Algae

Spirogyra
Chara
Vaucheria

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Algae

General characters

Autotrphs, Thallophytes, Chlorophyllous, Photosynthesis, Lichens, Mycorrhizal

- They also present in the moist soil and also present on the surface of Rocks and stones..
- Algal Cells have eukaryotic properties while some algal species have Flagella arranged in the special microtubules pattern the pattern is “9-plus-2” of Microtubules.
- Algal cells have specialized Nucleus.
- Many algae are Photoautotrophic in nature and make their own food by the process of Photosynthesis.
- They reproduce by Asexual and Sexual reproduction.
- Asexual reproduction takes place by different spore development.
- During the reproduction process by Mitosis, spores are formed.
- During sexual reproduction, well differentiate sex cells formed later on they mingle and Diploid zygote is produced .
- The zygote, later on, converts into sexual spores. When they get a sympathetic environment spores will germinate.
- After germination, development starts haploid organism formed which have a single set of chromosomes.
- They have Alternation of Generations during the reproduction.

Spirogyra

Division : Chlorophyta

Class: Chlorophyceae
Order: Zygmemales
Family: Zygnemaceae
Genus : spirogyra

Spirogyra are free-floating green algae present in freshwater habitats such as ponds, lakes, etc. commonly known as **"water silk or pond silk".** filamentous and unbranched vegetative structure. The genus Spirogyra is named after the unique spiral chloroplast present in the cells of algae.

- photosynthetic and contribute substantially to the total carbon dioxide fixation carried out.

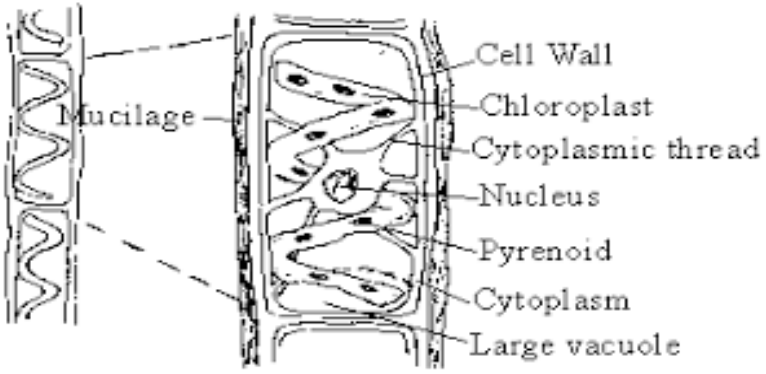
Spirogyra is classified under Chlorophyta due to the presence of chlorophyll. The genus contains around 400 species.

Spirogyra: Filament

Structure of Spirogyra

Spirogyra is an unbranched filamentous thallus with slimy mucilag - inous sheath around filament

- Multicellular thallus with cylindrical cell joined end to end
- They are 10-100 μm in width and may grow several centimetres in length
- The cell wall is made up of two layers, inner cellulose and outer pectose. The slimy mucilage sheath is present.
- In each cell, there is a nucleus, cytoplasm, a large central vacuole and spiral chloroplasts (1-16) ribbon-shaped and arranged spirally. Chloroplast contains many pyrenoids in a row. Pyrenoids store starch and protein



Spirogyra: An individual cell

Reproduction

Spirogyra undergo vegetative, asexual and sexual reproduction. The life cycle of Spirogyra is haplontic**,** i.e. the dominant stage is free-living haploid (n) gametophyte and the sporophyte is represented only by the diploid zygote (2n)

