

Pytophthora

Classification

Kingdom	:	Mycota
Division	:	Eumycota
Subdivision	:	Mastigomycotina
Class	:	Oomycetes
Order	:	Pernosporales
Family	:	Pythiaceae
Genus	:	<i>Phytophthora</i>

Habitat

- **Phytophthora** is represented by 48 species.
- Most of the species attack higher plants, mostly angiosperms and cause diseases of economic significance.
- Some species are facultative parasites and others as facultative saprophytes.
- One of the most common and well known species of *Phytophthora* is *P. infestans*, causing the disease called late blight of potato or Potato blight.
- Cool temperature and excess of water favours the growth of this fungus.
- In India *P. infestans* has been reported from Nilgiri Hills and Darjeeling.

Symptoms of *Phytophthora*

- The disease appears as small black or purplish black areas at the margins and tips of the leaf .
- These patches gradually enlarge and soon the entire crown may rot.
- Under favourable conditions all parts of the host undergo browning and rotting.
- If the soil is very moist, tubers are also affected and may rot completely.

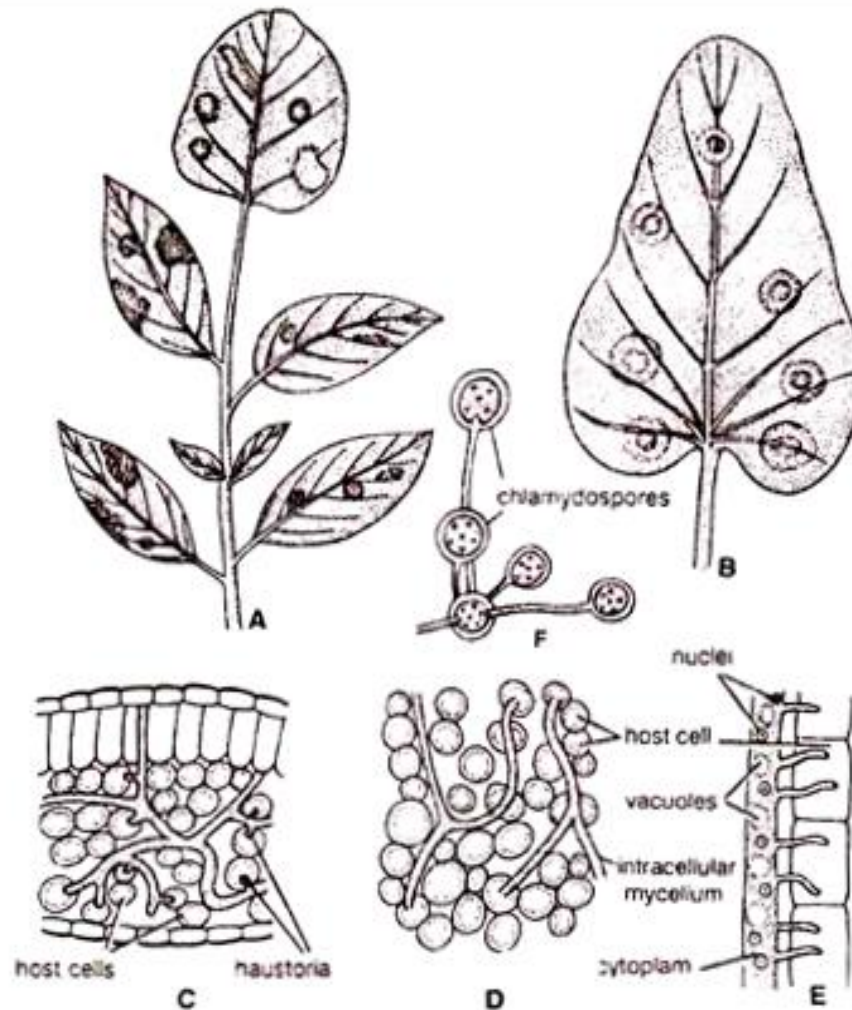


Fig. 7. (A-F) *Phytophthora* : Symptoms. (A) *P. infestans* on potato twig; (B) *P. colocasiae* on *Colocasia antiquorum*; (C) Intercellular mycelium with haustoria; (D) Intracellular mycelium; (E) Mycelium with slender haustoria; (F) Chlamydospores

