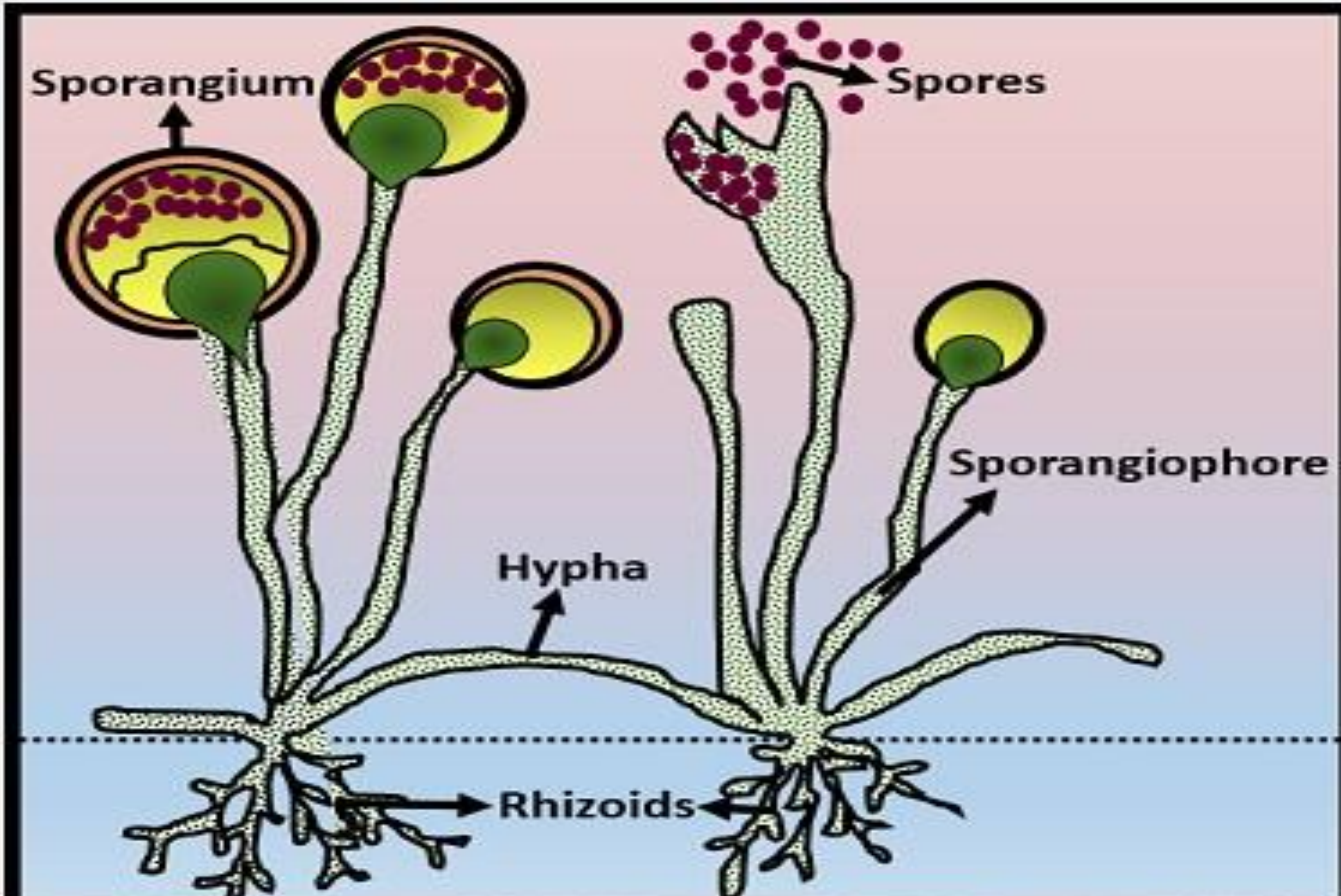
MUCOR

Occurrence and Habit

- The genus Mucor (L. muceo, be moldy) is represented by about 80 species, found throughout the world and about 17 species from India, commonly known as mould.
- They grow mostly as saprophytes on decaying fruits and vegetables, in soil (Mucor strictus, M. flavus), on various food- stuff-like bread, jellies, jams, syrups. M. mucedo, is a coprophilous species (grows on dungs of herbivorous animals like cow etc.), known as black mould.

Vegetative Structure

- Thallus is mycillial. The mycelium grows extensively on the surface of substratum.
- It consists of much branched, filamentous, slender, stout and coencytic hyphae.
- The call wall is made up of chitin.
- There are a large number of small nuclei distributed throughout the protoplasm of hyphae.
- Besides, the cytoplasm contain numerous small vacoules, reserve food material in the form of gylcogen and oil droplets.



