http://www.MetaPathogen.com:

# *Phytophthora infestans*



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## Taxonomy

cellular organisms - Eukaryota - stramenopiles - Oomycetes - Peronosporales - Phytophthora - Phytophthora infestans

*Phytophthora infestans* belongs to **Oomyctetes**. For a long time oomycetes were considered as close relatives of **Fungi** such as ascomyctetes (various molds, yeasts) and basidiomycetes (mushrooms, rusts and others). However, studies of metabolism, cell wall composition, and rRNA sequence indicate that oomycetes are more properly grouped with chrysophytes, diatoms, and brown algae.

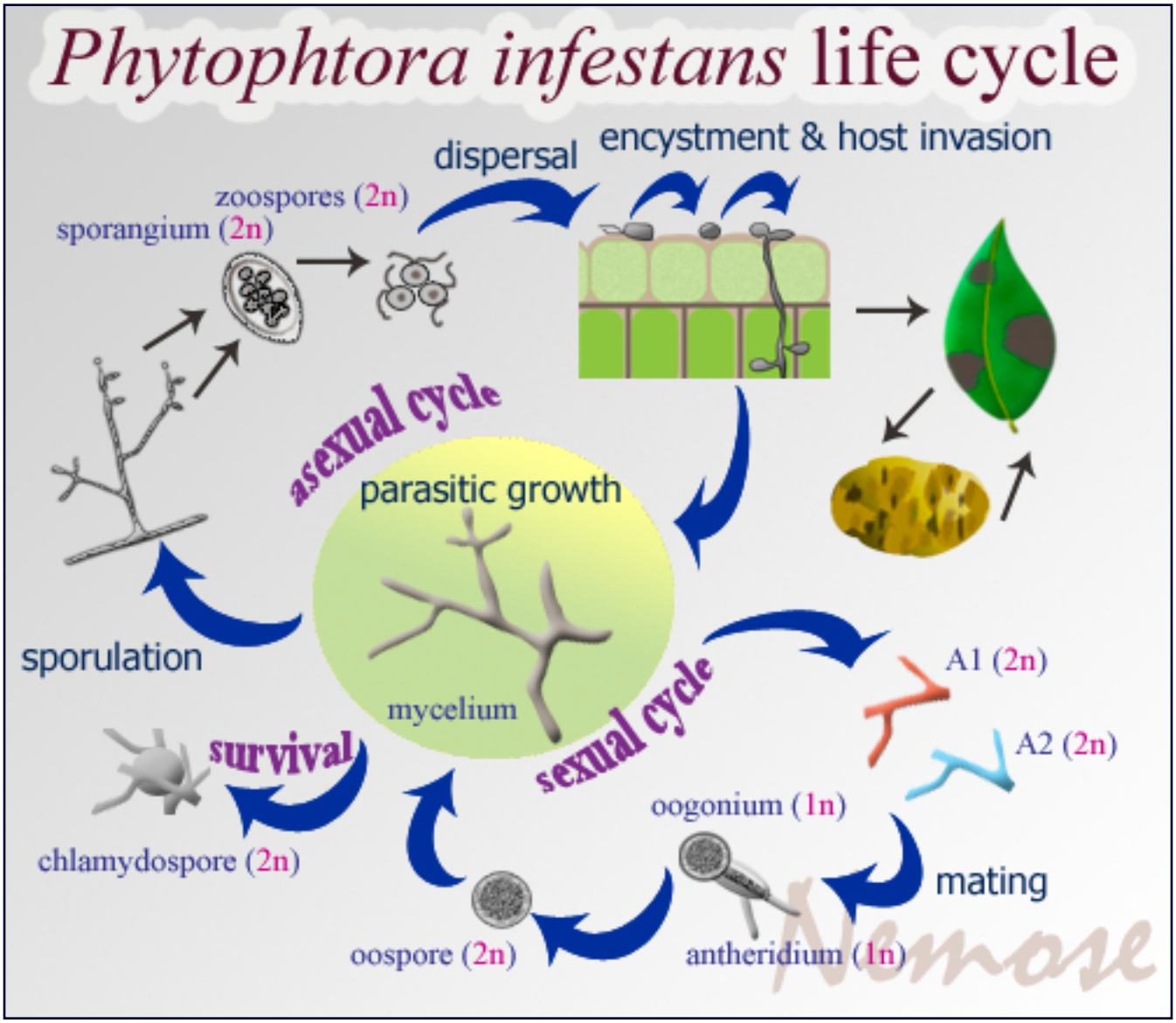
## Brief facts

- A highly infectious pathogenic organism that causes a serious disease of the potato, **late blight** or **potato blight**.
- The potato blight caused the Irish Potato Famine in 1845-49 which, it is estimated, caused over 1,000,000 people to starve to death and forced a further 2,000,000 to emigrate.