Vegetative structure

- It is profusely branched and consists of aseptate, hyaline, profusely branched, coenocytic, moderately thick hyphae about 4-8 μ in diameter.
- The hyphal wall is approximately 0.1 μ thick, made of glucans and cellulose.
- Septa remain suppressed in the vigorously growing hyphae.
- They, however, appear here and there in the old hyphae or in connection with the formation of reproductive organs. The fungus spreads through tissues of leaves, stems and tubers.
- There are intercellular and intracellular hyphae formed into the living cell.
- Haustoria develop as lateral outgrowths from the intercellular hyphae.
- The haustoria are variously shaped intracellular feeding structures. In *P. infestans* the haustoria are slender and finger like.
- The intracellular haustorium is connected with the intercellular hypha by a neck-like constriction at the penetration site.

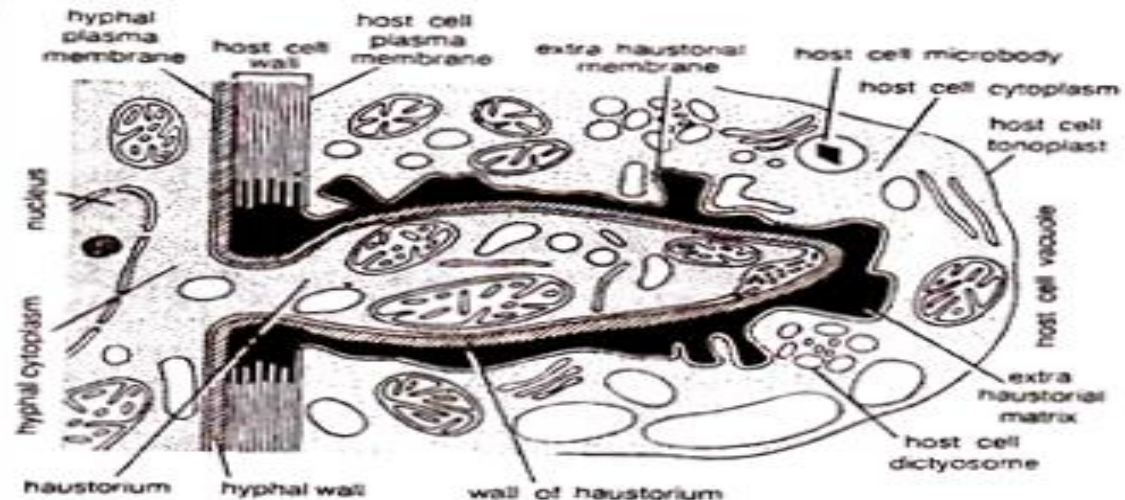


Fig. 8. *Phytophthora* : Diagrammatic representation of ultrastructure of the haustorium

Asexual Reproduction

Reproduction in *Phytophthora* sp.

- It occurs in favorable condition.
- In favourable condition, the branching hyphae arise (aerial hypha) from the internal mycelium.
- These aerial hyphae are hyaline, and sympodially branched and are of indeterminate growth.
- These special branched aerial hyphae are called sporangiophores (conidiophores).
- The sporangium is formed by the inflation of the tip of the side branch of the sporangiophore
- The sporangia are, thus, borne terminally but are subsequently shifted to a lateral position.
- The mature sporangia are lightly attached, the sporangiophore of *Phytophthora* is, therefore, sympodially branched.
- Temperature (**18° to 22°**) and humidity govern sporangial production.
- Under continuous light conditions no sporangia are produced by the fungus.
- The mature sporangium is a hyaline, oval to elliptical, thin-walled spore sac with a basal plug. It has a small stalk and an apical papilla.
- The sporangial wall is nearly 0.3 μ thick and appears to be faintly layered.
- Wind, rain splashes or contact with other leaves detach and spread or scatter the ripe sporangia on to the leaves of other potato plants.
- The main factors governing germination are moisture and temperature.
- Low temperature (12 to 15° C) induces (**zoospore**) formation and high temperature (20 to 23°C) favours direct germination by a germ tube (**conidia**).