Structure of Rhizopus

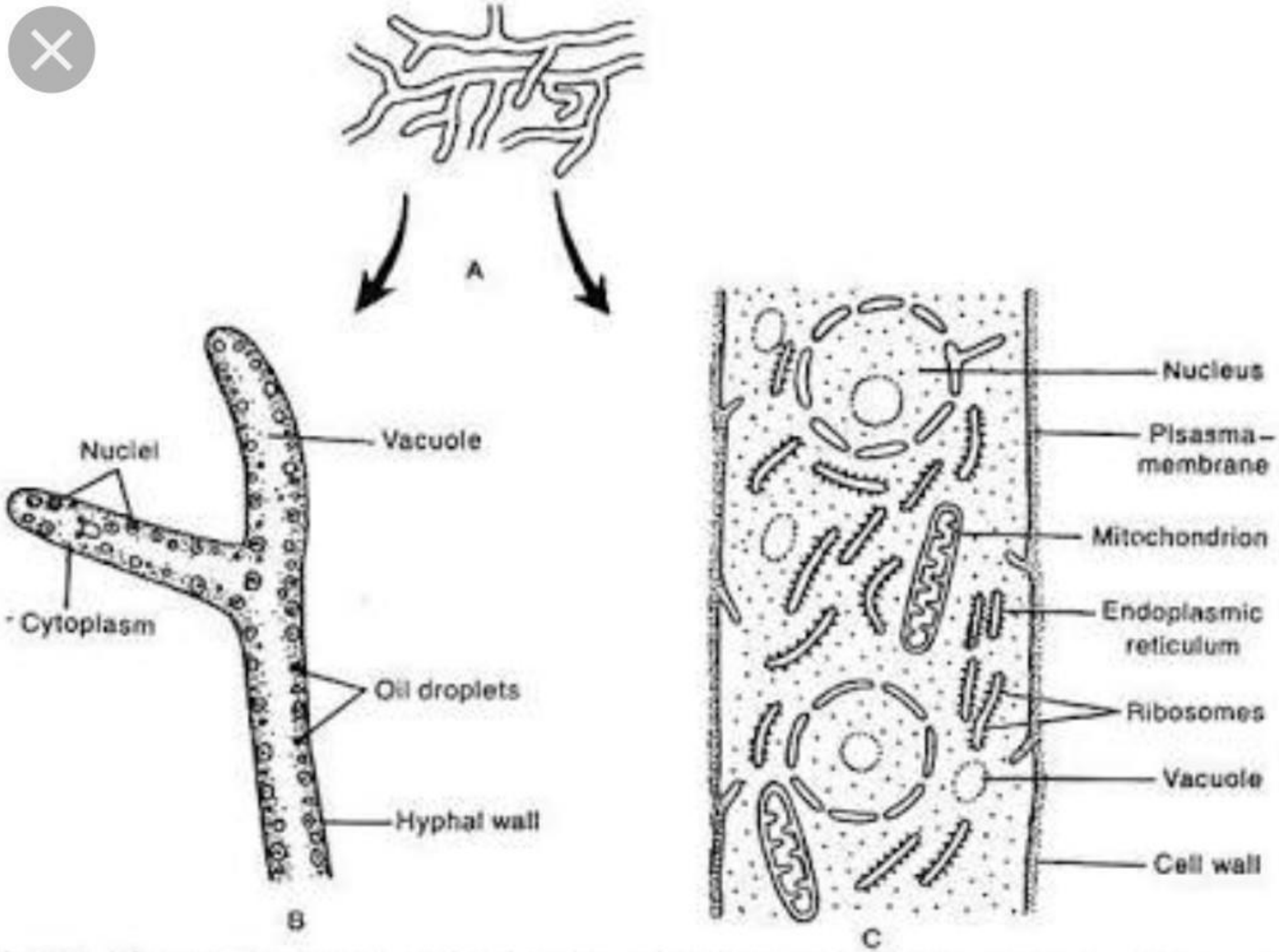


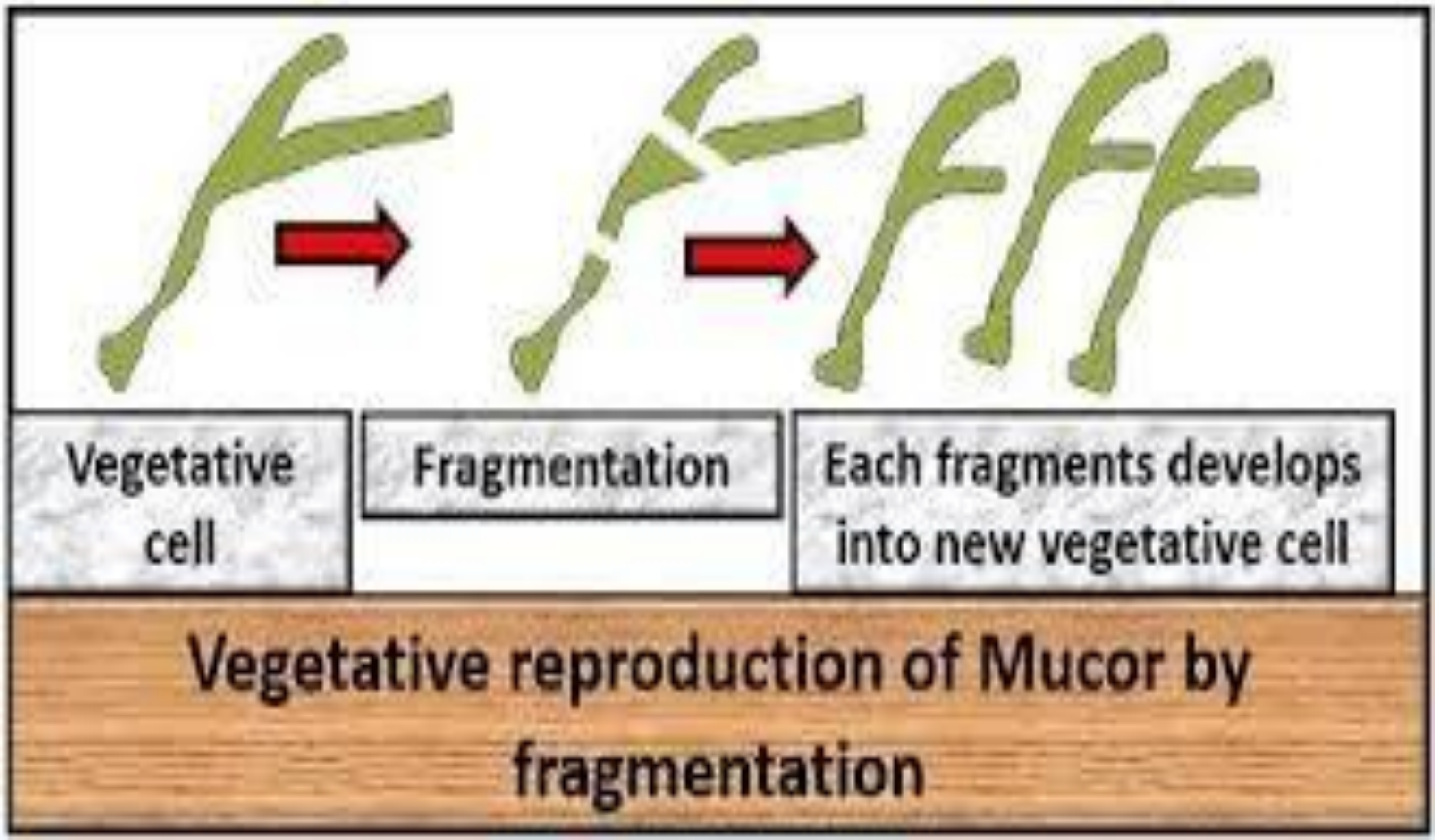
Fig. 4.27 : *Mucor* : A. Vegetative mycelium, B. Portion of hypha under light microscope, C. Portion of hypha under electron microscope

REPRODUCTION

- It reproduces by 3 ways:-
- Vegetative Reproduction
- Aexual Reproduction
- Sexual Reprodution

Vegetative Reproduction

- It takes place by fragmentation. Due to accidental breakage, the mycelium may break up into two or more units. Each unit is capable to grow as mother mycelium.


Vegetative cell
Fragmentation
Each fragments develops into new vegetative cell
Vegetative reproduction of Mucor by fragmentation

Asexual Reproduction

- It takes place by the formation of sporangiospore, oidia and chlamydospore (Fig. 4.28).
- SPORANGIOSPORE FORMATION:-
- During favourable condition, the nonmotile spores known as sporangiospores or aplanospores are formed inside the sporangium.
- The sporangiophores develop singly and scatteredly on the upper side of the superficial mycelium (Fig. 4.28B). The sporangiophore is generally unbranched, however it is branched in M. brunneus and M. racemosus.
- With maturity, the protoplast inside the sporangium is differentiated into a thick dense layer of multi-nucleate cytoplasm towards the peripheral region just inside the sporangial wall, called sporoplasm and a vacuolated portion with a few nuclei towards the centre, called columellaplasm.
- Soon, the peripheral sporiferous zone undergoes protoplasmic cleavage to produce a large number of small, polyhedral, multinucleate, non-motile sporangiospore.
- These spores are globose to oval in shape, thick-walled, dark coloured and store reserve food material in the form of glycogen and oil.

. They fill the entire peripheral cavity of sporangia.

