

Division
Amastigomycota

Subdivision
Zygomycotina

Subdivision: Zygomycotina (Conjugate fungi/ Lower fungi)

- Non motile sporangiospores (aplanospores)
- Sexual Zygosporangia

Classes –

1. Zygomycetes

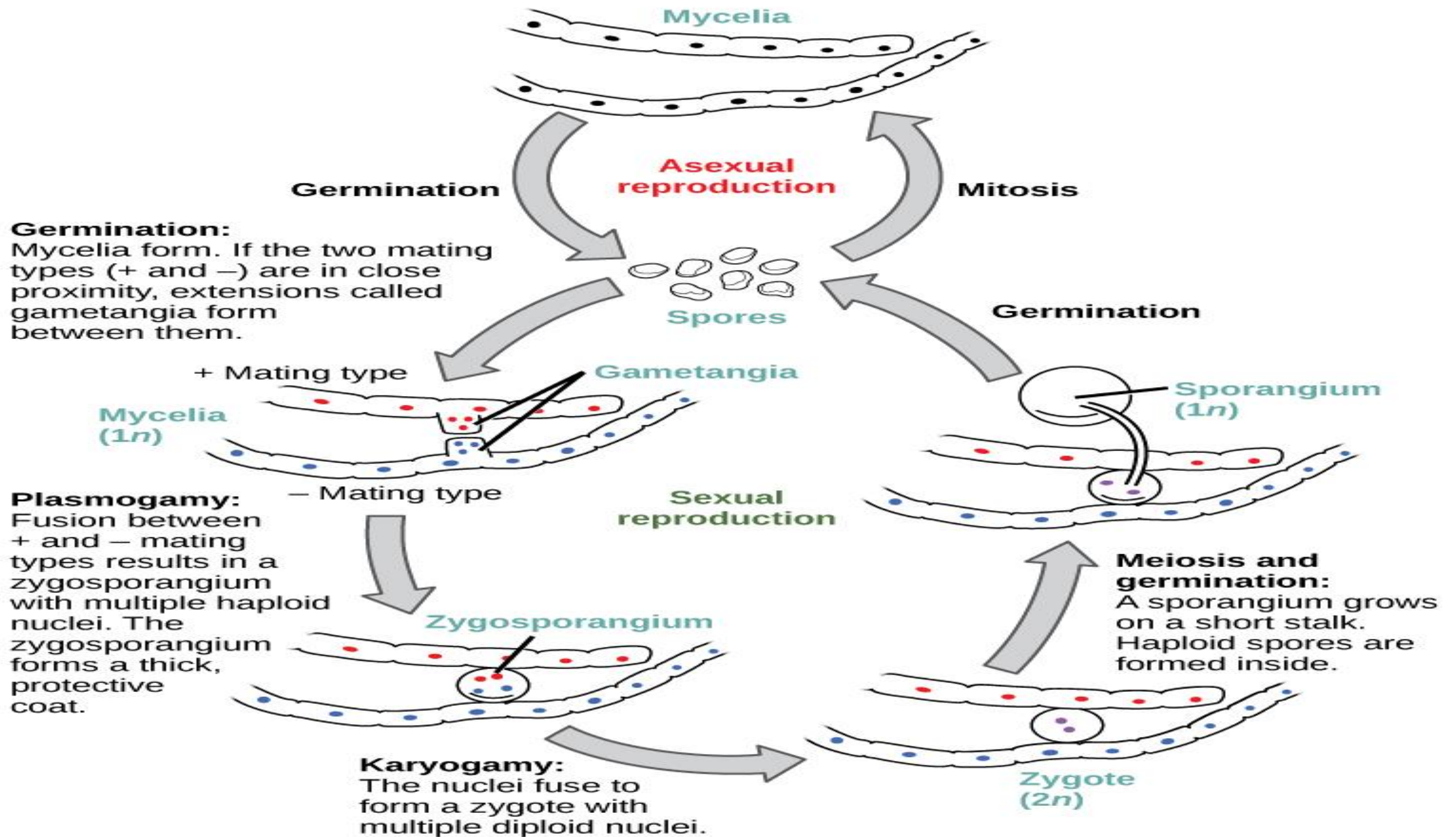
Order: Mucorales, Glomales, Entomophthorales

2. Trichomycetes

Class Zygomycetes

- Mycelium coenocytic made up of chitin
- Absence of flagellated bodies
- Aplanospores
- Copulation of two equal gametangia
- Thick walled resting spores called Zygosporangia
- Members mostly saprobes, facultative or weak parasites and obligate parasites

Zygomycete Life Cycle



Class Zygomycetes: Order Mucorales

- Often called as Pin molds due to black dots in cobweb like hyphae
- Also called sugar fungi due to efficient utilization of simplest carbohydrates (sugar)
- Also called black bread molds
- Cause mucormycosis in human and animals
- Many species have industrial importance for production of lactic acid, fumaric acid and alcohol (Rhizopus spp.)
- Under appropriated fermentation conditions some of the members are capable to rearrange five member ring of steroid molecules in to six member
- Mucor sp. are used to make Sufu (Chinees cheese) and Rhizopus sp. for Tempeh (solid food) from soybean
- Some species are used to make betacarotene
- Some species are used for bioassay of thiamine