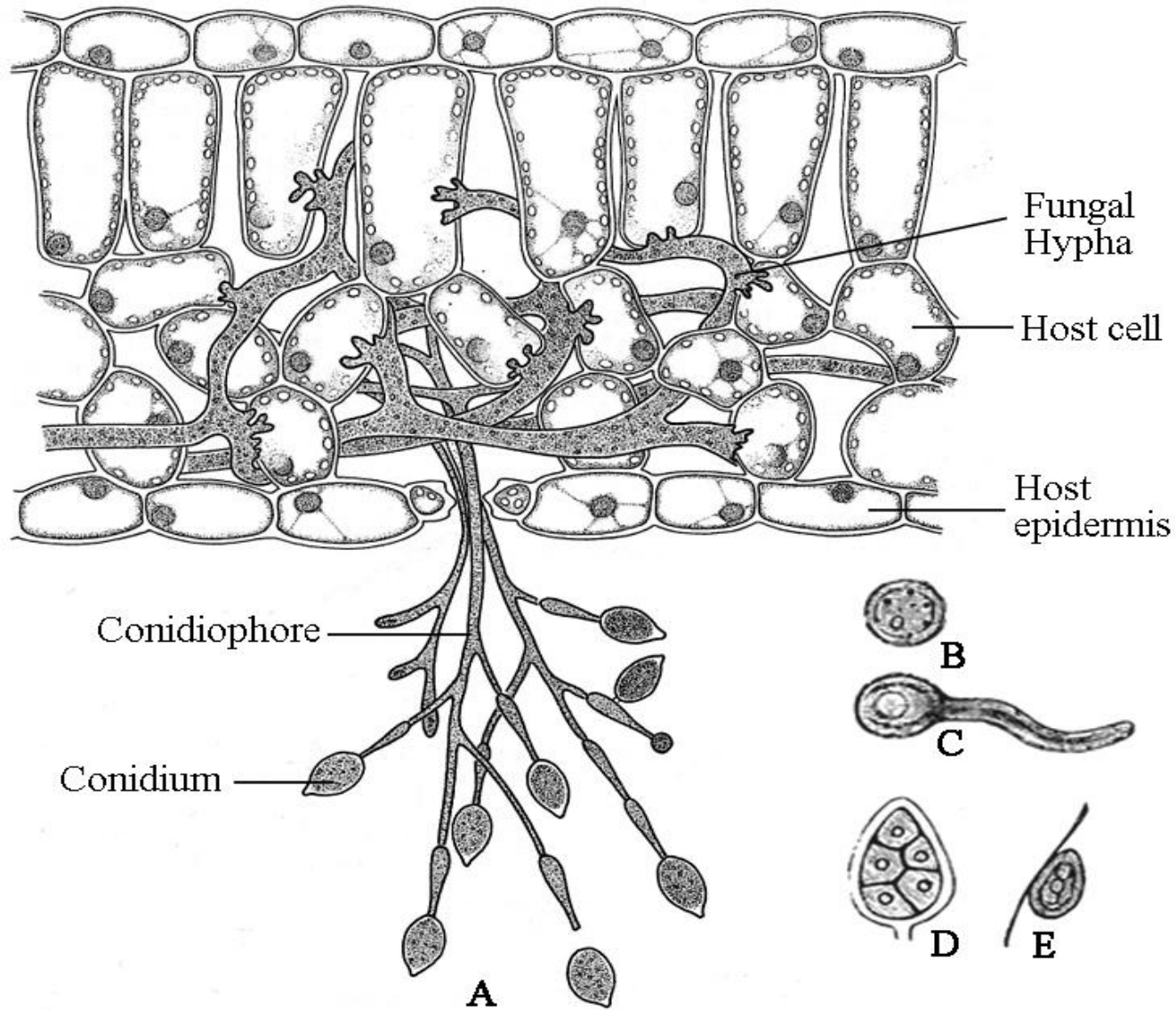


Fig: Phytophthora. (A) Fungal hyphae showing conidiophore bearing conidia, (B,C) Germination of Conidium, (D,E) Production of Zoospore.