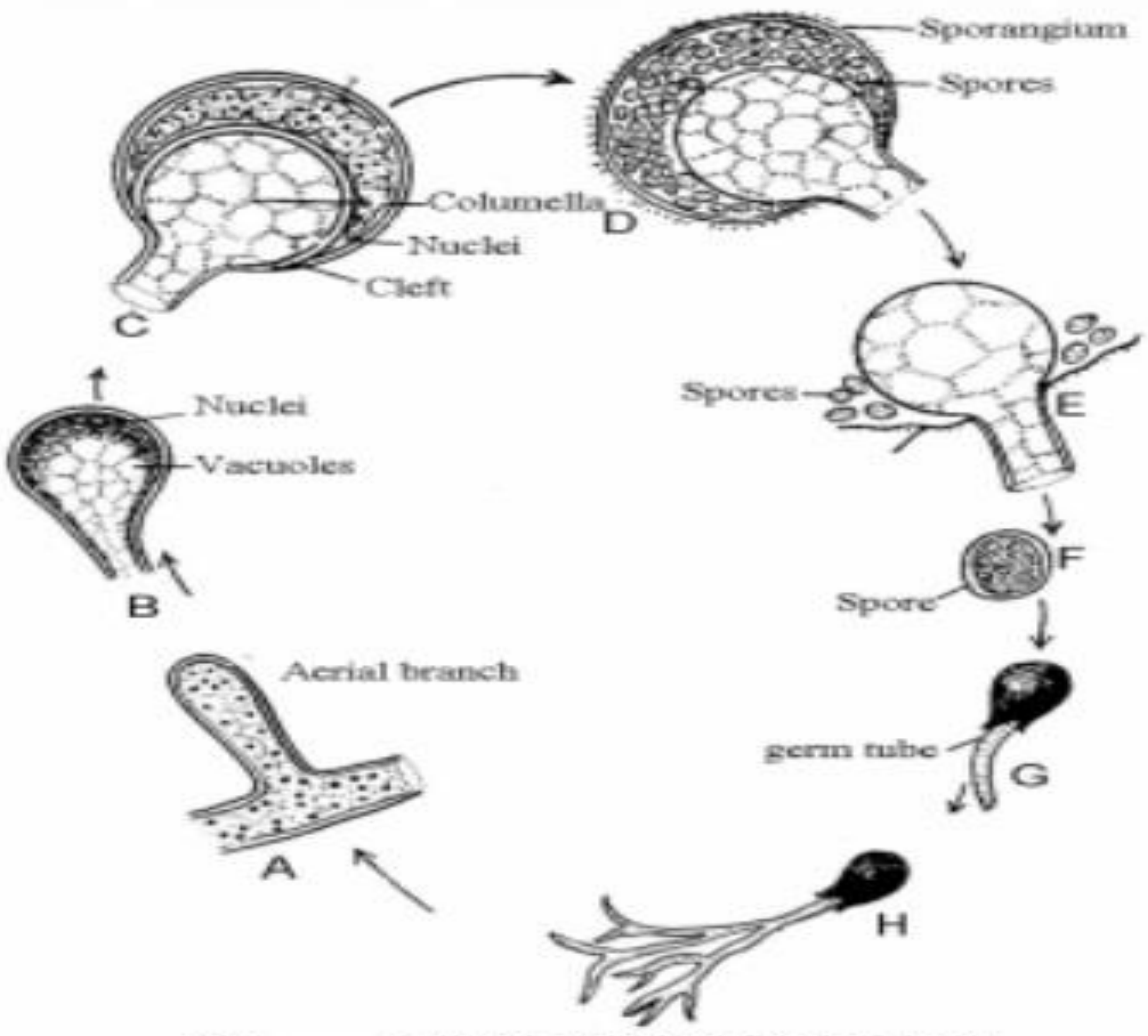


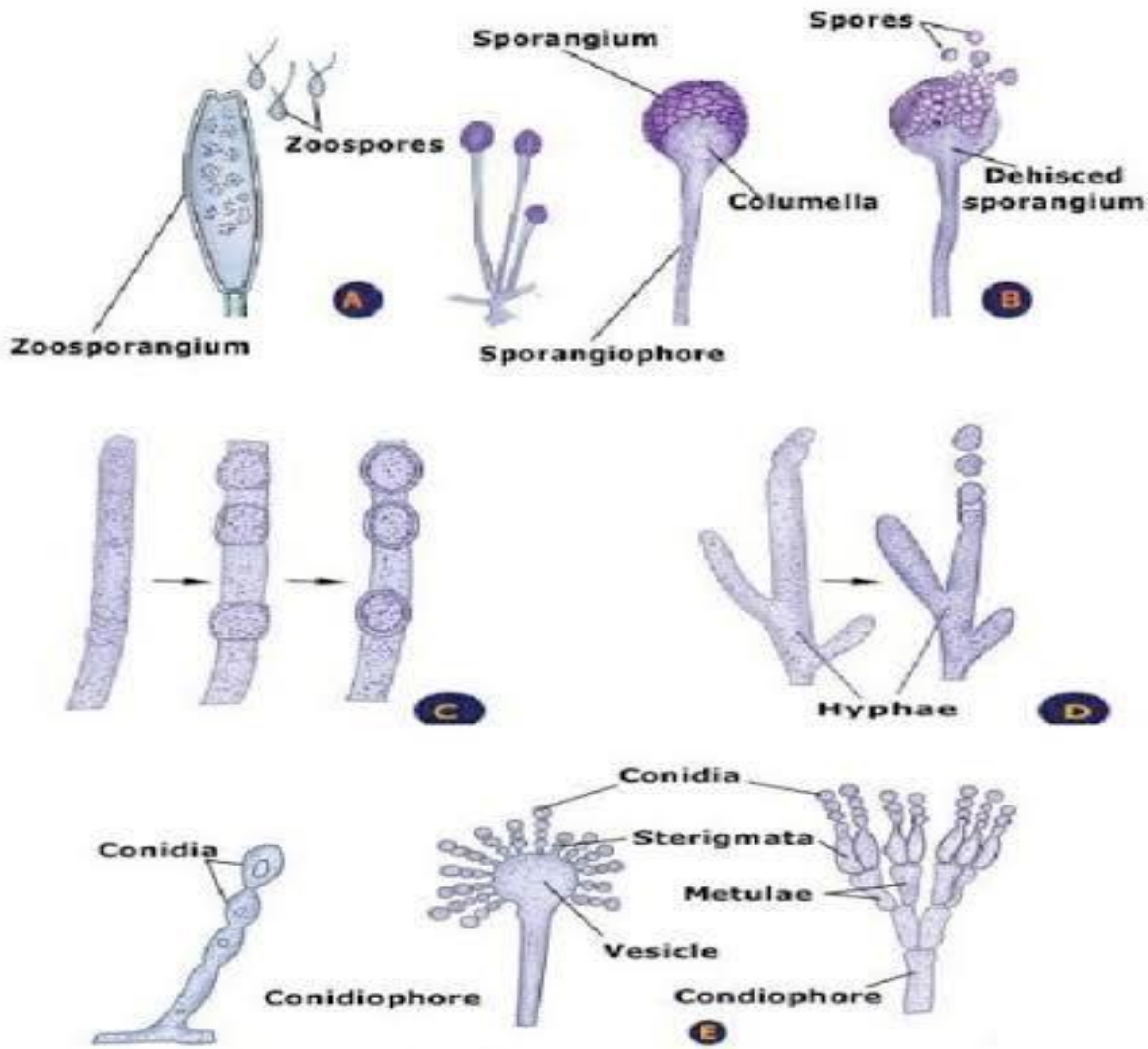
Fig. **Asexual reproduction in *Mucor*.**

Oidia Formation

- Oidia are thin walled bid-like structures formed by mycelium grew in a medium rich in sugar. After detachment, the oidia increase by budding like yeast. This stage is called torula stage. Later, they develop to mycelia.

Chlamydospore Formation

- During unfavourable condition, thick-walled, nutrition rich, intercalary mycelium segments are developed by septation of mycelium which are termed as chlamydospores. They get separated from each other when the connecting mycelium dries up. In favourable condition, the chlamy- dospore germinates and gives rise to a new mycelium.



A. Zoospores; B. Sporangiospores; C. Chalmydospores; D. Oidia; E. Conidia

Sexual Reproduction

- Formation of Zygospore
- Sexual reproduction takes place during unfavourable condition by means of gametangial copulation. The gametangia look alike and by conjugation, they give rise to zygospore. Most of the species of Mucor are heterothallic (M.-mucedo, M. hiemalis), but few species (M. tenuis, M. genereosis) are homothallic (Fig. 4.28).
- In heterothallic species, zygospores are produced by the union of two gametangia developed from mycelia of compatible strains; whereas, in homothallic species, the uniting gametangia develop from mycelia that derived on germination of a single spore.
- When two mycelia of compatible strains come close to each other, the mycelia produce small outgrowth, called progametangia (Fig. 4.28L, M). The apical region of the two progametangia come in close contact. Nuclei and cytoplasm of each progametangium push more and more towards the apical region and its tip swells up with dense protoplasm.

Zygospore formation cont.

- After maturation of gametangia, the common wall at the point of their contact dissolves and the protoplast of both the gametangia unite to form zygospore (Fig. 4.280, P). The nuclei of opposite gametangia fuse together to form diploid (2n) nuclei, unpaired nuclei gradually degenerate.
- The diploid nuclei undergo meiosis before resting stage of zygospore. In heterothallic species normally 50% of the nuclei are of “+” strain and the other 50% of “-” strain.
- The young zygospore enlarges and probably secretes five layered (two in exospore and three in endospore) thick wall, of which the outer one is black and warty. The zygospore then undergoes a period of rest.
- After resting period, the zygospore germinates and, on germination, the innermost layer comes out after cracking the outer walls and produces a promycelium. The content of the zygospore migrates into the tip of the promycelium which swells up and differentiates into a lower stalk like germsporangiophore and the upper spherical germsporangium (Fig. 4.28Q).