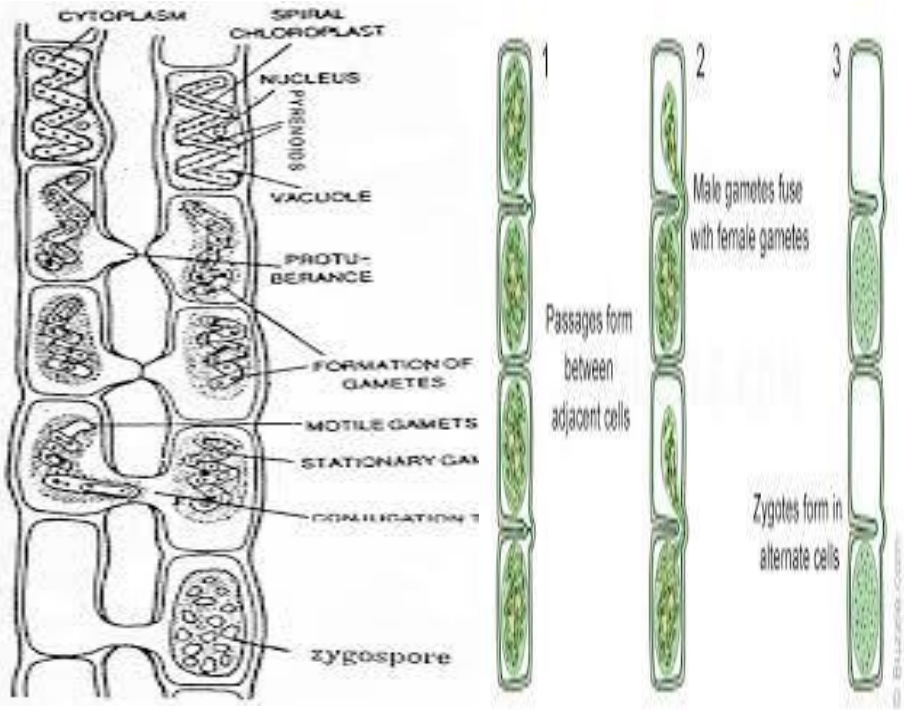
Vegetative reproduction is by fragmentation. preferred mode . due to mechanical injury or dissolution of the middle lamella with a change in the salinity and temperature of the water, Sometimes the middle lamella of one cell protrudes into an adjacent cell resulting in the breakage of the filament

Asexual reproduction is found in few of the species of Spirogyra. Asexual reproduction is by the formation of azygospores, akinetes or aplanospores.

- **aplanospores** (under unfavourable conditions) The protoplast shrinks and forms a wall around it which results in the formation of aplanospores.
- **Akinetes and aplanospores** are also formed similarly but they have a thicker cell wall of cellulose and pectin, non-motile spores
- **Azygospores (parthenospores)** are the gametes, that failed to fuse during sexual reproduction and develop into a new filament asexually.

Sexual reproduction :isogamous, Conjugation is of two types, Scalariform conjugation and lateral conjugation.

- **Scalariform Conjugation (**H-shape conjugation**)**:
- In scalariform conjugation, two filaments of Spirogyra sp come together and lie side by side. The structure formed looks like a ladder.



Tube-like structure develops from each cell of the two filaments lying together

Conjugation canal is formed of the developing tube. The male gamete fuses with female gamete of the other filament and one of the filaments becomes empty and the other has zygotes which are released after the decay of the parent filament and germinate under favourable conditions

Lateral Conjugation:

adjacent cells of a Spirogyra sp function as male and female gametes. Conjugation tubes are formed between cells of the same filament.

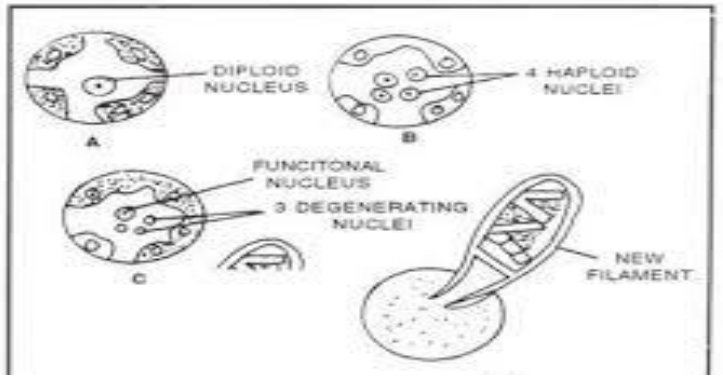
Direct lateral conjugation: Passage is formed between two adjacent cells through the middle lamella. Male gametes fuse with female gametes. Zygotes are formed in alternate cells

Indirect lateral conjugation: The conjugation canal is formed by the cell having male gamete and joins the adjacent cell having female gamete

- The entire protoplast of a Spirogyra act as a gamete. They are known as **aplanogametes.** Aplanogametes are formed in the gametangia, which are formed at the end of the growing season of Spirogyra.
- The zygote in Spirogyra is known as **zygospore**s. Zygospores are diploid (2n) and formed by the fusion of male and female gametes. It is the only diploid stage in the life cycle.
- The zygospore has a thick cell wall made up of three layers; exosporium (outer layer of cellulose), mesosporium (middle layer of chitin and cellulose) and endosporium (inner layer of cellulose).
- The zygospore remains dormant until favourable conditions.