Structure

- Mycelium white, cottony, branched and coenocytic
- Branches come in contact with substratum produce rhizoidal branches

Asexual reproduction

- Asexual reproduction by sporangiospores and chlamydospores
- Sporangia may be multispored (Mucor, Rhizopus), few spored, columella absent (Radiomyces), monosporous sporangiola on vesicles (Cunninghamella) and few spored merosporangia (Syncephalestrum)

Sexual reproduction

- Through gametangial fusion and formation of Zygosporangia
- Thallus may be homothallic or heterothallic
- Individual gametes are developed on zygosporangia called progametangia
- Zygosporangia are developed after fusion of gametangia which is thick walled highly pigmented with yellow or black colour

Examples

- Family Mucoraceae – *Mucor*, *Rhizopus*, *Absidia*
- Family Pilobolaceae – *Pilobolus*
- Family Cunninghamhamellaceae – *Cunninghamella*

Mucor

- Soil, dung and on organic matter
- Hyphae coarse, coenocytic, branched with tapering ends
- Substrate mycelium do not produce rhizoids
- Erect sporangiophores bear globose or spherical sporangia at terminar position
- Sporangia contain enlarged columella
- Spores adhere to each other and disseminated by splashing raindrops
- Do not cause lab contamination through air
- May show yeast like growth under anaerobic condition and revert back to mycelial growth under aerobic condition (Dimorphism)