Zygospore formation cont.

- The haploid nuclei of germsporangium form haploid spores called sporangiospores inside the germsporangium. These spores are also known as meiospores (Fig. 4.28R). Each meiospore, after liberation, germinates like sporangiospore and forms a new mycelium like the mother thallus (Fig. 4.28S).
- Sometimes failure of gametangial copulation results in parthenogenic development of zygospore by any one gametangium called azygospore or parthenospore. It is, however, haploid in nature and its nucleus does not undergo meiosis before spore formation.

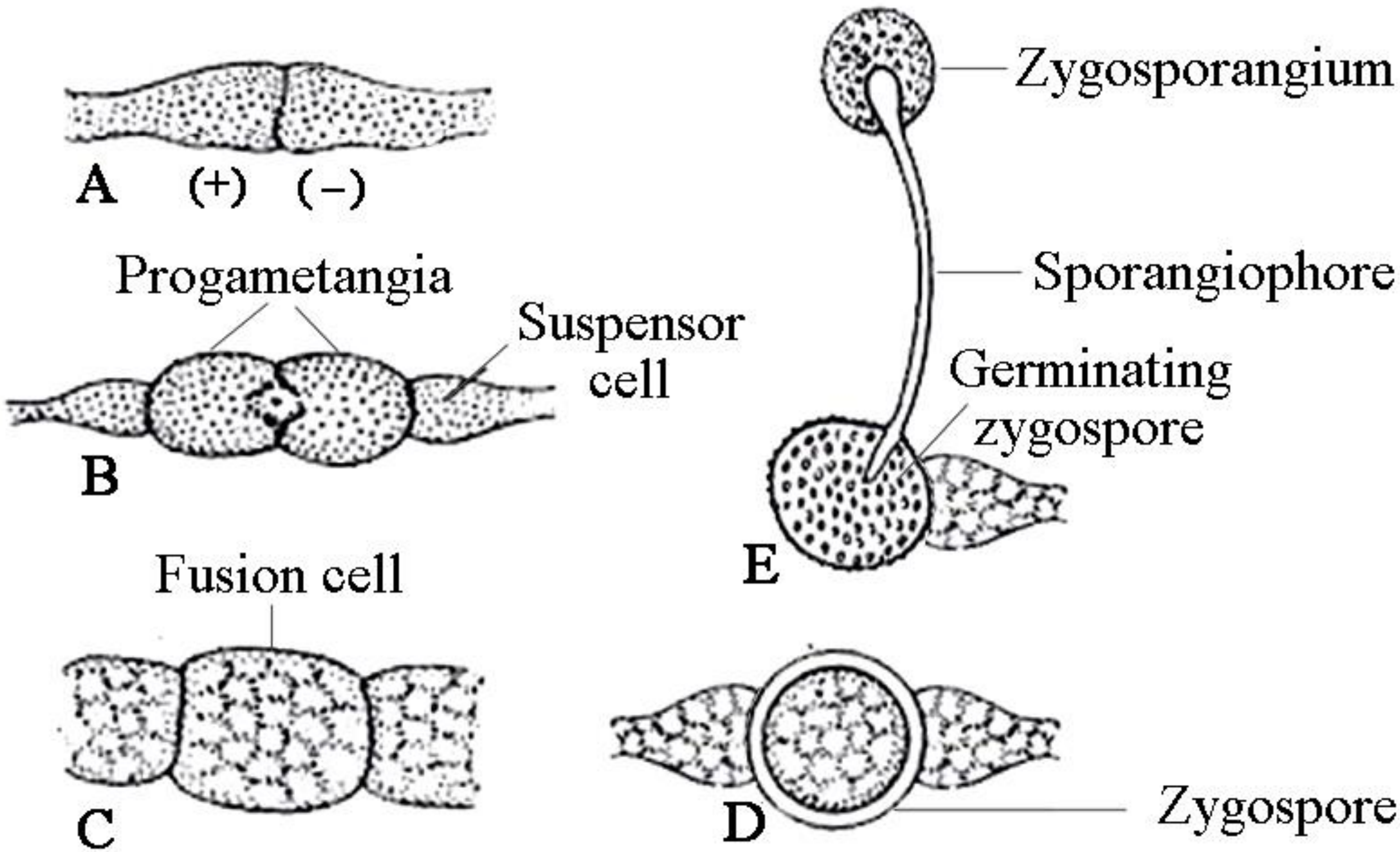
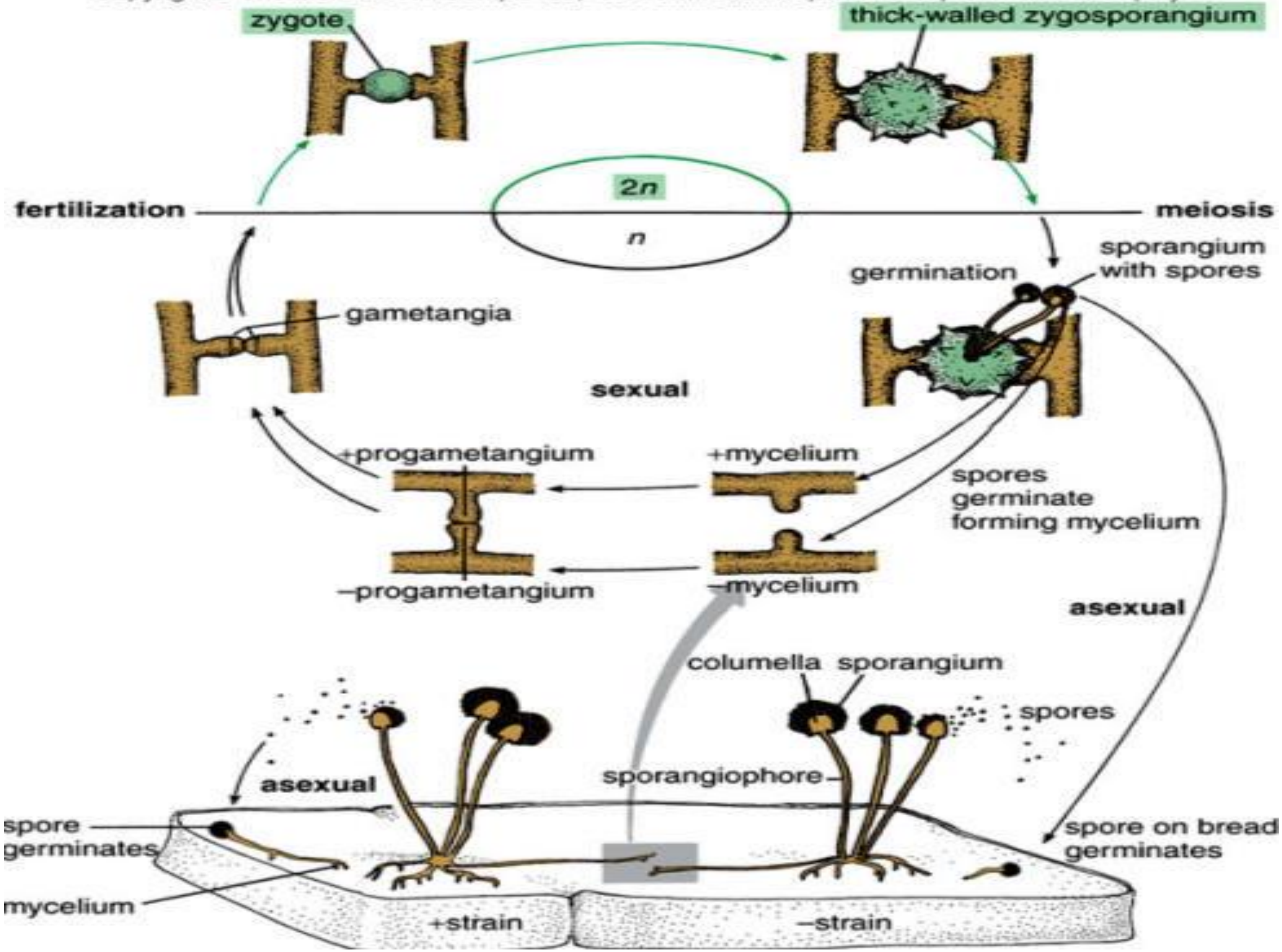