Germination, the zygospore undergoes meiosis to form 4 haploid (n) nucleus, only one survives and others disintegrate.

- Developing zygospore burst open to form germ tube.
- The germ tube divides repeatedly and develops into
- a new haploid filament.



Spirog yra: Germination

Chara

Class – Chlorophyceae
Order – Charales
Family – Characeae
Genus – *Chara*

Chara is commonly called as **'stone wort'** It is a submerged aquatic freshwater alga growing attached to the mud of the lakes and slow running streams. The thallus is often encrusted with $CaCO_3$ and $MgCO_3$.

Thallus structure

- The plant body is multicellular, macroscopic and is differentiated into main axis and rhizoids. The rhizoids are thread-like, multicellular structures arise from the lower part of the thallus. The rhizoids fix the main axis on the substratum and helps in the absorption of salts and solutes.
- The main axis is branched, long and is differentiated into nodes and internodes. The internode is made up of an elongated cell in the centre called axial cell or internodal cell.
- The axial cell is surrounded by vertically elongated small cells which originate from the node. They are called cortical cells.
- Branches of limited growth. Branches of unlimited growth. The growth of the main axis and its branching takes place by the apical cell.
- The nodal cells are uninucleate with few ellipsoidal chloroplasts. The internodal cells are elongated and possesses a large central vacuole, many nuclei and numerous discoidal chloroplasts. The cytoplasm is divided into outer ectoplasm and inner endoplasm. The endoplasm shows cytoplasmic streaming.

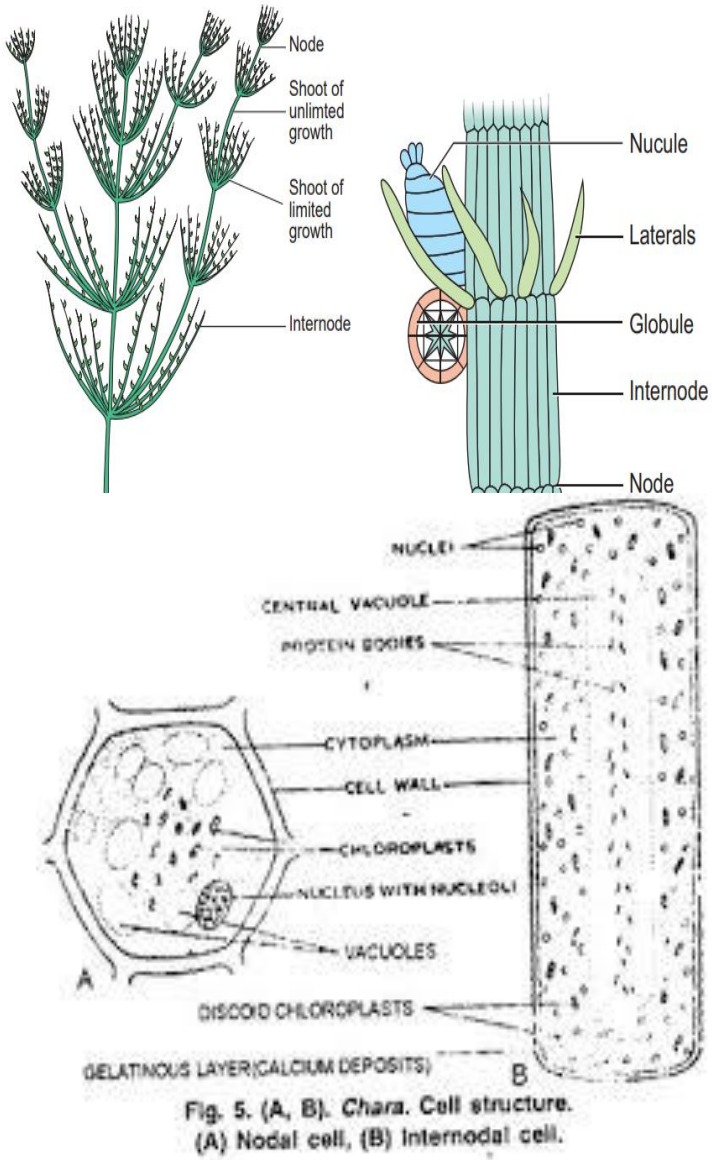


Fig. 5. (A, B). *Chara*. Cell structure. (A) Nodal cell, (B) Internodal cell.