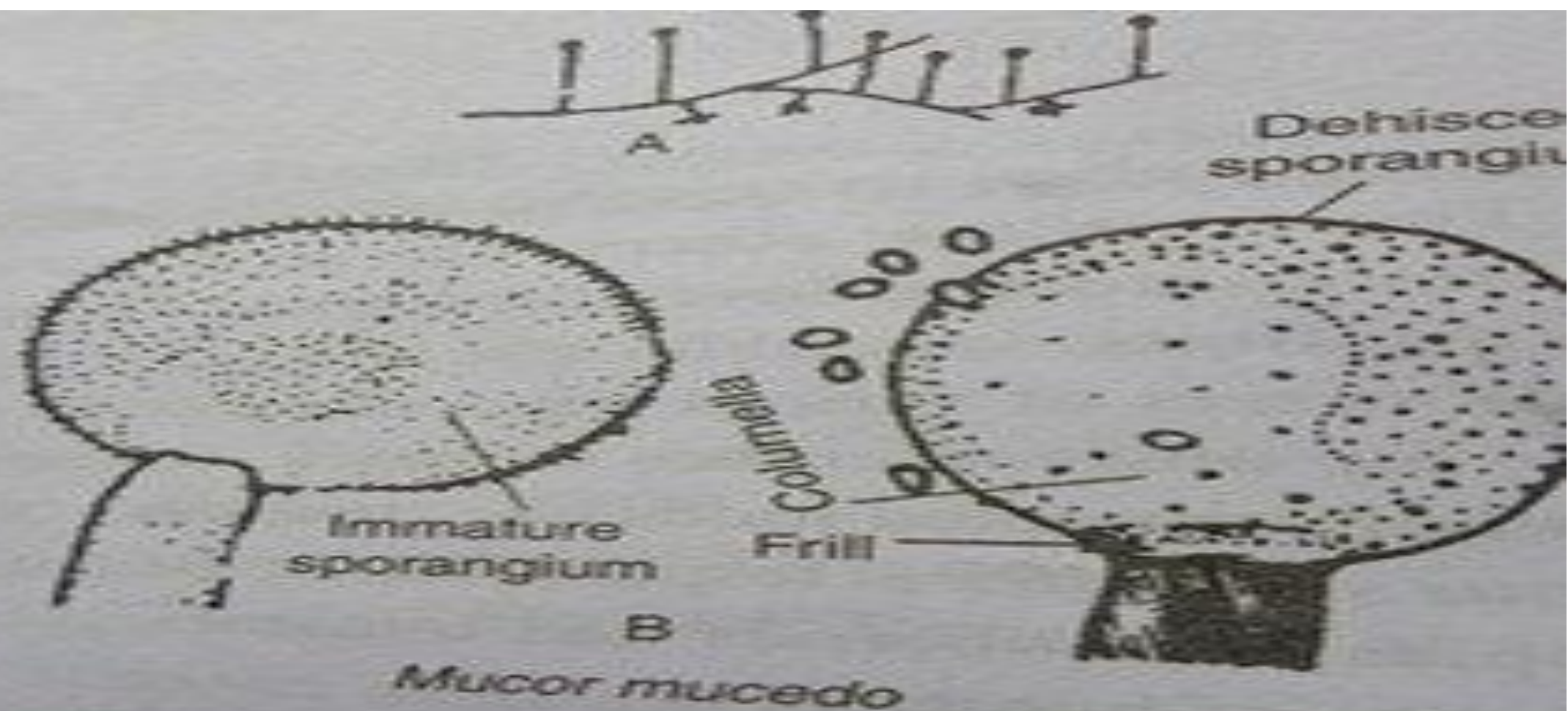
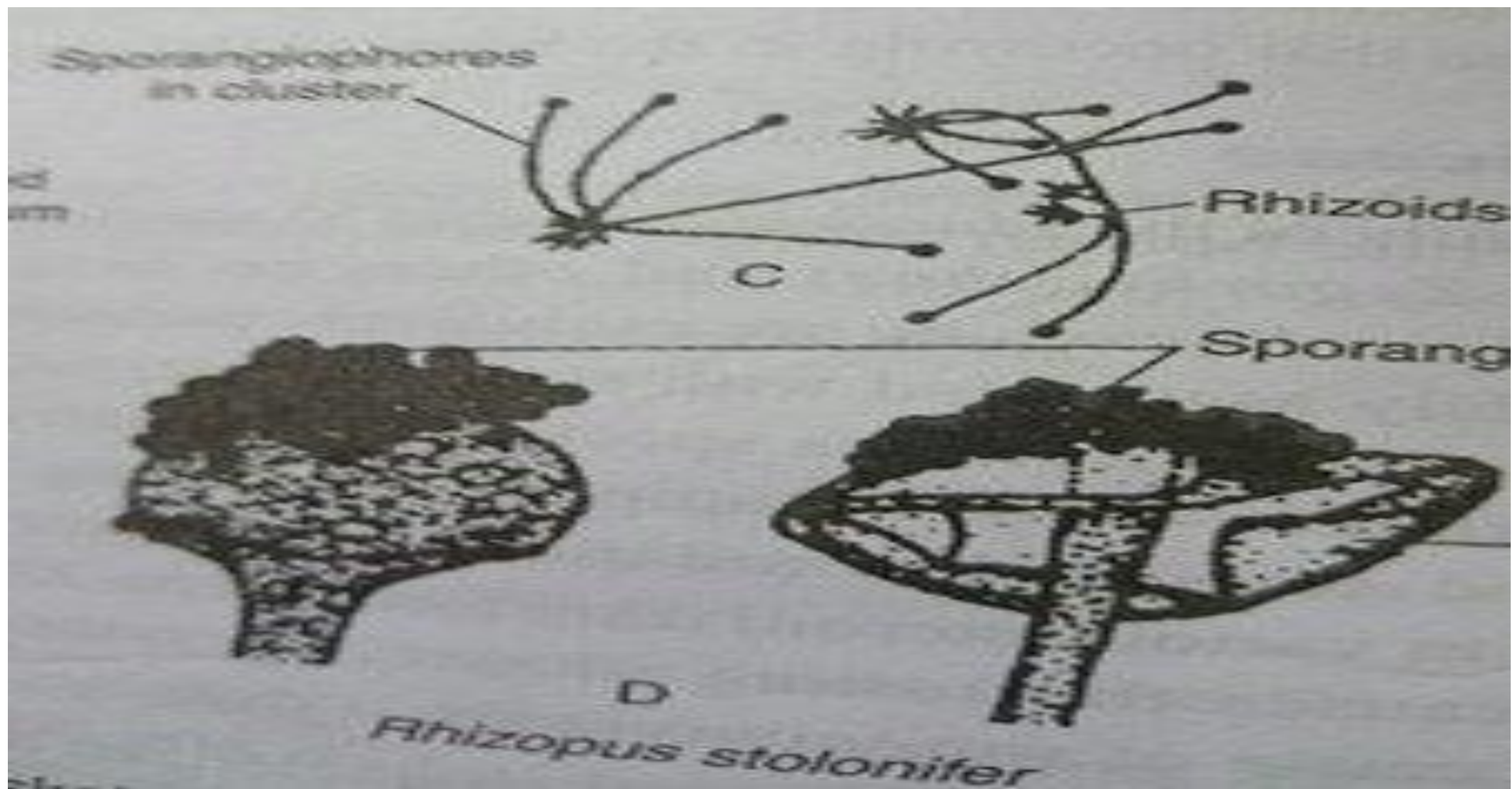


Fig. 4.6. *Mucor mucedo* (A and B). (A) H
 sporangia, the latter
 Rhiz

Rhizopus

- **Common bread mold**
- **Important for production of lactic acid and formic acid**
- **Causal organism of mucormycosis**
- **Vegetative mycelium differentiated into horizontal aerial (stolon) and branched rhizoidal**
- **Thallus mostly heterthallic**
- **Sporangia contain columella**
- **Thick walled zygosporangium**



