

Division: Mastigomycota (Water molds)

- **Motile Zoospores**
- **Sexual Oospores**

Classes –

1. **Chytridiomycetes**
2. **Hphochytridiomycetes**
3. **Oomycetes**

1. CHYTRIDIOMYCETES

(CHYTRIDS)

- The Chytridiomycetes are simple, microscopic organisms that live in both water and soil
- Unicellular and primitively branched
- They may be a single cell, living within the cell of a host alga or higher plant or have true mycelia and live on the surface of a host
- The motile cells have one whiplash flagellum
- The cell walls of chytrids are made up of chitin, a tough resistant carbohydrate
- Some have cellulose in their cell walls also

STRUCTURE

- In either case, the fungus may be anchored to its substrate by structures called RHIZOIDS
- Thallus may be monocentric (single sporangium) or polycentric (multiple sporangium)
- Obligate anaerobic fungi which lack mitochondria
- Fermentation of sugar resulted in mixture of formate, acetate, lactate, ethanol, CO₂ and H₂

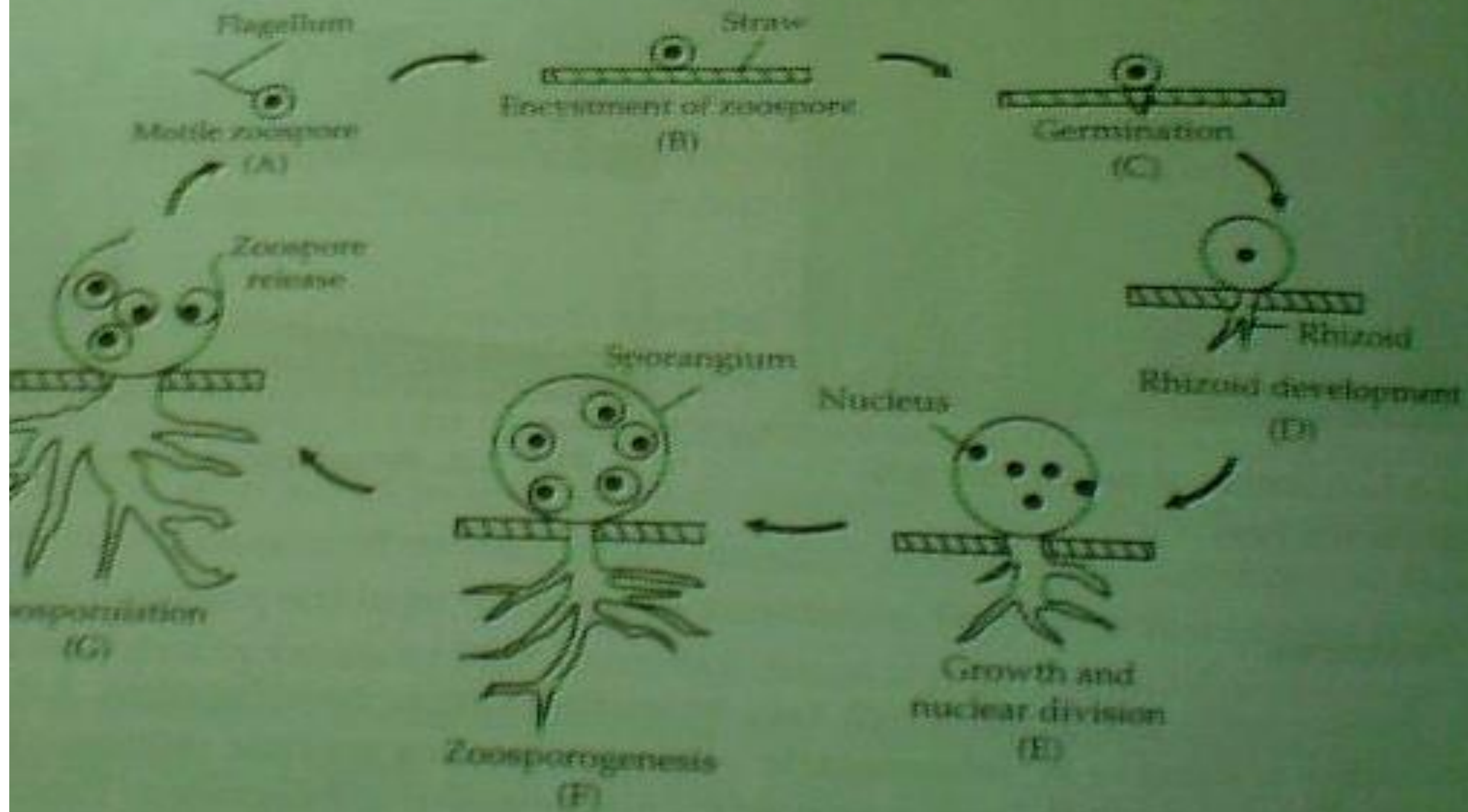
Examples

- **Allomyces spp. as saprophytes**
- **Some are parasitic on economic plants**

Physoderma (causes brown spot of corn)

Synchytrium (causes black wart disease of potato tubers)

Urophlyctis (causes crown wart of alfalfa)



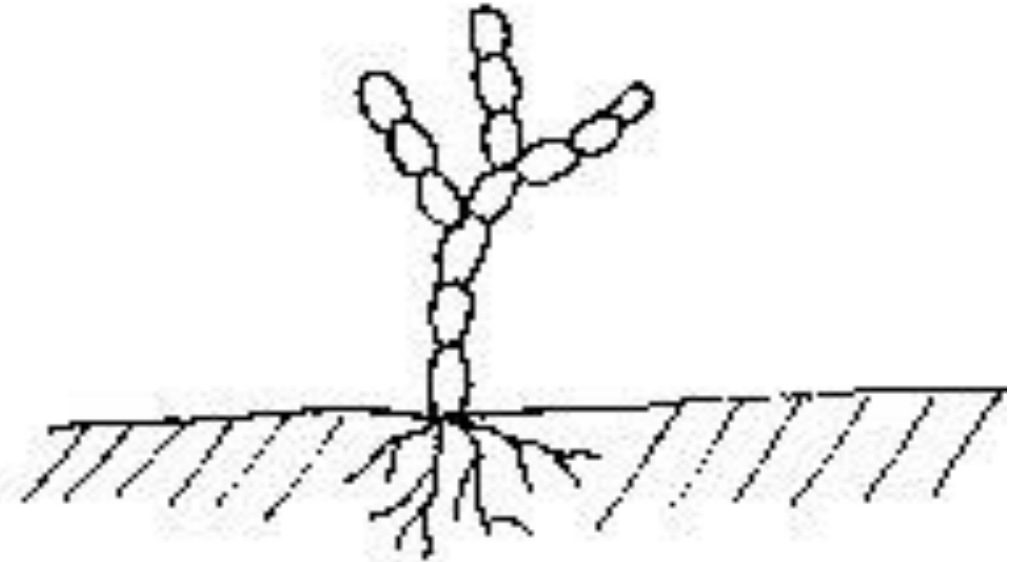
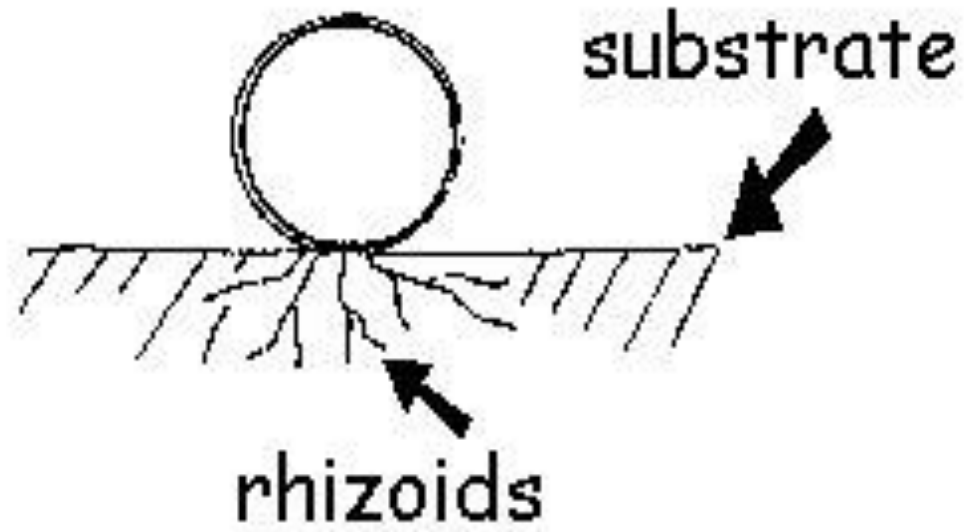
Allomyces