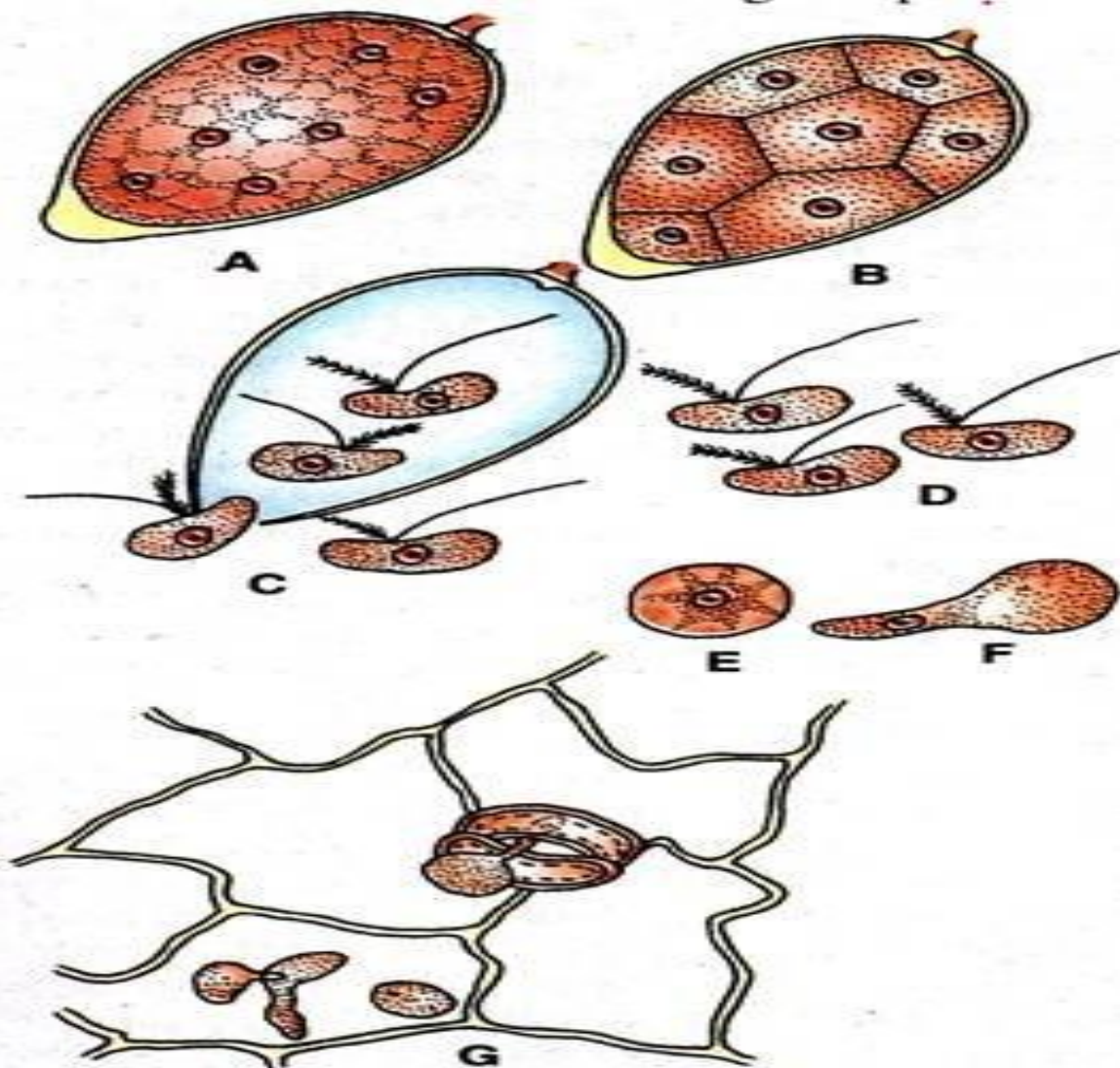


Fig. 6.30 (A-G). *Phytophthora infestans*. Stages in indirect germination of sporangium and germination of a zoospore (A, B, E-G after—Ward).

Sexual Reproduction

- In Phytophthora sexual reproduction is **oogamous**.
- Each strain produces both types of sex organs when the two strains of opposite mating types occur in the same host near each other.