- For a long time *Phytophthora infestans* had been under control in North America because represented by only one mating type the pathogen was not able to quickly develop resistance to pesticides used against it. However in late 80's, the second mating type of the *Phytophthora* was first noticed in Wisconsin, and had probably already spread throughout of North America. The presence of the second mating type allows sexual reproduction and quicker gene recombination, which, in turn, leads to more rapid development of resistance to pesticides.
- The disease also affect other members of *Solanaceae* family such as tomato and eggplant.

## Hosts of *Phytophthora infestans*

- **Solanum tuberosum (potato, papas): life cycle, tuber anatomy at GeoChemBio** (link opens in new window)
- **Solanum lycopersicum (Lycopersicon esculentum, Lycopersicon lycopersicum), tomato: life cycle, flower and fruit anatomy at GeoChemBio** (link opens in new window)




## Developmental stages

The organism is diploid on all stages of its life cycle, with the exception of haploid nuclei formed within **gametangia** during sexual reproduction.

- sexual

  in response to the hormones, male and female **gametangia** (**antheridia** and **oogonia** are formed within a mating zone in which normal vegetative growth and asexual sporulation are inhibited

- gametogenesis

  haploid nuclei are generated within the gametangia

- oospore formation

  gametes fuse and a diploid **oospore** containing one viable nucleus is generated; progeny of the $A^1$ or $A^2$ type develop from the germinated oospore

- asexual

  under conditions of high humidity the asexual cycle of the pathogen normally takes 5 – 7 days but may be shorter under higher temperatures; four to six cycles may be necessary to progress from a few initial, unseen infections to significant areas of foliage destruction; significant visual evidence of progressing infection in a field crop may not appear until 4 – 6 weeks after its initial infection

  - sporulation

    the pathogen generate sac-like structures, **sporangia** born on specialized branches called **sporangiophores**; airborn sporangia may infect plants over several kilometres if they are not desiccated en route; at temperatures lower than 15, one sporangium may produce 10-12 motile biflagellated spores called **zoospores**

  - germination

    the sporangia or zoospore produces a

germ tube; plant penetration occurs when the tip of the germ tube differentiates into an **appresorium** which enables invasion of the underlying host cell; penetration can take only 2 hours

- direct germination

  at temperatures above 15° sporangia can germinate directly

- indirect germination

  when the zoospores are released; after short motile period, they encyst and produce germ tubes; zoospores can be washed down the stems and reach daughter tubers

- vegetative growth

  hyphae grow intercellularly invading the host tissue and forming biotrophic relationships with plant cells through **haustoria**; the host cells eventually die; as the infestation proceeds new sporangia are formed on the plant surface

## Tissues

- sporangium

  sac-like structure containing asexual spores; sporangia are hyaline (clear) and

lemon-shaped; they are formed on specialized branches called **sporangiophores**; sporangia are relatively short-lived; they are seen as a white halo on underside of the infected leaf

- zoospore

  zoospores emerge from **sporangia** under favorable conditions

- cyst

  encysted zoospore; overwintering form of zoospores which retract or shed their flagella and secrete a wall that protects them from harsh environments

- mycelium

  mycelium constitutes a main biomass of vegetative stage of *Phytophthora infestans*; the mycelium is **coenocytic**, i. e. it represents a multinucleate cytoplasmic mass enclosed by a single cell wall

- chlamydospore

  a thick-walled, asexual fungal spore that is derived from a hyphal cell and can function as a resting spore

## Mating types

*P. infestans* is **heterophalic**, i.e., two mating types are present.

- mating type $A^1$ — prevalent mating type
- mating type $A^2$ — rarely occuring mating type of the organism, however, recent distribution of the $A^2$ mating type has had significant impacts on disease severity and incidence

# References

## PubMed articles


- Judelson HS. The genetics and biology of *Phytophthora infestans*: modern approaches to a historical challenge. *Fungal Genet Biol. 1997 Oct;22 (2):65-76.* **PMID: 9367653**
- Latijnhouwers M, de Wit PJ, Govers F. Oomycetes and fungi: similar weaponry to attack plants. *Trends Microbiol. 2003 Oct;11(10):462-9.* **PMID: 14557029**

- Major topic ***Phytophthora***: **Free full text articles in PubMed**

## Websites

- **Wikipedia: *Phytophtora infestans***
- **Return of the Potato Blight**
- **Potato Late Blight: The Disease and its Control (guide, .pdf)**

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