- **Seprophytic fungi found in mud and soil**
- **Can be isolated from air dried soil of tropical climate with boiled mustered seed baits**
- **The thallus is differentiated into trunk like portion with rhizoides and dichotomously branched above part**
- **Showing isomorphic alternation of generation**

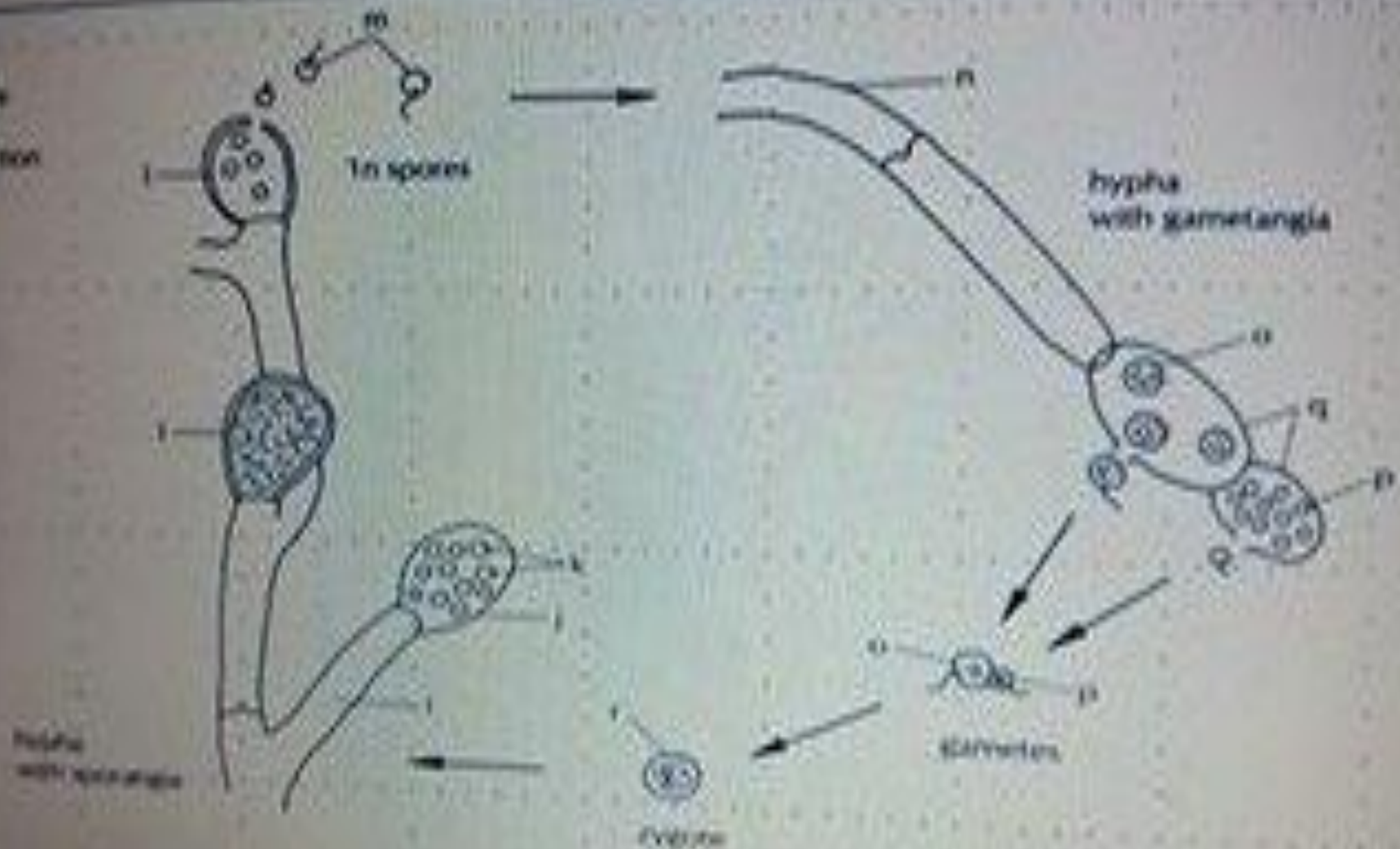
Allomyces

- The $2n$ mycelium produces thin-walled spore-bearing structures called sporangia on hyphal strands
- From a sporangium, $2n$ spores emerge
- Other, thick-walled sporangia produce $1n$ spores by meiosis (nuclear divisions that reduce the number of chromosomes by half)
- A $1n$ spore germinates into a $1n$ hypha, which produces $1n$ sex cells (gametes, o, p) in gametangia
- Fusion of unlike gametes into a zygote results in the germination of spore-bearing hyphae