Reproduction

- **Vegetative reproduction** takes place by Amylum stars, Root bulbils, Amorphous bulbils and secondary protonema.
- **Sexual reproduction:** Oogamous. Sex organs are macroscopic and are produced on the branches of limited growth. The male sex organ is called Antheridium or **Globule** and the female sex organ is called Oogonium or **Nucule**. The Nucule is located above the Globule.
- **Male fructification**: globule is spherical, macroscopic and its wall is made up of eight cells called shield cells. Manubrium – center of shield cell- rod shaped handle like cell.10 capitula- more or less rounded cells. The antheridium has spermatogenous filaments. These filaments produce antherozoids.
- **Female fructification:** The nucule is covered by five spirally twisted tube cells and five coronal cells are present at the top of the nucule. The centre of the nucule possesses a single egg.

Fertilization

- At maturity the tube cells separate and a narrow slit is formed. The antherozoids penetrate the oogonium and one of them fuses with the egg to form a diploid oospore.

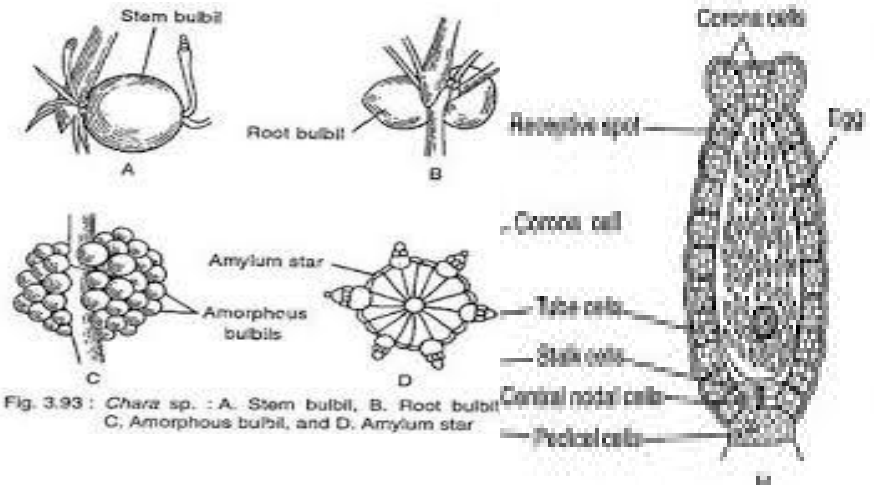
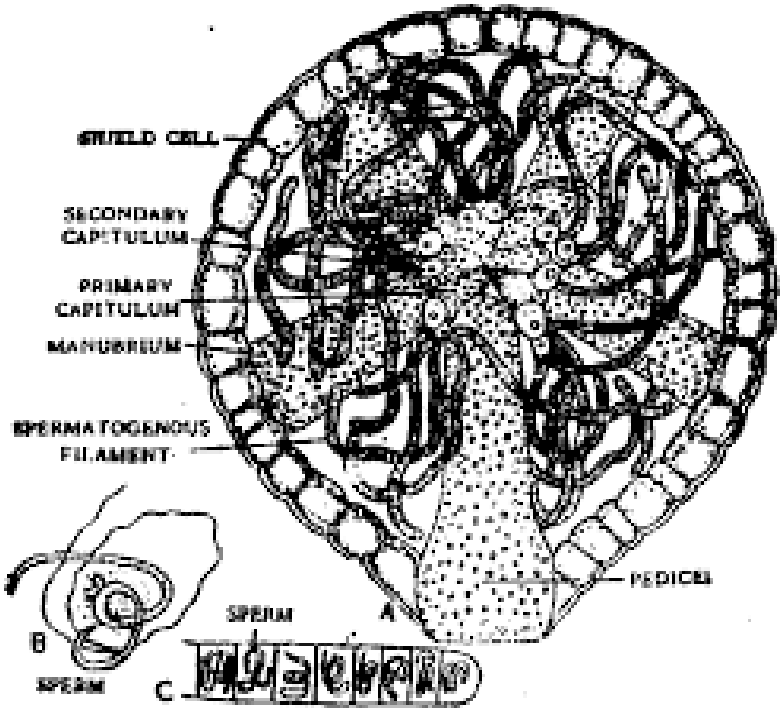


Fig. 3.93 : *Chara* sp. : A. Stem bulbil, B. Root bulbil C. Amorphous bulbil, and D. Amylum star