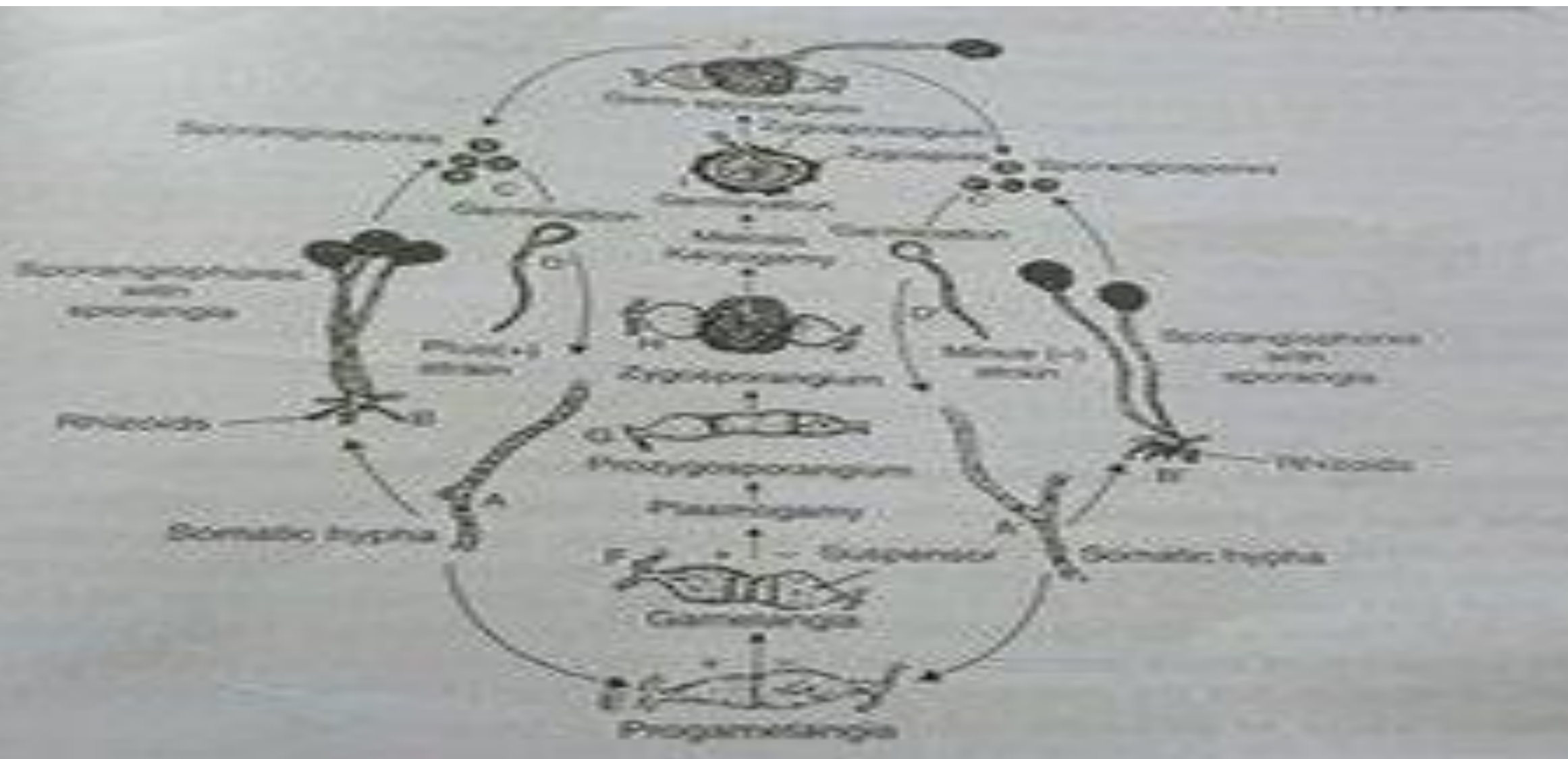


Fig. 4.2. Life cycle of *Rhizopus stolonifer* (= *R. nigricans*), the common bread mold fungus, a typical zygomycete.

Pilobolus

- Hat thrower, fungus gun
- Found on dung of horse, buffalo, goat rabbit etc.
- Typical sporangiophores made up of three parts; basal swollen trophocyst, elongated stipe, and subsporangial vesicle
- Terminal flattened, black, heavily cutinized sporangium
- The sporangiophores are typically phototropic and bend in the direction of light
- The subsporangial vesicle is turgid and full of liquid which bursts to discharge the sporangium
- The production of sporangia is a rhythmic phenomenon require alternate light and dark
- Successive production after 24 hrs. intervals
- Circadian rhythm of 24 hour biological clock