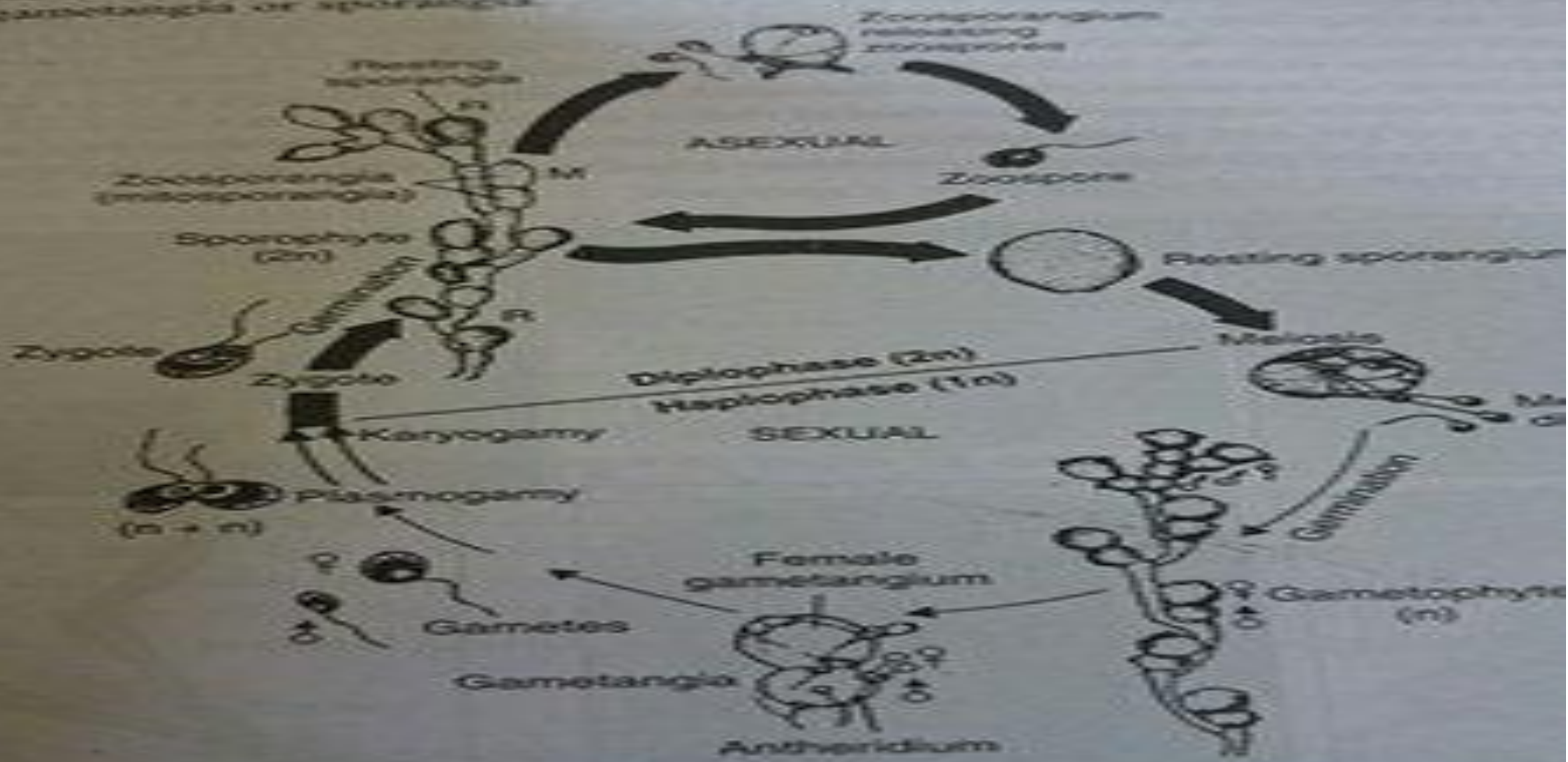
Allomyces



Asexual
Clonal
reproduction



life cycle (Fig. 3.19) there is an isomorphic alternation of generations. The zoophyte forms gametes, and the resulting zygotes develop into diploid zoosporangia and resting sporangia are formed. The two types of thalli are alike and there is no essential difference in their nutrition and physiology.



omyces arbuscula—an example of isomorphic alternation of generations. The zoophyte forms gametes and the resulting zygotes develop into diploid zoosporangia and resting sporangia (also called meiosporangia).

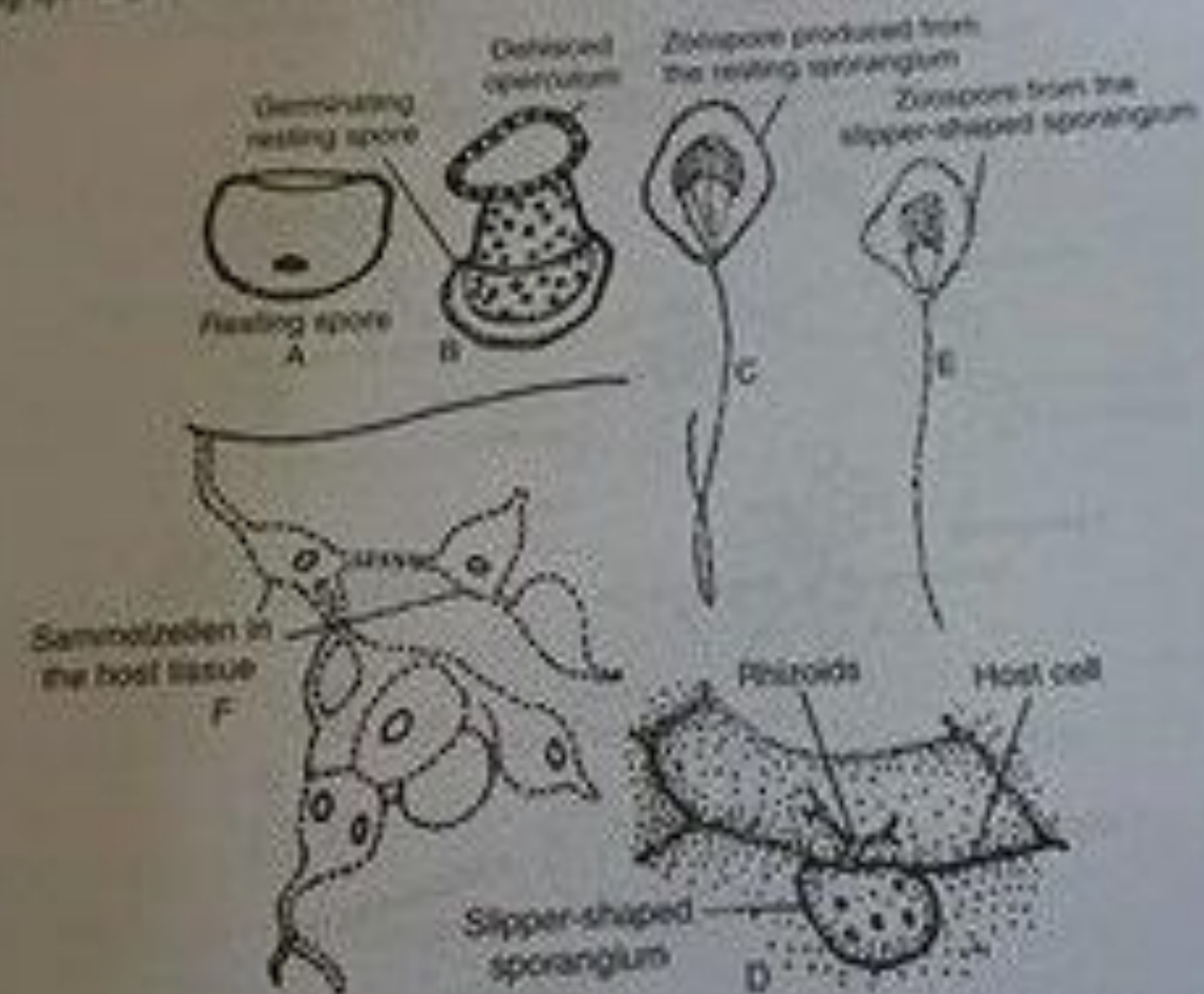
Economic Importance

- The female gametangia and gametes secrete a hormone called sirenin for chemotactic attraction of male gametes