Vegetative reproduction **Nucule**

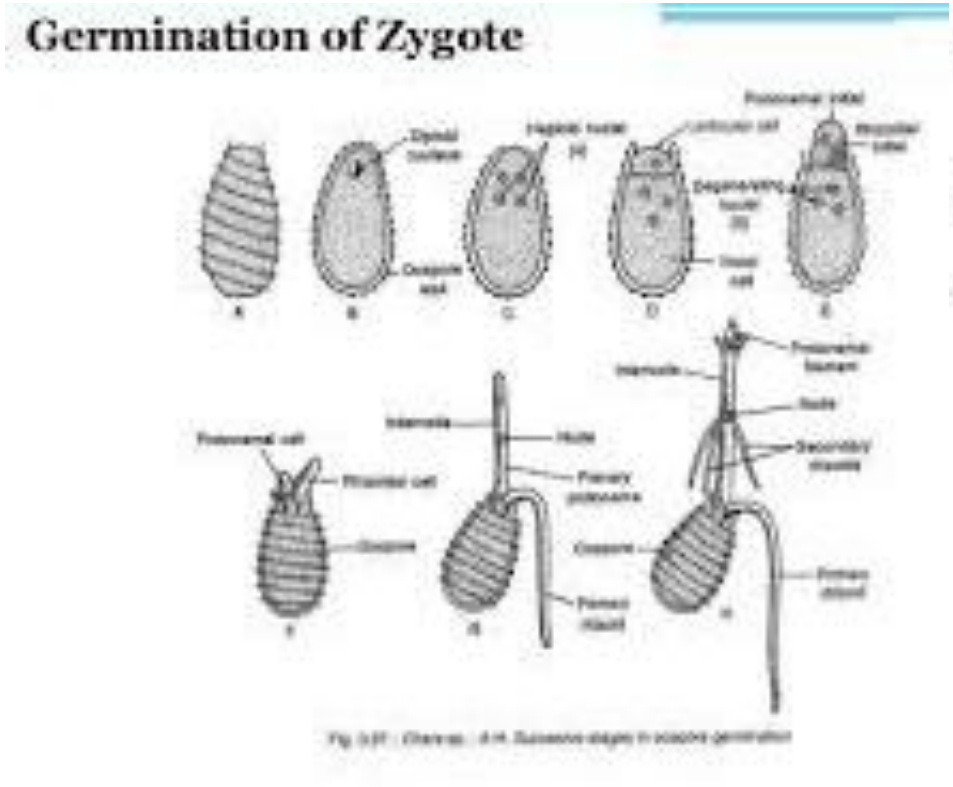


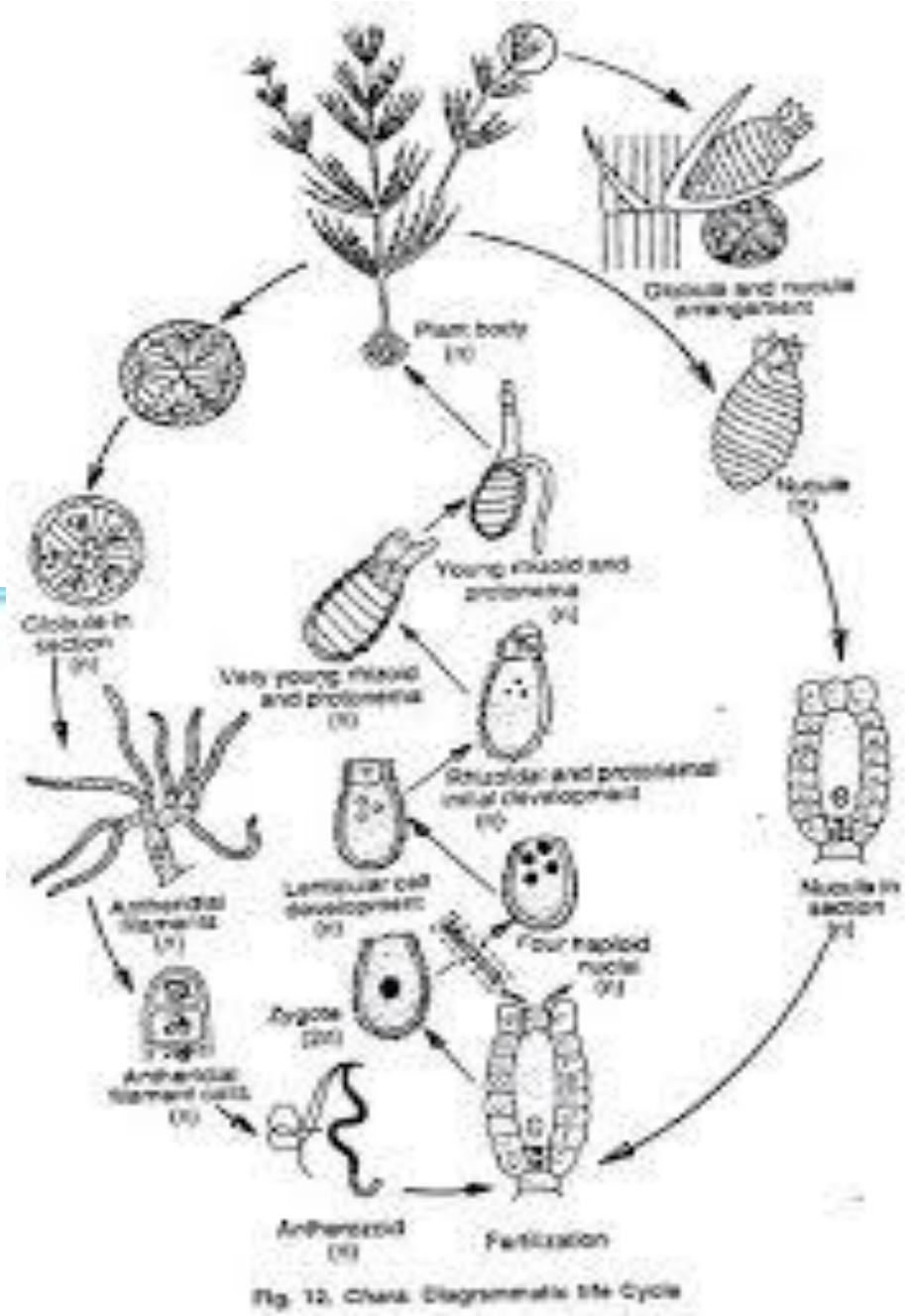
Globule

Germination

The oospore secretes a thick wall around and germinates after the resting period. The nucleus of the oospore divides to form 4 haploid daughter nuclei of which, three degenerate. The oospore or zygote germinates to produce haploid protonema. The plant body of *Chara* is haploid and oospore is the only diploid phase in the life cycle.

The life cycle is of **haplontic** type. Alternation of generations is present.





Vaucheria

Class: Xanthpphyceae
Order: Heterosiphonales
Family: vaucheriaceae
Genus: Vaucheria

fresh water. on moist soil. They form dark green mats.

Vegetative structure filamentous. The filament is cylindrical, branched, tubular, erect coenocytic. The filament is attached to the substratum by hepteron. Hepteron is colourless branched rhizoid like structure. Filamnent increases in length by apical growth. Cross walls are absent.

Cell structure

The cell wall is thin. It consists of inner layer of **cellulose** and an *outer layer of* ***pectic substances.*** The filaments are coenocytie. Septum is present only at the base of reproductive structure. The cell has peripheral layer of cytoplasm.

bIlk cytoplasm surrounds a large central vacuole. Vacuole is filled with cell sap. Many small nuclei are present. Cytoplasm also contains small **discoidal chloroplast.** Chloroplasts are small, oval, circular or elliptical.

The pigments are chlorophyll a, chlorophyll e, **beta-carotene** and **xanthophylls. X**anthophylls are dominant pigment. Its gives the thallus yellow-green color. Pyrenoids are absent. The reserve food material is oil drops. Starch is absent.

