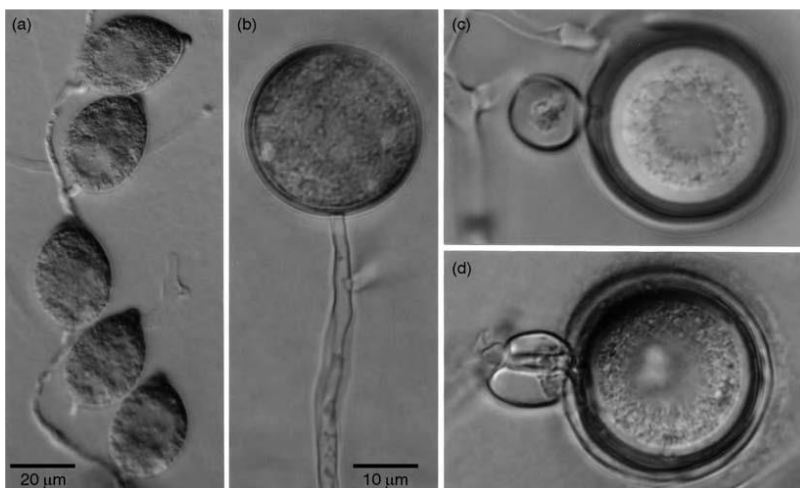
*Phytophthora infestans*. (a) Sporangiophores penetrating a stoma of a potato leaf. (b) Zoospores and zoospore cysts, one formed inside a zoosporangium. (c) Intercellular mycelium from a potato tuber showing the finger-like haustoria penetrating the cell walls. Note the thickening of the cell walls around the haustorium..

## Vegetative growth

Most species form an aseptate mycelium producing branches at right angles, often constricted at their point of origin. Septa may be present in older cultures. Within the host, the mycelium is intercellular, but haustoria may be formed. Haustoria are typical of biotrophic pathogens such as the Peronosporales but may also be formed during initial biotrophic phases of infections which subsequently turn necrotrophic.

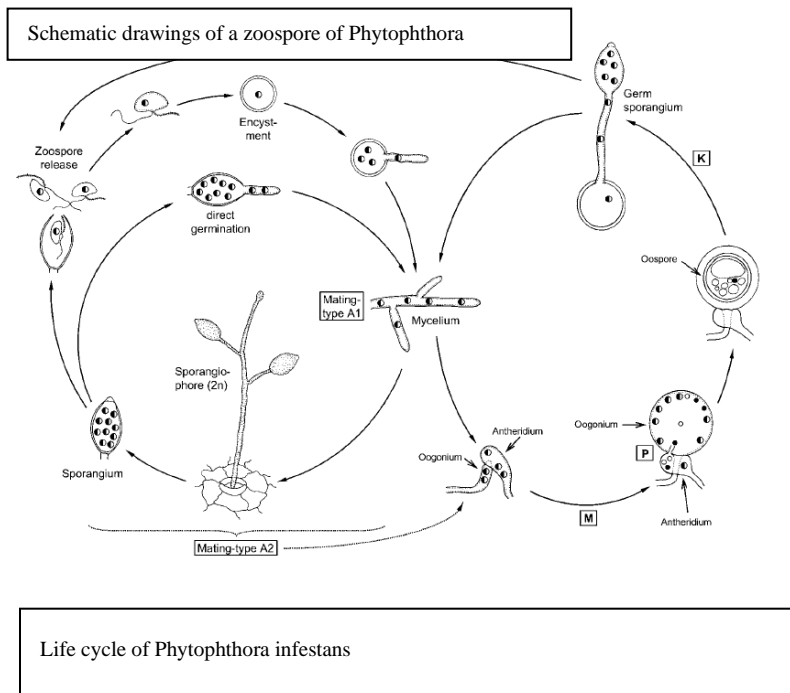
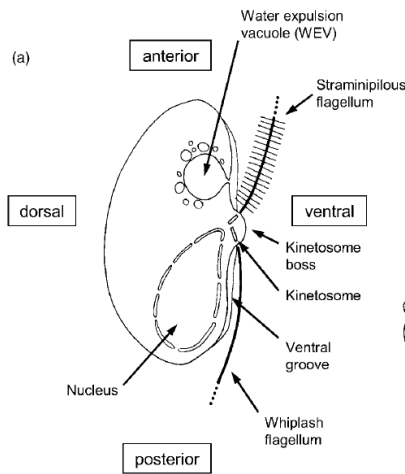
## Asexual reproduction

The sporangia of *Phytophthora* spp. are usually pear-shaped or lemon-shaped and arise on simple or branched sporangiophores which are more clearly differentiated than those of *Pythium*. On the host plant, the sporangiophores may emerge through the stomata, as in *P. infestans*. Thick-walled asexual spherical chlamydospores have also been described for many *Phytophthora* spp. and can survive in soil for several years.



Reproductive structures in *Phytophthora cactorum*. (a) Sporangia. (b) Chlamydospore. (c) Oospore showing the paragynous mode of fertilization. (d) Oospore with amphigynous fertilization. (b\_d) to same scale.

Zoospores of *Phytophthora* swim for several hours, travelling distances of a few centimetres in water or wet soil, although they can be spread much further by passive movement within water currents. They are attracted chemotactically to plant roots by non-specific root exudates such as amino acids, host-specific substances, or the electrical field generated by plant roots. Zoospores of *Phytophthora* are kidney-shaped; both flagella arise from the kinetosome boss protruding from within the longitudinal groove at the ventral surface.



## **Possible questions of this section**

- What are the characteristic features of the kingdom straminipila?
- What are the main characters of oomycota?
- Why the order Pythiales is important?
- What are the differences between Phytophthora and Pythium?
- What does it mean by oogamous fungi?
- What are staminipilous and whiplash flagella?
- What is taxonomy? What are functions of taxonomy?
- What does it mean by saying traditional taxonomic methods?

- What are macro and microscopic features of fungi?
- Why molecular methods is more objective than traditional methods of taxonomy?
- What is hierarchy of taxonomic terms? Give an example
- Give characteristic features of kingdom Protista