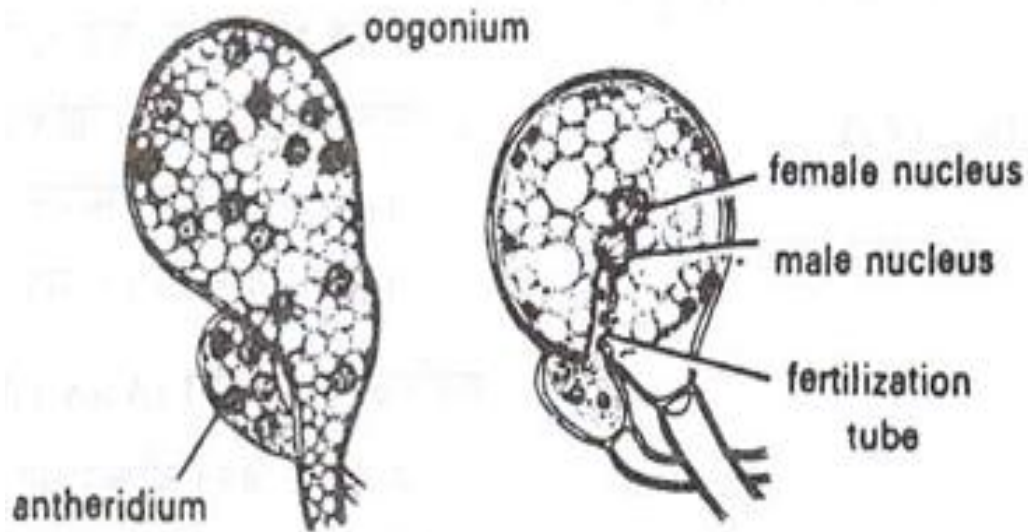
Antheridium

- Antheridium arises as a short lateral hypha from the mycelium with its tip inflated to form a more or less clavate structure.
- Usually the young antheridium is not separated by a septum from the supporting hypha or stalk.
- Mature antheridium is funnel-shaped, sits on the oogonial stalk forming a collar-like structure around the base of the oogonium during fertilization stage. The antheridium contains about 12 nuclei.
- Prior to fertilization all the nuclei except one degenerate.

The surviving one functions as the male nucleus.

Oogonium

- It arises as a short, lateral hypha without any inflation. It contains dense, multinucleate cytoplasm.
- It lies above the antheridium and is spherical or pear-shaped in form.
- Towards maturity it increases in size.
- At this stage the oogonial protoplast becomes differentiated into an outer or peripheral periplasm and central dense vacuolated cytoplasm called ooplasm.
- Prior to fertilization the single nucleus in the ooplasm divides into two daughter nuclei.
- One of these degenerates. The surviving one functions as the egg or oosphere nucleus.



Fertilization

- The intervening walls between the antheridium and the oogonial stalk at the point of contact (**Plasmogamy**).
- The functional male travels through the fertilization tube and fertilized with the female nuclei (**Karyogamy**). The fertilized cell is called **Oospore (2n)**.
- Oospore secretes a heavy wall around it and becomes an empty space between the oogonial wall and the thick oospore wall.
- It is a resting spore and thus considered to be an **important overwintering structure** which plays a significant role as an important propagule in the disease cycle.
- **Oospore** germination takes place after the decay of the host tissues and on the onset of conditions suitable for germination.