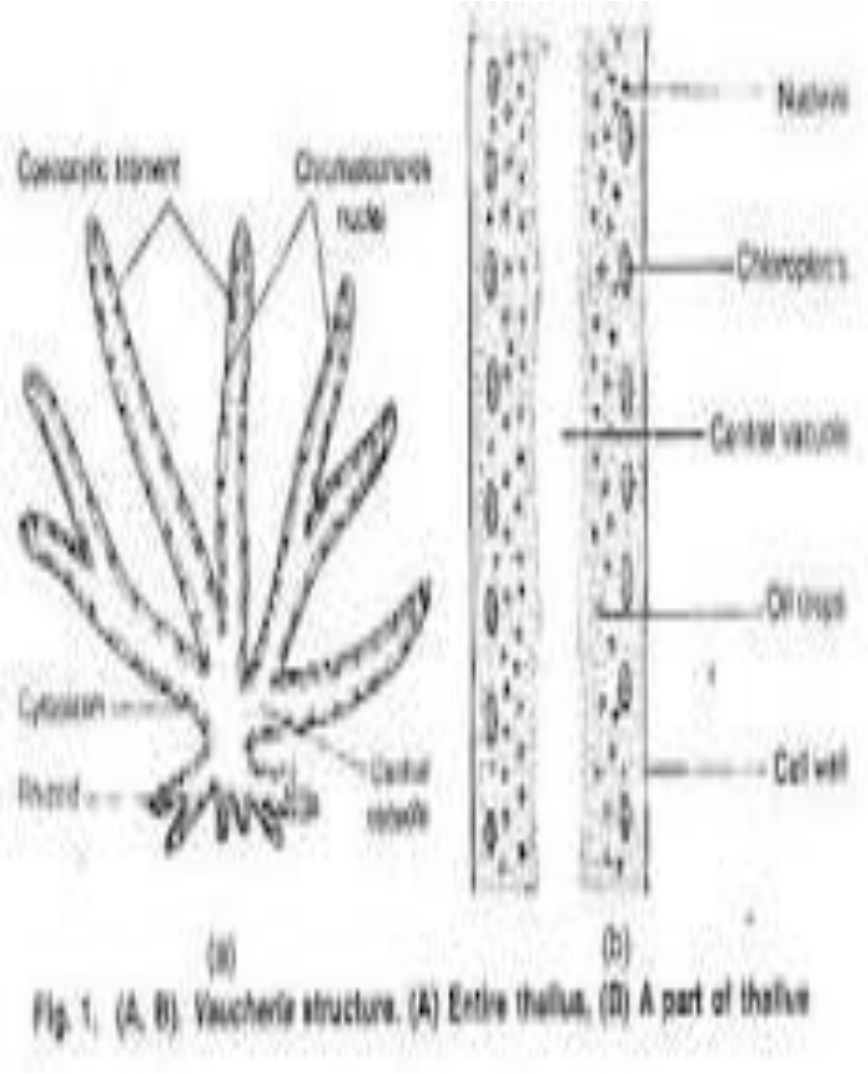


Fig. 1. (A, B) Vaucheria structure. (A) Entire thallus, (B) A part of thallus

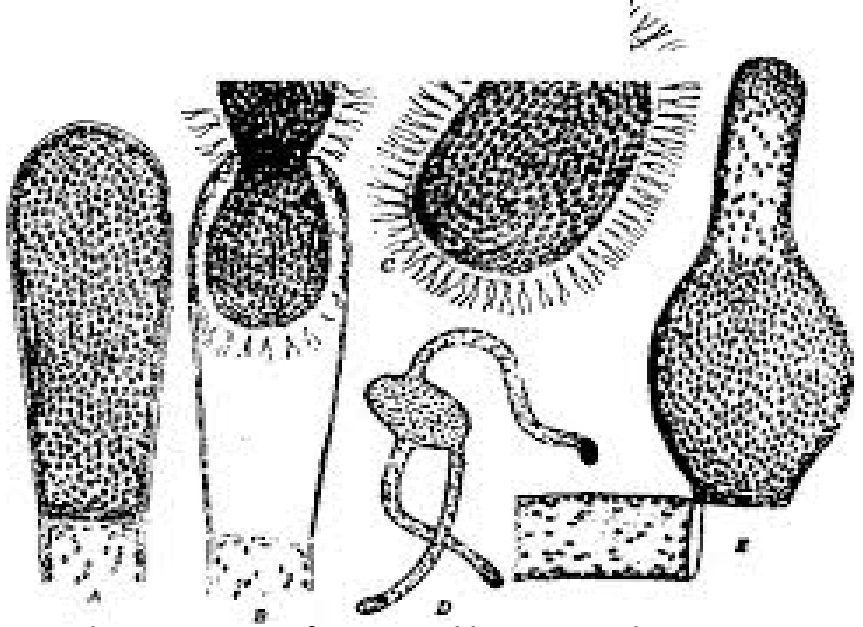
Reproduction

Vegetative reproduction

not a common mode of reproduction. by fragmentation. The filaments are broken accidentally into fragments. Each fragment develops into new plant.

Asexual reproduction

Zoospores: produced in sporangia. The tip of the filament enlarges. A septum separates the tip from the filament. The protoplast of sporangium contracts. It is changed into single multinucleate zoospore. Many flagella develop on the surface of zoospore. Two flagella are present opposite to each nucleus. The center of zoospore is occupied by a vacuole. The zoospore comes out through a pore. It then settles on the surface and undergoes a period of rest. Then zoospore lost flagella. Now zoospore secretes a thick wall around it. It germinates and form two or more **germ tubes** which grow to form new filaments. One of the tube acts as **hepteron**.