Physoderma

- *Physoderma maydis* causing brown spot of Maize
- An obligate parasite causing small, water soaked spots on lower parts of leaves and stem
- The symptoms are due to smooth, thick walled resting sporangia and spores
- In favorable environments they become endosporangia and germinate by formation of zoospores

the resting spore
infected

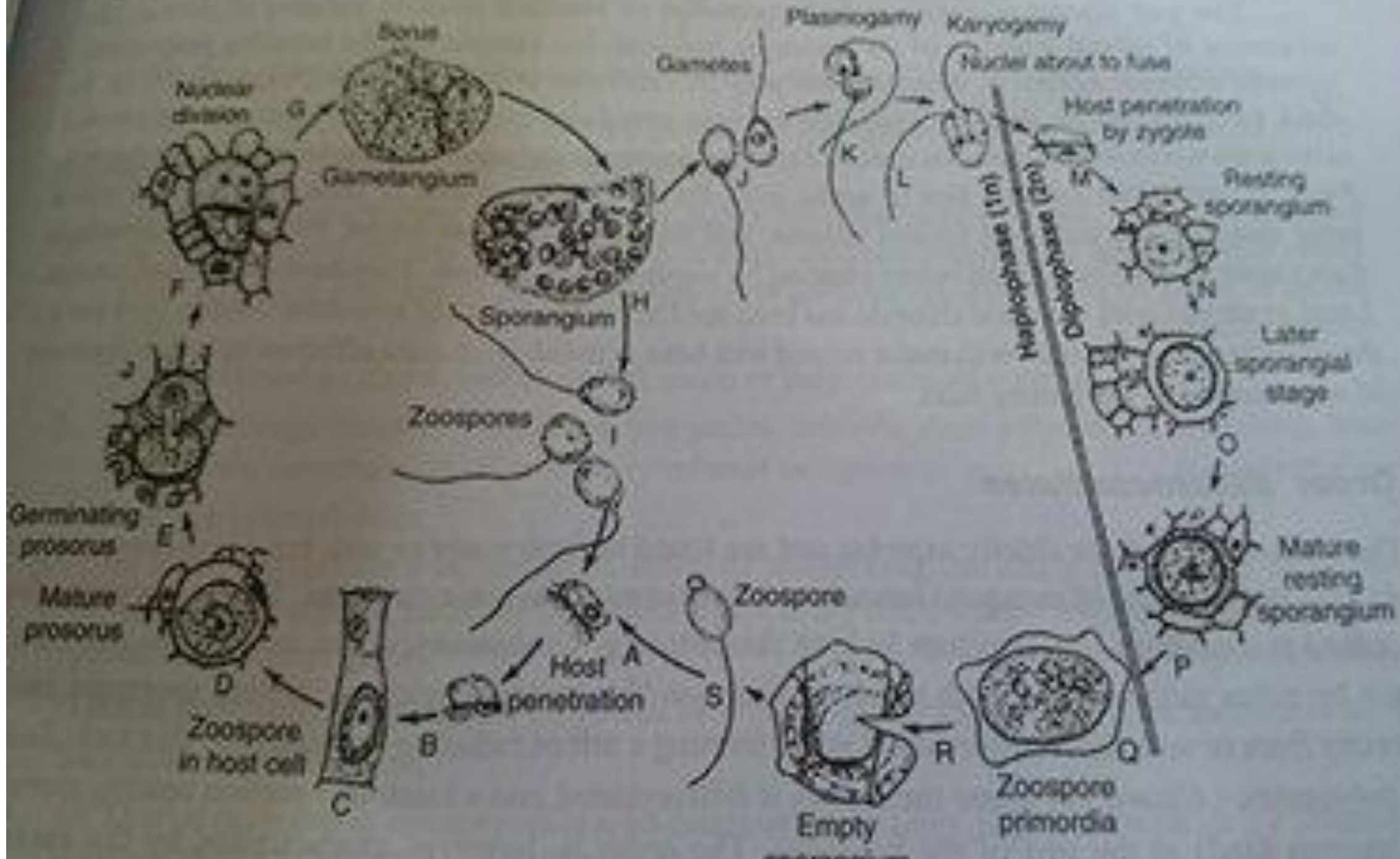


Economic Importance

- The whole leaf may be affected causing vigour loss
- Plants become stunted
- Spots near nodes cause lodging

Synchytrium

- *S. endobioticum* causing black wart of potato Galls on aerial shoots and tubers Release of zoospores from warts in soil
- Host penetration Infected cell enlarge forming gall The pathogen becomes spherical and fills the cell called prosorus
- Repeated nuclear division and wall formation resulted in formation of sorus
- Bursting of sporangia and release of zoospores Formation of resting sporangia by sexual reproduction Wart formation is result of hypertrophy and hyperplasia in host cells



Economic Importance

- Parasitic to economically important angiospermic plants
- Distributed to all potato growing areas of world with hilly areas and cool moist climate
- Yield of potato tubers is reduced

2. Hphochytridiomycetes

- Single celled monocentric or polycentric thallus with rhizoids
- Anteriorly uniflagellate tinsel type zoospores
- Cell wall contain both chitin and cellulose
- Thallus osmotrophic saprobes but some may be biotrophs as parasitic on algae and other fungi in marine and terrestrial forms

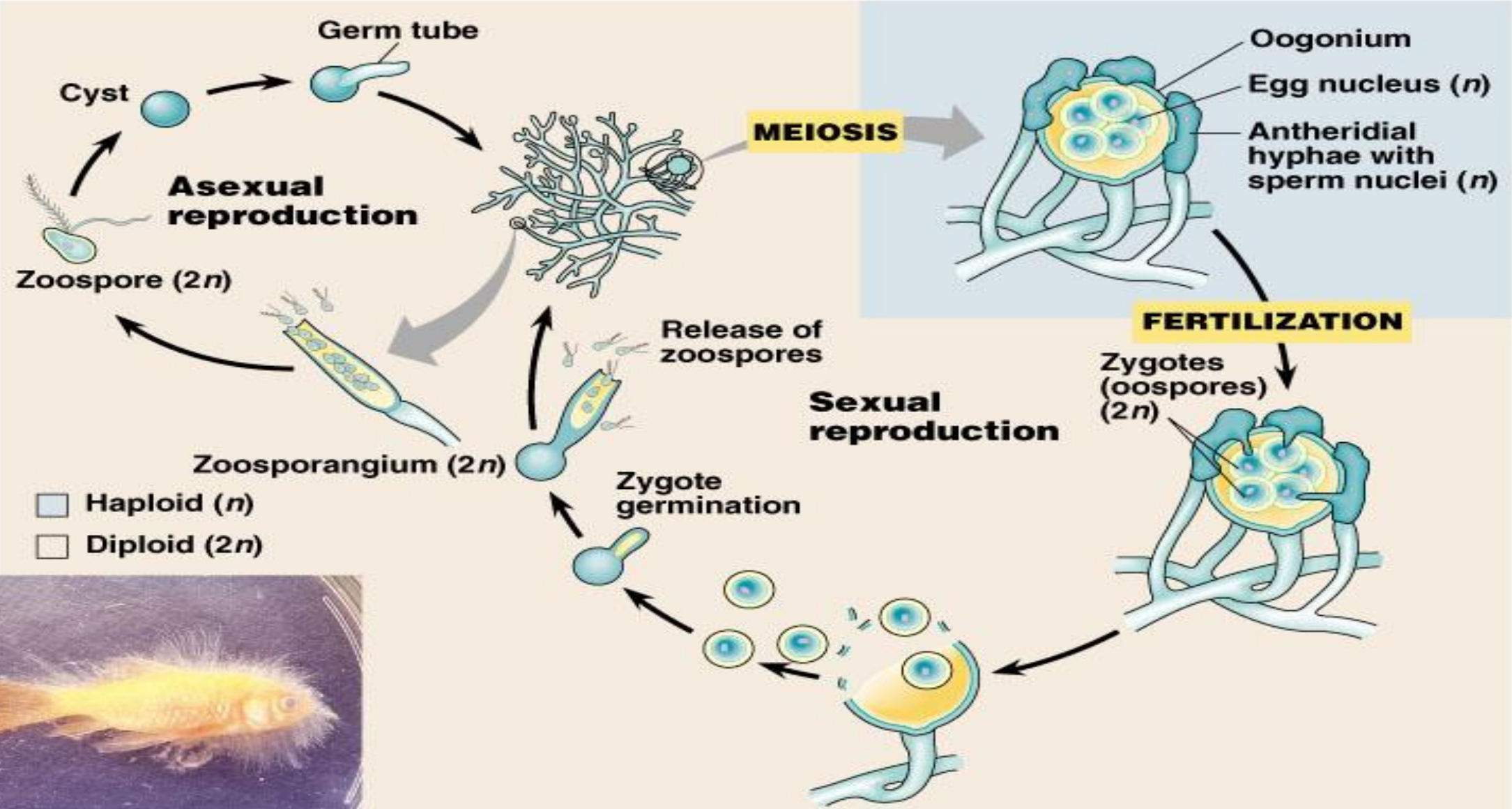
Ex. Anisulpidium, Rhizidiomyces and Hyphochytrium