Fig: ***Mucor spp.*** Development of zygospore and its germination.


zygote
thick-walled zygosporangium
2n
fertilization
meiosis
n
germination
sporangium with spores
gametangia
sexual
+progametangium
+mycelium
spores germinate forming mycelium
−progametangium
−mycelium
asexual
columella
sporangium
spores
asexual
sporangiophore
spore germinates
spore on bread germinates
mycelium
+strain
−strain

HETEROTHALLISM IN MUCOR

- Mucor mucedo and Mucor stolonifer are the typical heterothallic species. In heterothallic species the fusion can take place only among the different strained hyphae, which develop on different mycelia of different (+ and -) strains. In these species the zygospores cannot be produced by the fusion of two hyphae of the same strain. In 1904 Blakeslee reported that in heterothallic species whenever the mycelia of + and – strains remain apart from each other, the zygospores are not produced and only the sporangia are formed.
- On the other hand, when + and – mycelia grow together, the fusion takes place and the zygospores are produced. Morphologically the + and – strained mycelia are quite similar in structure, but different in physiological behaviour. In other words, they are morphologically identical and physiologically different.

HETEROTHALLISM CONT.

- Sometimes, it has also been observed that the growth of the + mycelium is comparatively faster, and the gametangia of + mycelium are bigger than that of the – mycelium, and they can be distinguished as female and male gametangia. Many mycologists do not support this view and advocate that this behaviour is only because of nutrition.
- Blakeslee proved the phenomenon of heterothallism on the basis of experiments. He inoculated many + and – strained spores on the agar medium in a petri dish and observed that the fusion occurs only at those points where the hyphae of different strains (i.e., + and -) come in contact. The zygospores were only produced at the points of contact of different strained hyphae. Absolutely no zygospores were produced at the points of contact of same strained hyphae.

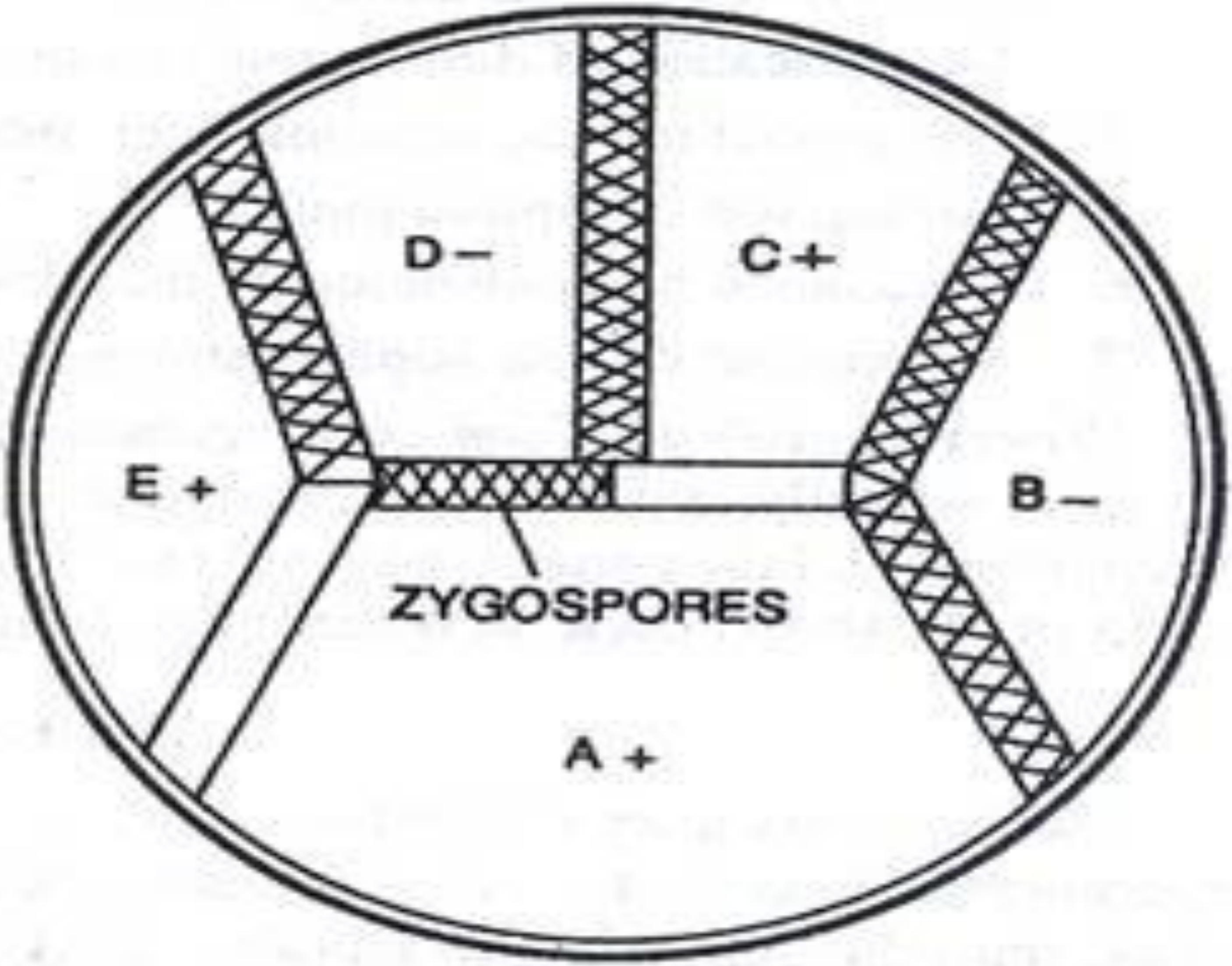


Fig. 17.1. Heterothallism in Mucorales-Blakeslee's experiment.