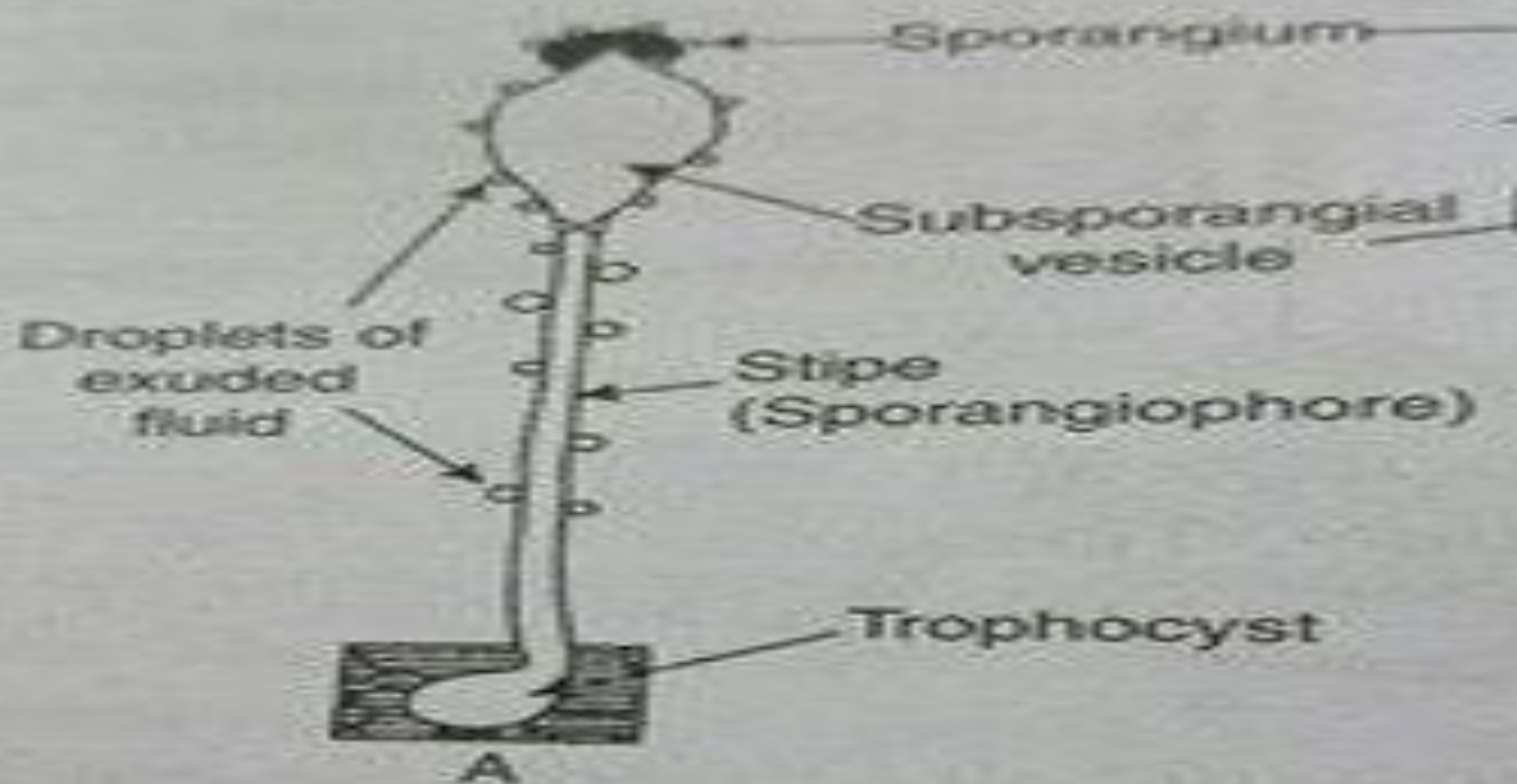
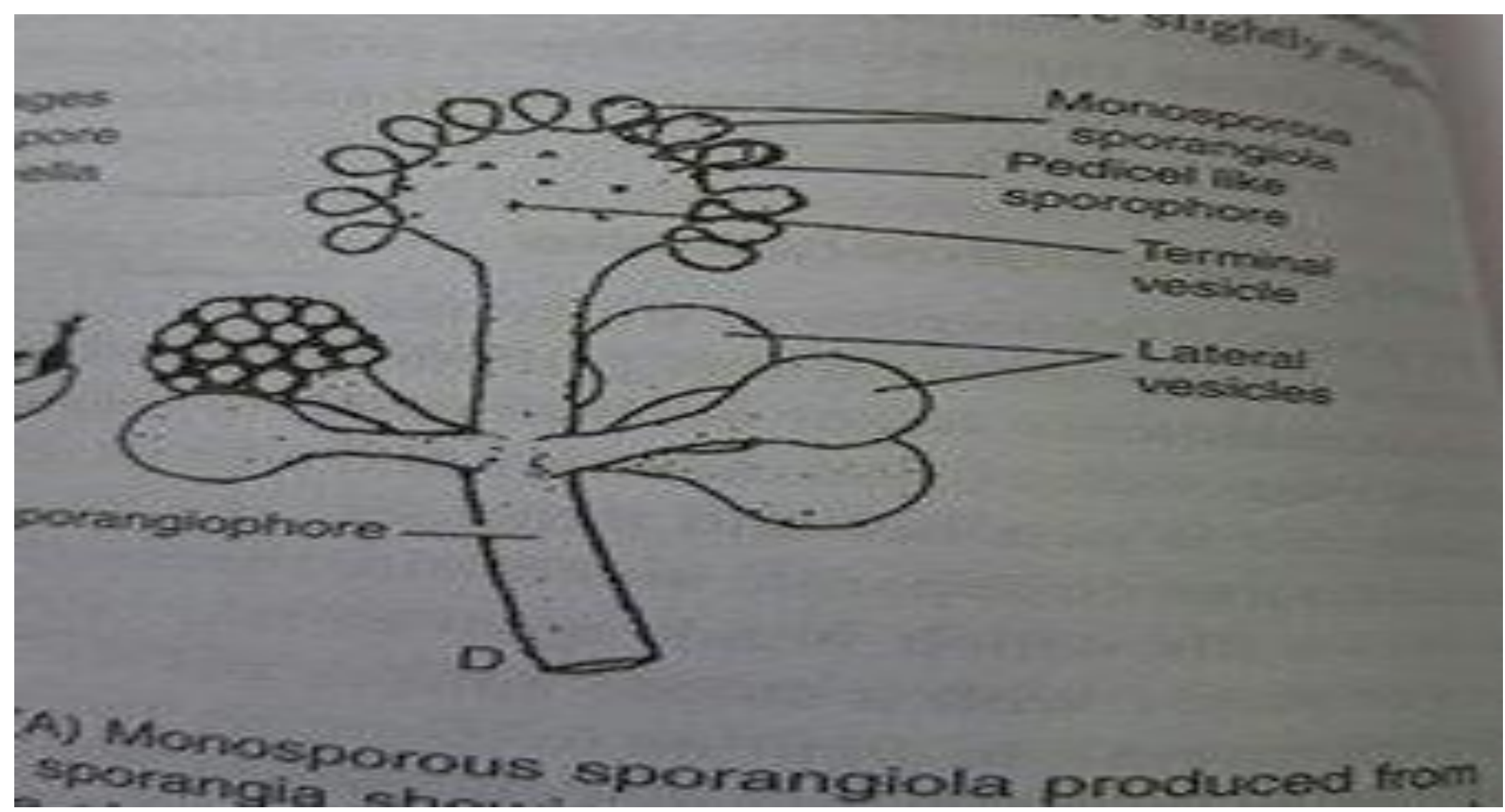