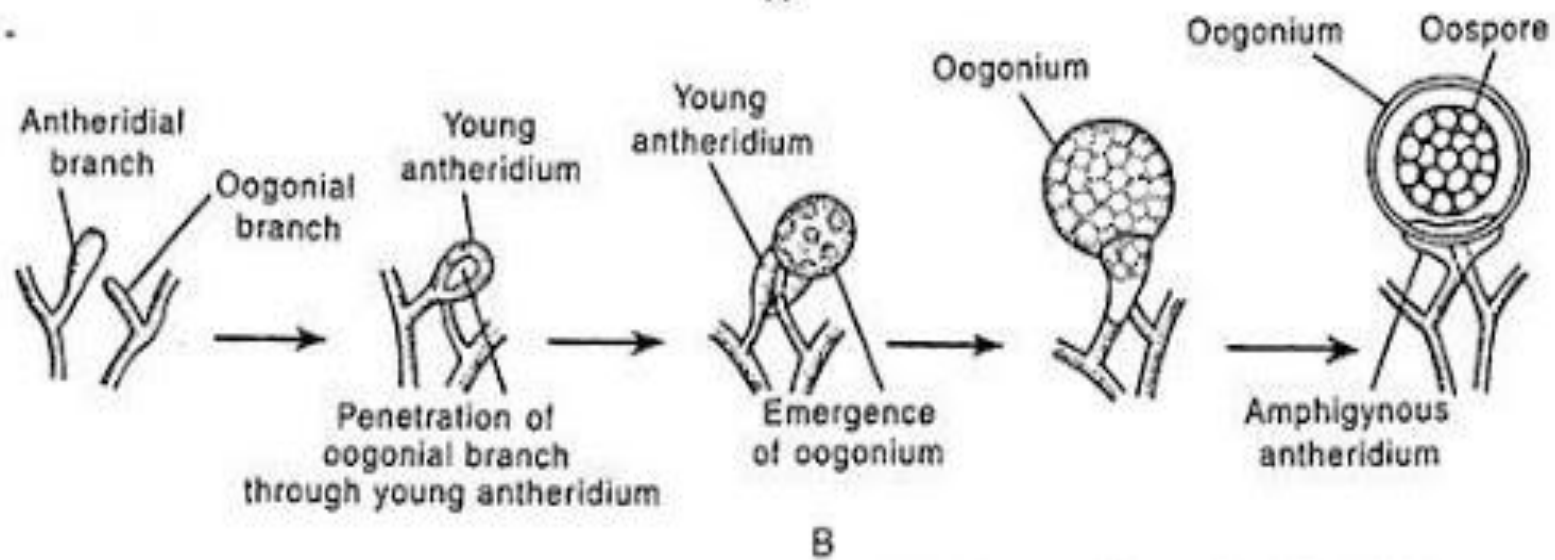
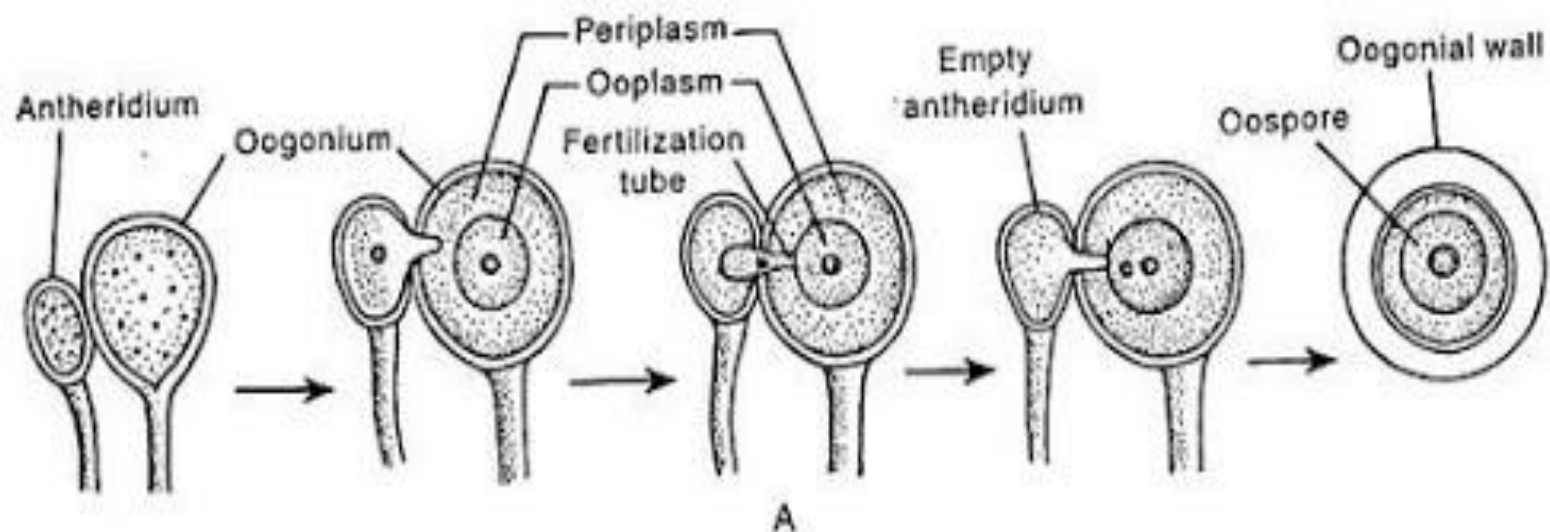


Fig. 4.23 : Development of oospore in Paragynous (A) and Amphigynous (B) species of *Phytophthora*