3. Oomycetes

(Water Molds, Downy Mildews, White Rusts)

- Organisms are microscopic and found in water and moist soil. The most advanced forms live entirely within a plant or animal host
- They range from one cell to copious amounts of threadlike strands
- Each strand of a threadlike tubular filament is called a hypha
- The cell wall contains cellulose and β glucans; sugar alcohols absent
- Reproduction is by oospores, sexually produced, nonmotile cells; and, asexually, by zoospores with two unlike flagella that are used for motility

Life cycle



Examples

- *Achyla* spp. seprophytic, decomposing organic matter on water or moist places
- *Albugo* spp. (causes white rust of horseradish, cabbage, sweet potato, morning glory, spinach)
- *Aphanomyces* (causes root disease of sugar beets, peas)
- *Phytophthora infestans* (causes late blight of potato),
Phytophthora ramorum (causes sudden oak death)
- *Plasmopara viticola* (causes downy mildew of grapes)
- *Pythium debaryanum* (causes damping-off of seedlings),
Saprolegnia (causes disease of fish eggs and fish)

Achlya

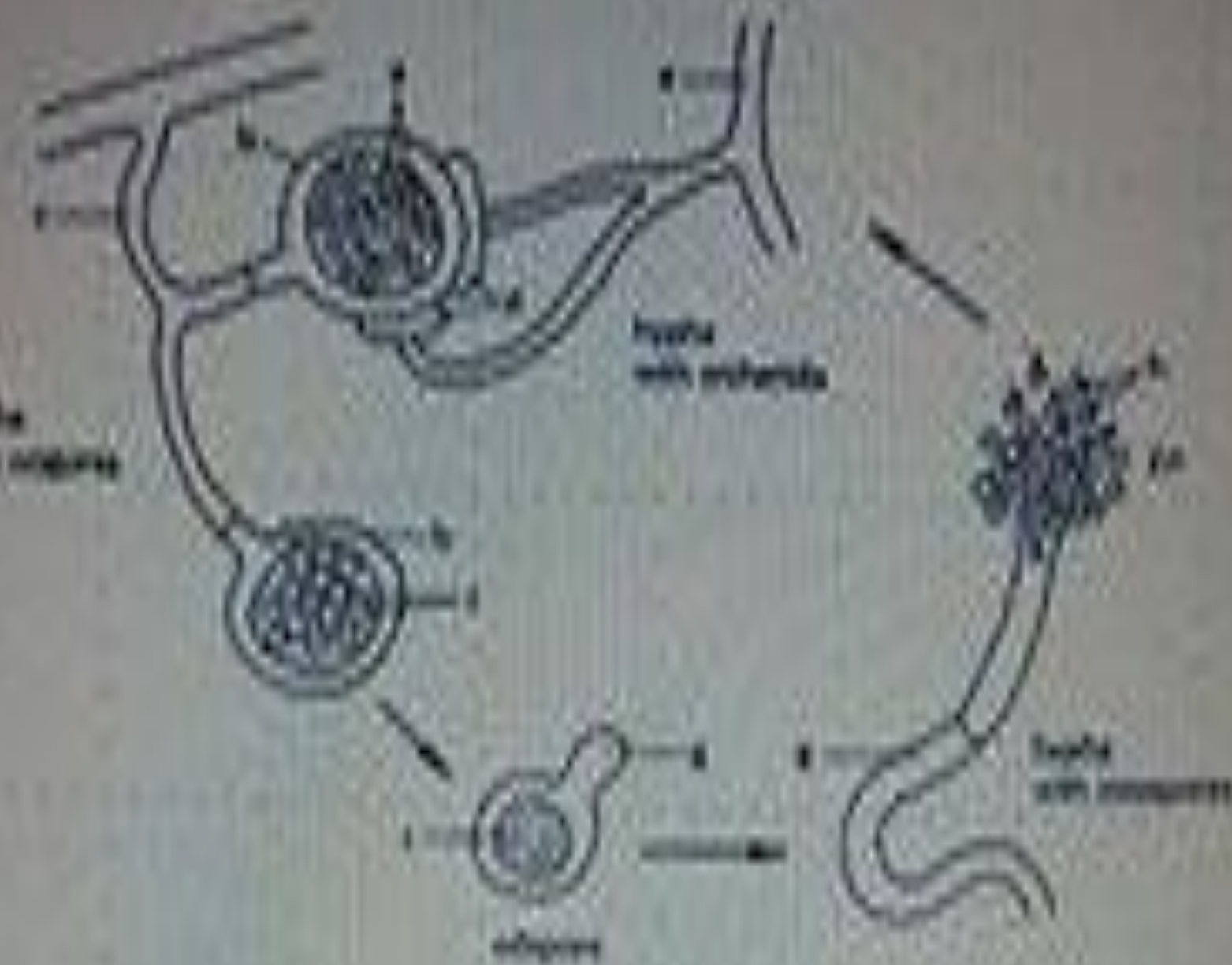
- This water mold has separate male and female individuals
- Eggs are produced in an egg chamber (oogonium) on the hypha and from a male individual, antheridia with male gametes branch from a hypha
- After fertilization by a male gamete from the antheridium, an egg develops into a $2n$ oospore
- The oospore germinates to form a new body of hyphal stands that produces biflagellated zoospores