Fig. 4.11. *Pilobolus kleinii*.

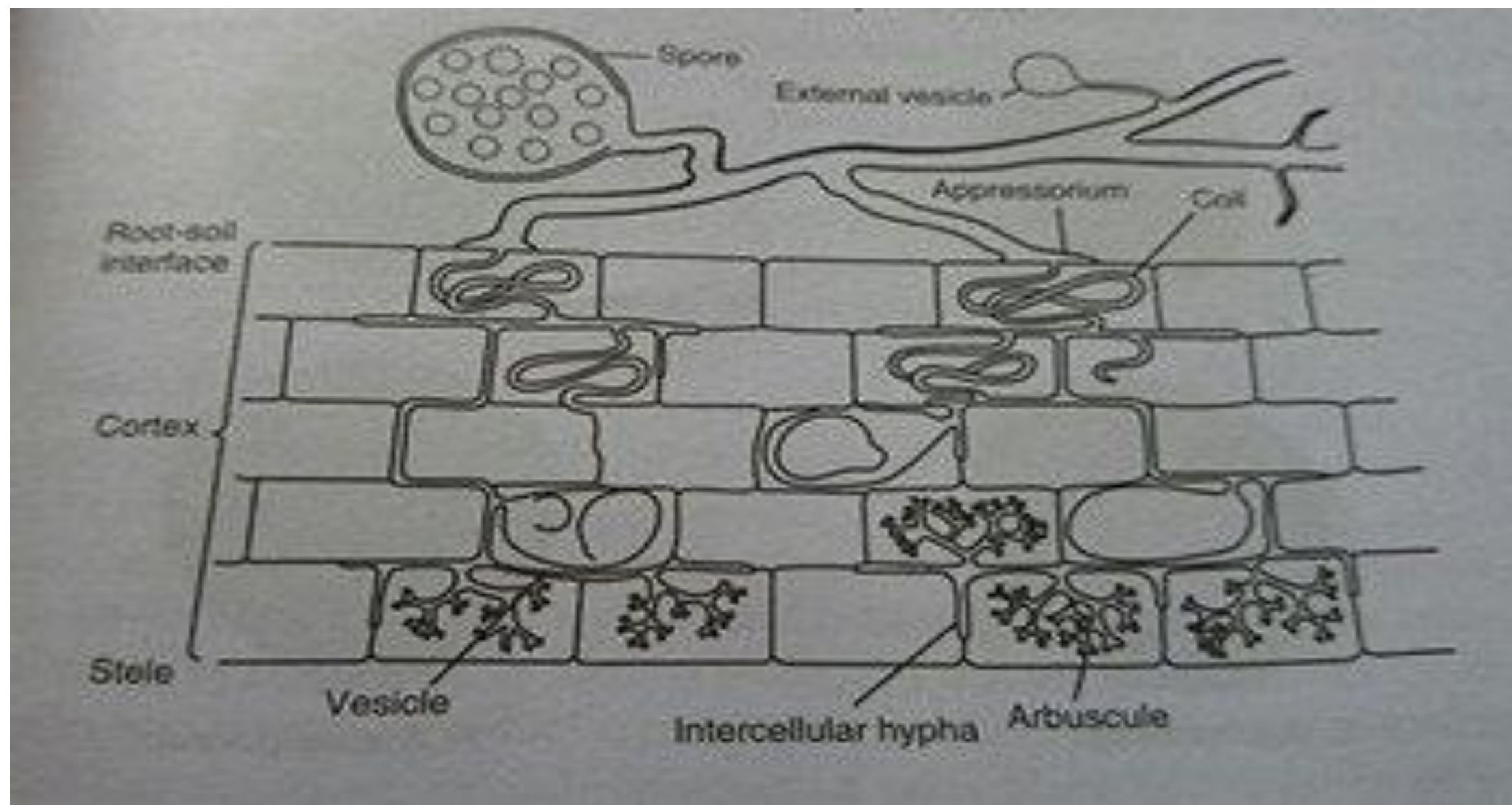
Cunninghamella

- Saprophytic fungus found in soil, nuts and decaying vegetables
- Formation of unispored sporangia
- Hyaline, born on swollen globose vesicle at the tip of branch
- Sporangial wall thick smooth or spiny



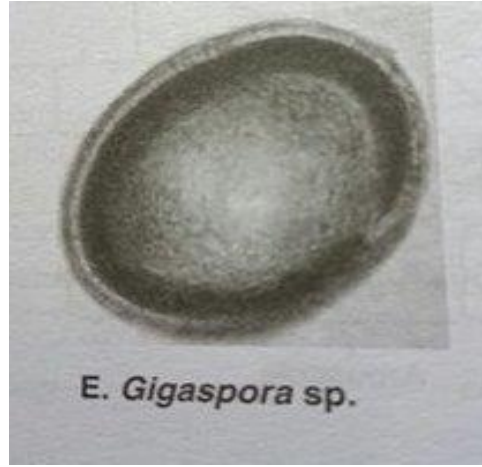
Class Zygomycetes: Order Glomales

- Mycorrhizal relationship with most angiospermic and gymnospermic plants
- Obligate biotrophic fungi
- VAM/AM fungi
- Arbuscles are branched haustoria for nutrient exchange
- Vesicles are swellings for energy storage
- Six representative genera recognized
 - Sporocarpic genera – *Glomus* and *Sclerocystis*
 - Nonsporocarpic genera – *Gigaspora*, *Scutellospora*,
Acaulospora and *Entrophospora*

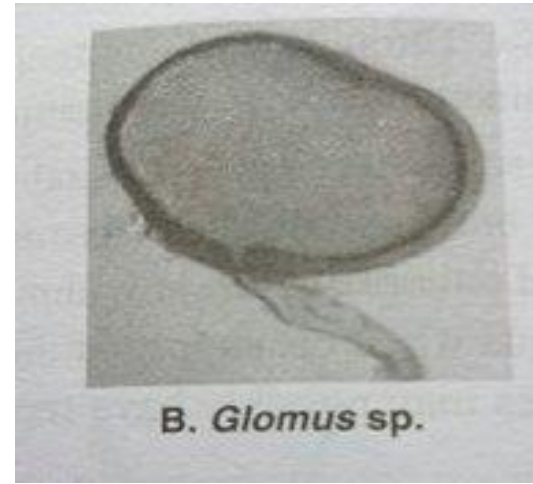




C. *Gigaspora* sp.



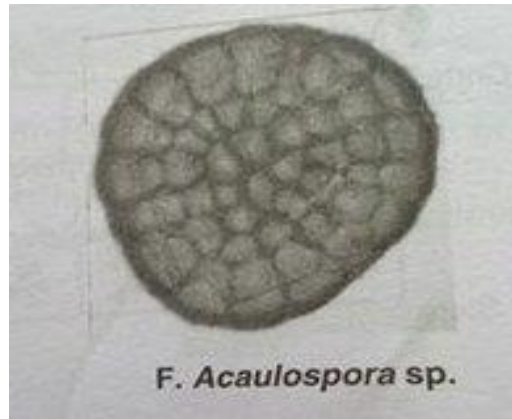
E. *Gigaspora* sp.



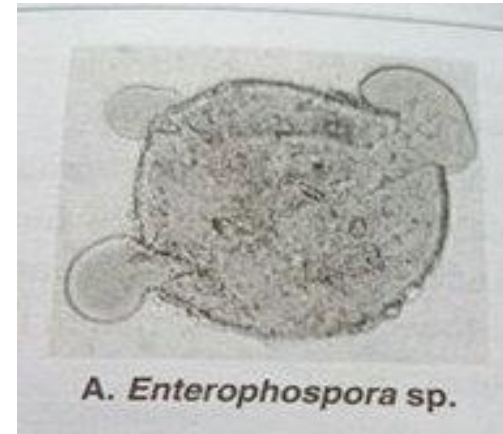
B. *Glomus* sp.