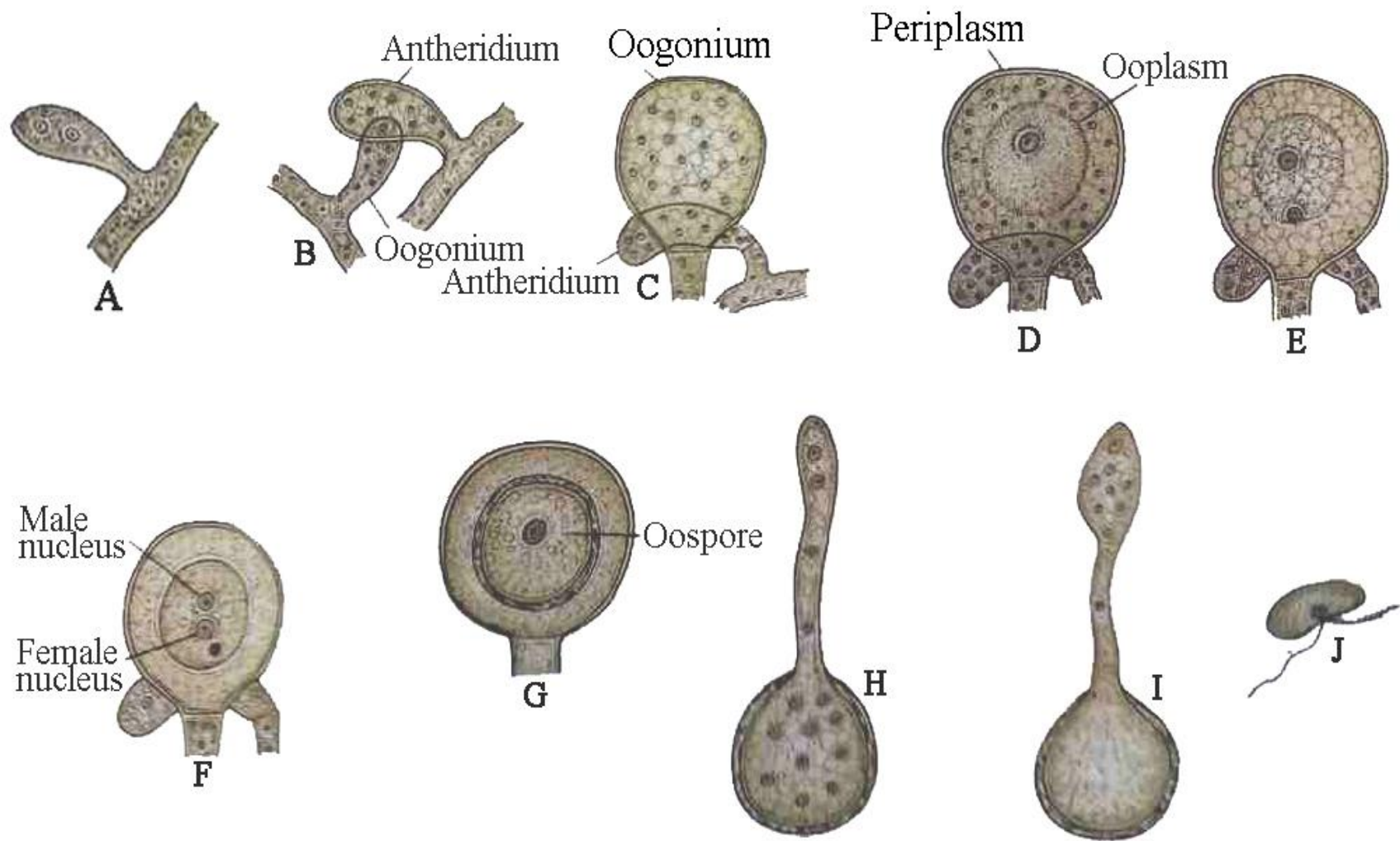


Fig: *Phytophthora infestans*. (A-G) Showing stages in the development of sex organs and fertilization, (H & I) Germination of oospore, (J) Liberated zoospore.

Germination of oospore

- During the pregermination stage *Phytophthora* oospore absorbs water and swell.
- The diploid oospore nucleus divides meiotically and later on successive divisions result in the formation of few or many nuclei in the oospore..
- The exospore cracks and the endospore comes out in the form of a germ tube which develops a sporangium at the tip.
- The contents of sporangium may divide to form zoospores (Fig. 10 K) or sometimes may directly develop into a mycelium (*P. cactorum*).
- The germ tube in *P. infestant* usually of ends in a terminal papillate germ sporangium typical of the species in methods of germination.
- Thus, it completes its life (Figs. 11, 12) cycle only within its host tissue.
- It lives as dormant mycelium in the dead host remains lying in the soil.