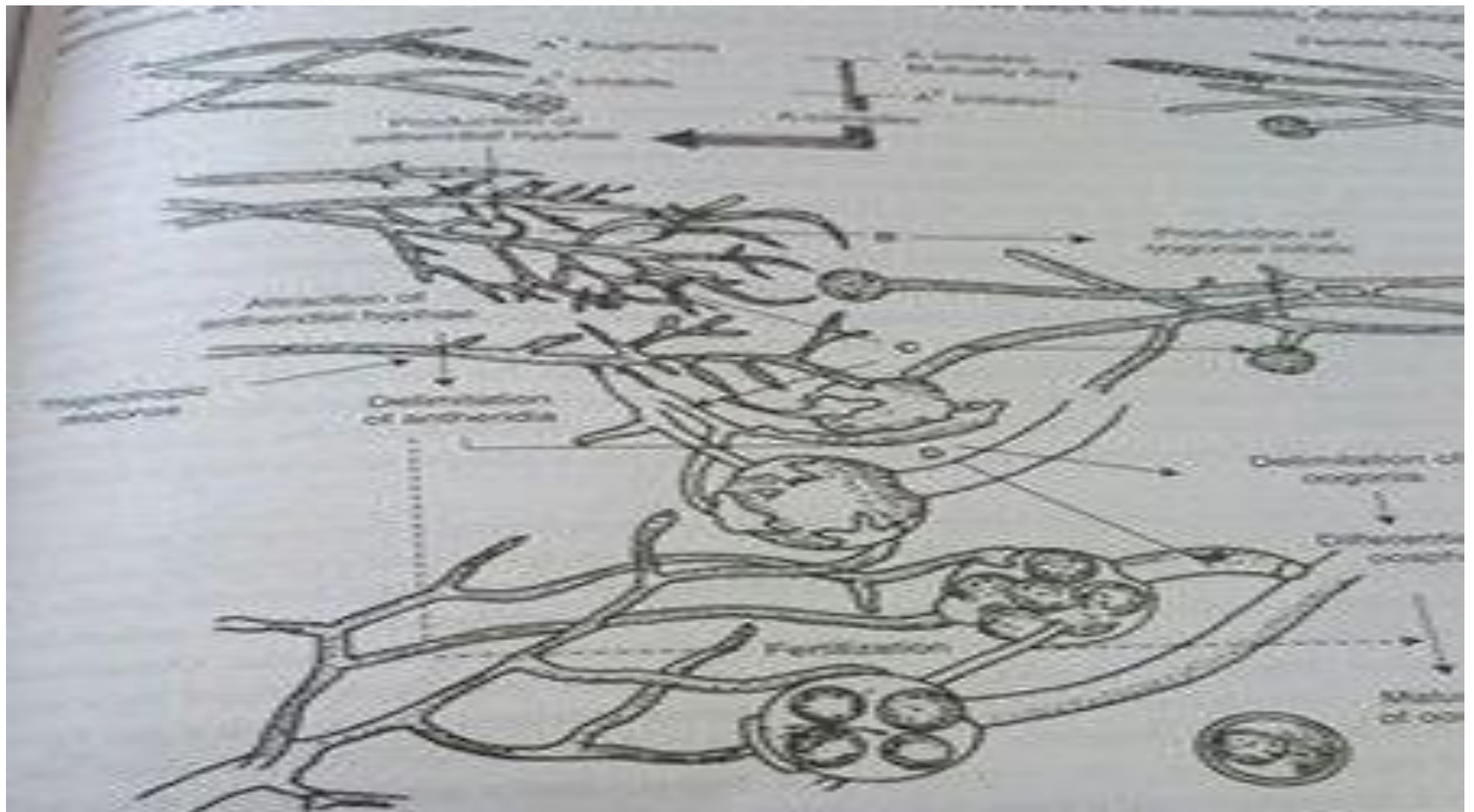
Alga
Virus
Mikroorganism

Hypha
with sporangia

Hypha
with sporangia

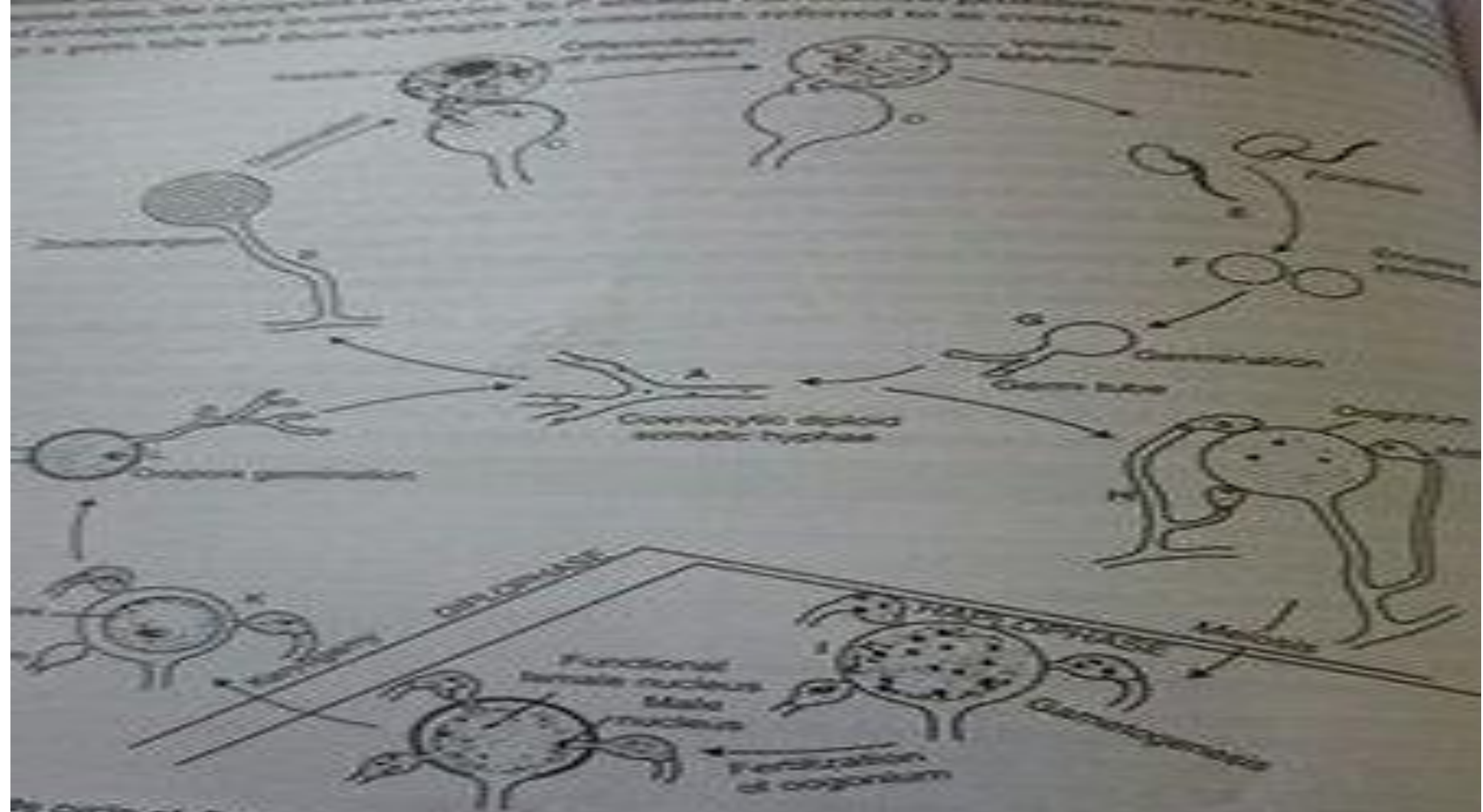
Hypha
with sporangia





Pythium

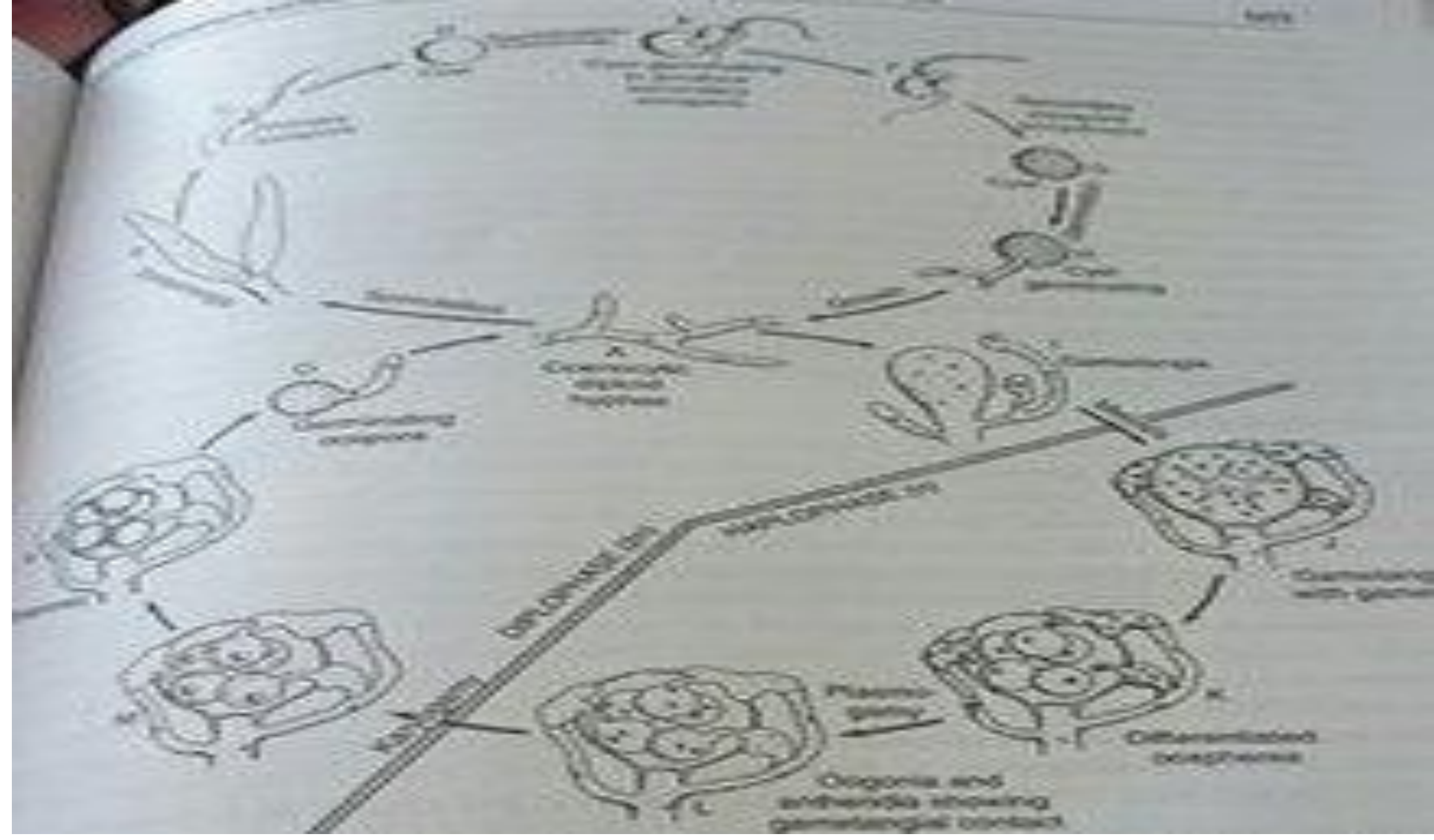
- **Facultative parasite can live in dry soil saprophytically**
- **Causing damping off and fruit rot in vegetable crops**
- **Ability to produce strong pectolytic and cellulolytic enzymes to invade host tissues**
- **Mycelium is coenocytic with granular cytoplasm**
- **Hyphae both inter and intracellular without haustoria**



The cycle of *Pythium debaryanum*. (Modified from Alexopoulos and Mims, 1968)

Saprolegnia

- Common saprophyte found in soil and decaying plant and animal substrates
- Thallus well developed coenocytic hyphae with terminal sporangia
- Reproduce both by asexual and sexual reproduction
- Zoospores terminally biflagellate with tinsel and whiplash flagella
- Primary and secondary zoospores



Phytophthora

- **Causing late blight of Potato**
- **Symptoms appear on leaves as hydrotic areas with indefinite margins**
- **The lesions become brown and almost black causing heavy crop loss**
- **During wet and humid conditions a white wooly fungal growth consisting sporangiophores and sporangia appears on underside of infected leaves**
- **Some species show heterothallism**

Plasmopara

- Causing downy mildew of grapes, sunflower
- It is a biotrophic parasite produces intercellular mycelium with knob like haustoria
- Sporangiohores emerges through stomata with short tunicate branches right angles to axis
- Sporangia are hyaline, lemon shaped produce zoospores both externally and internally
- Oospores are produce during unfavorable condtions