D. *Acaulospora* sp.



F. *Acaulospora* sp.

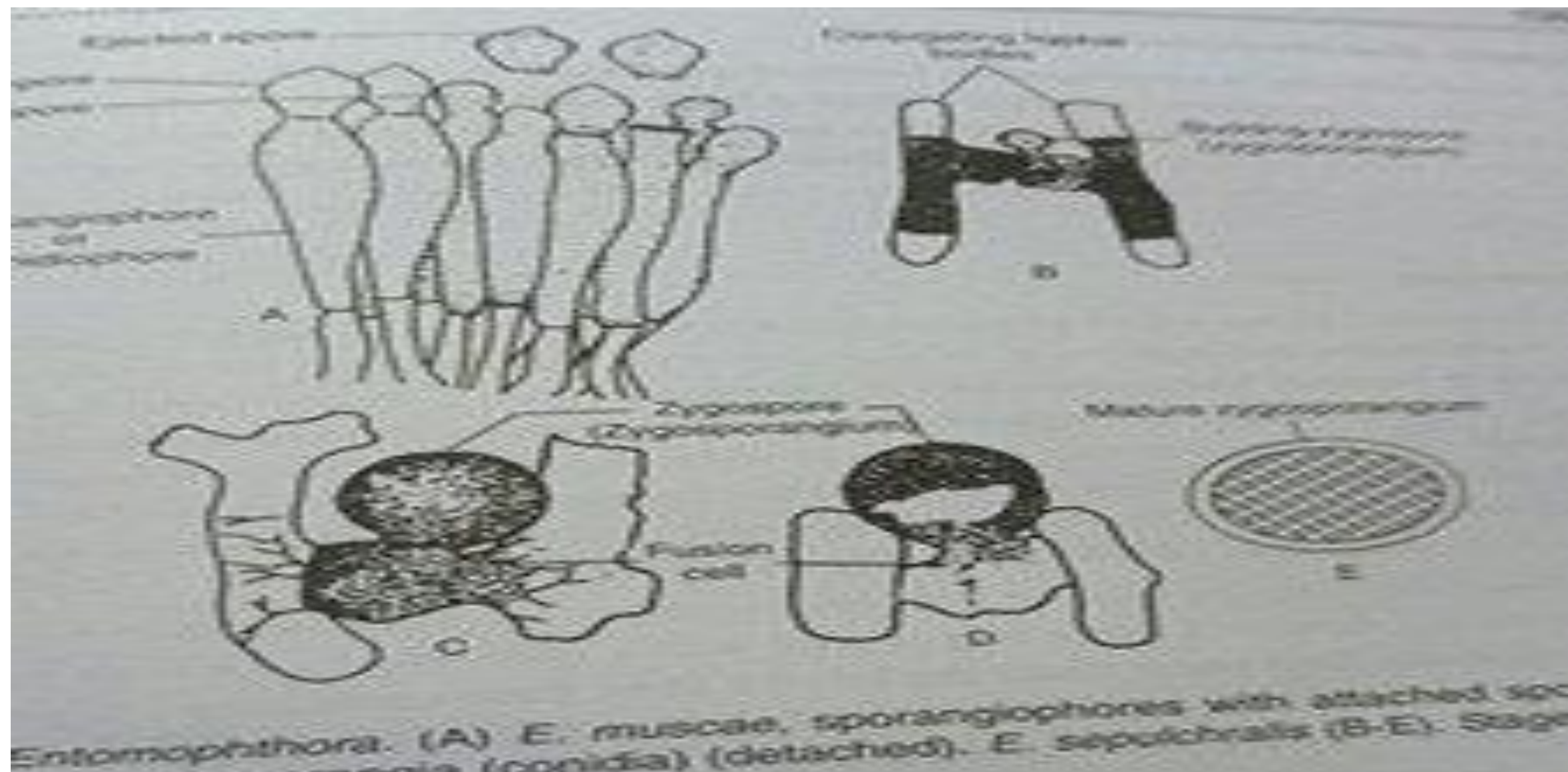


A. *Enterophospora* sp.

Class Zygomycetes:

Order Entomophthorales

- **Parasitic on arthropodes and insects**
- **Also called fly fungus**
- **Fungal mycelium breaks into multinucleated hyphal bodies grown on artificial media called sporogenous cell bears conidia**
- **Conidia primary, secondary and tertiary**
- **Multinucleated resting body develop parthenogenetically within the body of dead fly**



Class Tricomycetes

- Commonly called hair fungi, gut inhabiting fungi or arthropod fungi
- Thallus not well developed coenocytic or perforated septate
- Asexual reproduction by sporangiospores, arthrospores , amoeboid cells or trichospores
- A trichospore is dehiscent unispored sporangium with one to several appendages at its base
- Sexual spore may be absent or zygosporangium

Examples

- Harpella
- Smittium
- Amoebidium

Economic Importance

Species	Product	Uses
Several <i>Mucor</i> and <i>Rhizopus</i> spp.	Lipases and proteases	Leather, detergent and medical industry (steroid transformation)
<i>Rhizopus</i>	Cellulases	Food production (i.e., tofu)
<i>R. oryzae</i> , other <i>Rhizopus</i> spp.	Fumaric acid	Diverse
<i>Rhizopus</i> spp.	Lactic acid	Diverse
<i>R. delemar</i>	Biotin	Diverse
<i>Mortierella romanniana</i> , <i>Mortierella vinacea</i> and <i>Mucor indicus</i>	Linolenic acid	Diverse
<i>Mortierella alpina</i>	Arachidonic acid	Diverse
<i>Blakeslea trispora</i>	β -carotene	Diverse