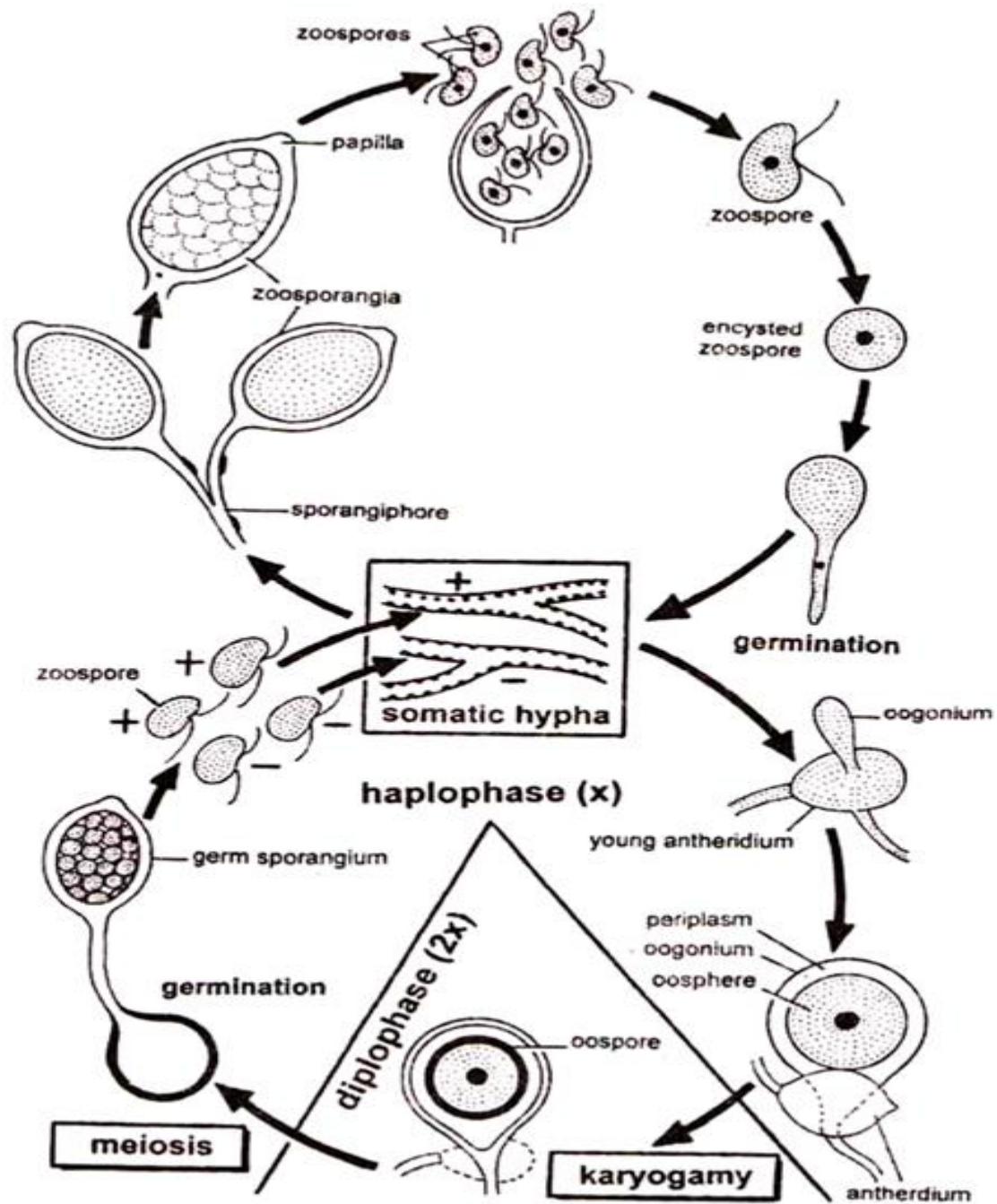


Fig. 11. *Phytophthora* : Diagrammatic life cycle



THANK
YOU