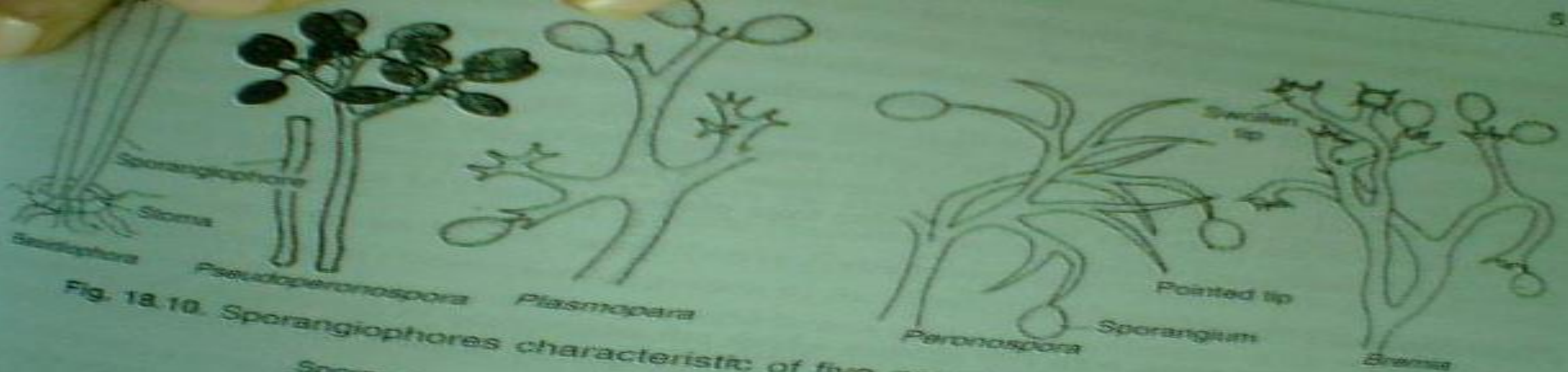
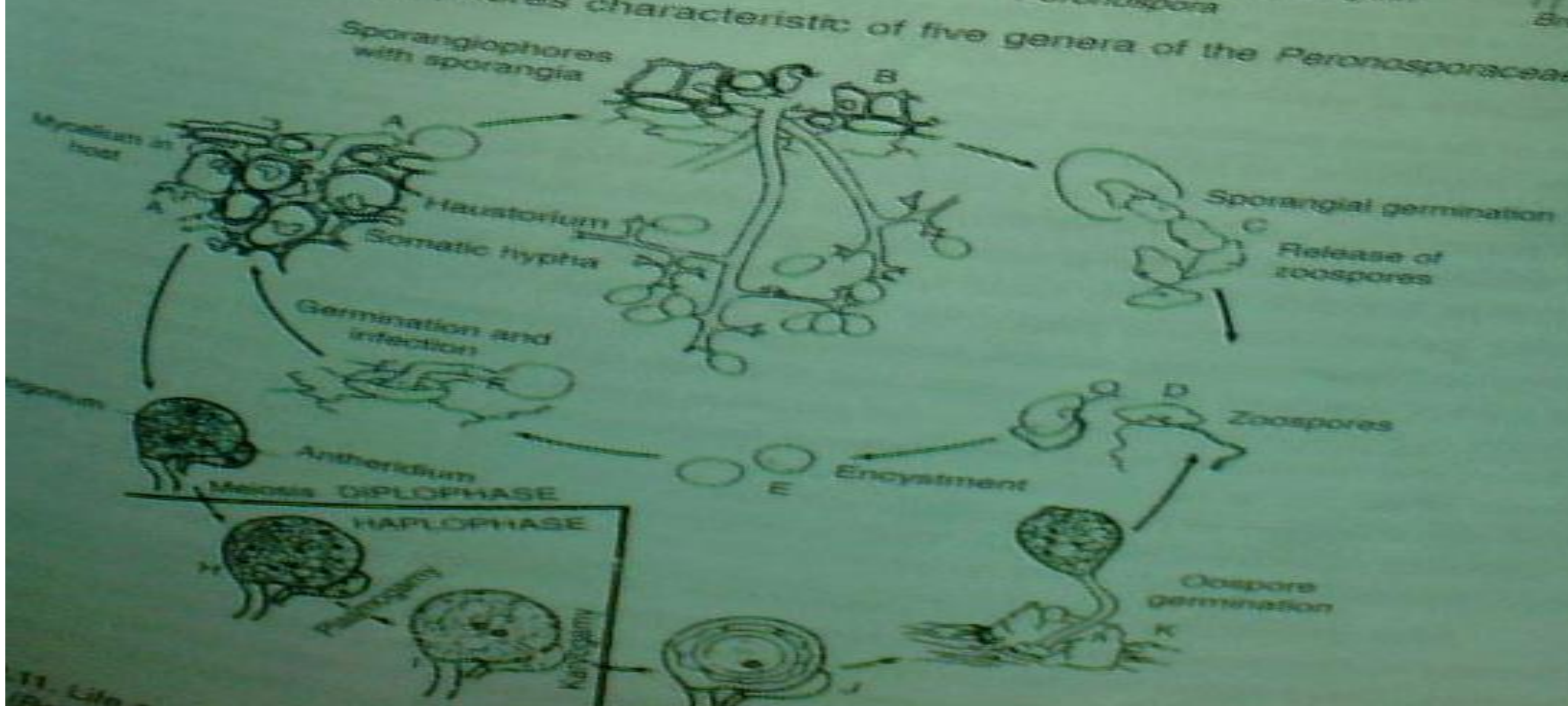


Fig. 18.10. Sporangiophores characteristic of five genera of the Peronosporaceae



Albugo

- **Causing white rust in vegetable crops**
- **Biotrophic parasite forming rusty pustules on lower side of foliage and epidermal parts of plants**
- **Fungus may follow systemic growth and cause hypertrophy and hyperplasia in host**
- **Mycelium intercellular with knob like haustoria**
- **Short club shaped sporangiophores produce internally which push the mesophyll tissue forming pustules**
- **Oospores are produce during off season**

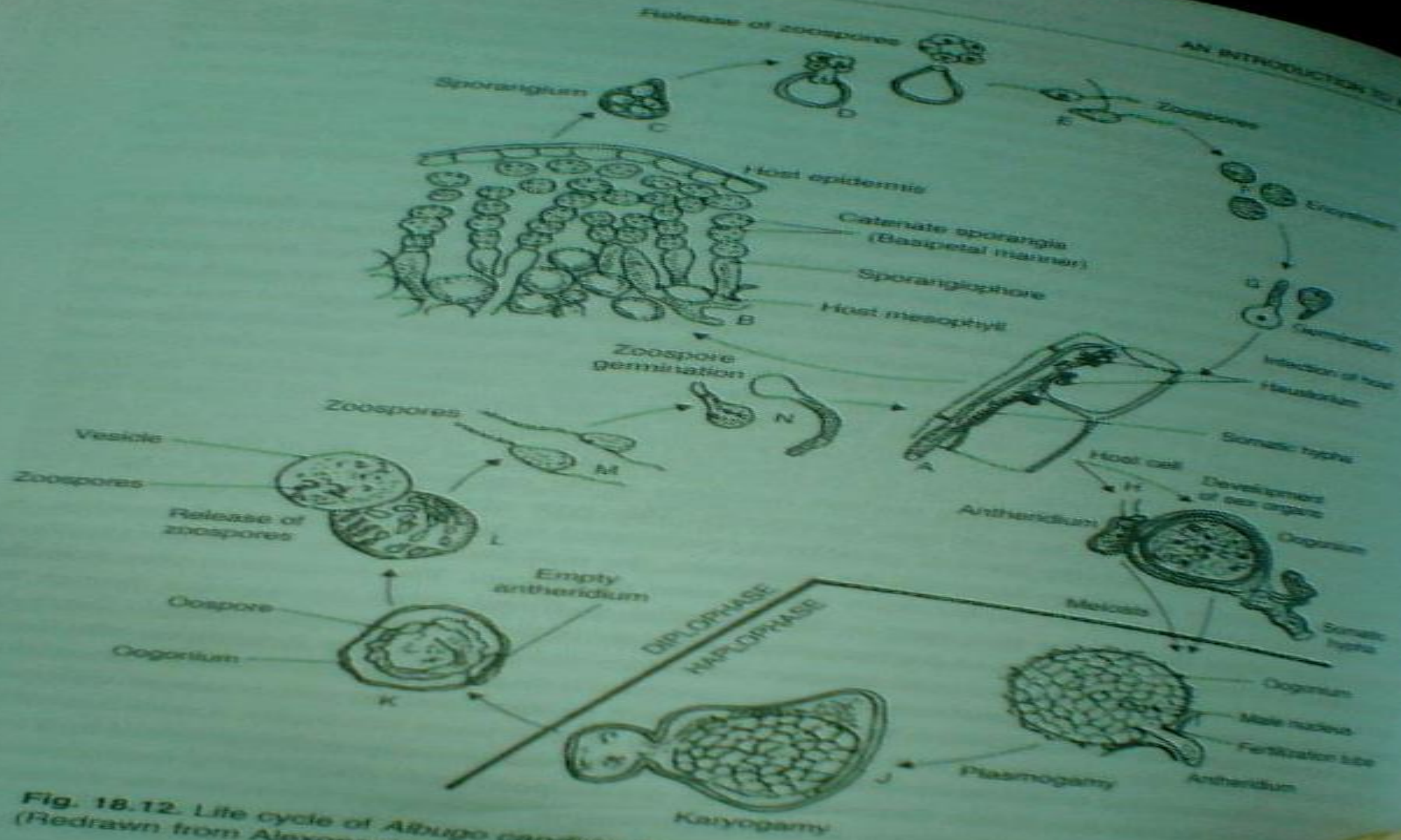


Fig. 18.12. Life cycle of *Albugo candida*. (Redrawn from Alexopoulos)