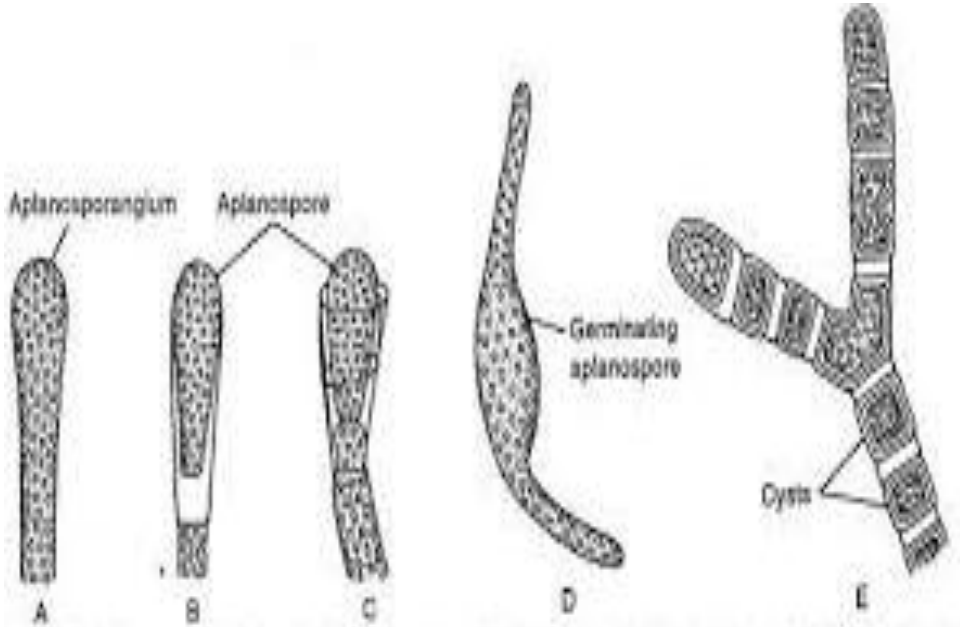


Vaucheria: Zoospore formation, liberation and germination

Aplanospore (non-motile**):** produced in terrestrial forms within **aplanosporangia** present at the tip of short lateral branches. The protoplast of sporangium is changed into aplanospore. The sporangial wall ruptures and releases the aplanospore which develops new plants by :

Direct development: In this case, aplanospore germinate to form new plant directly.

Indirect development: It occurs during extreme desiccating conditions or in low temperature. Sometimes, thin wall divides the contents of aplanospore in to many parts. Each part develops **cysts** or **hypnospores.** This stage of Vaucheria is called **Gongrosira stage** as it resembles the alga Gongrosira. The cyst ruptures in favorable conditions and protoplast comes out by amoeboid movement. This protoplast become spherical and secretes new wall. It germinates to form new filament.



35 : Vaucheria sp. : A-C. Formation of aplanospore, D. Germination of aplanospore, and E. Gongrosira stage with thick-walled cysts (akinetes or hypnospores)

Sexual reproduction (oogamous, homothallic).

The male reproductive organ is antheridia and female reproductive organ is oogonia.

Antheridium antheridium is stalked, cylindrical, tubular and hook shaped. The antheridium is club shaped. It is produced in the apex of short branches. A septum separates it from remaining filament. Antheridium forms a hook. The protoplast of antheridium is divided into many uninucleate parts. Each pan develops two lateral flagella and becomes **antherozoid.** The flagella are unequal in size which are laterally inserted and pointed in opposite directions. An apical pore is developed at the tip of antheridium.

Oogonium are produced near antheridia on the same filament. The development of oogonium starts after the development of antheridium.

Ooganium is produced from short lateral branch. These branches are present near the antheridium. A bulge is produce in the filament. A large mass of cytoplasm with many nuclei and chloroplast move into it. A septum cut off it from main branch. The oogonium swells and becomes globose. The multinucleate protoplast of oogonium is changed into single egg or oosphere. Only one nucleus is left in it as other are degenerated. A pore is produced in the wall of oogonium.

Fertilization

only one of many antherozoids fuses with the oosphere. The size of male nucleus increases before fusion. The zygote secretes thick wall and it becomes oospore.

Germination of oospore : The oospore germinates into new filament directly. First division is meiotic. Thus haploid number is restored.

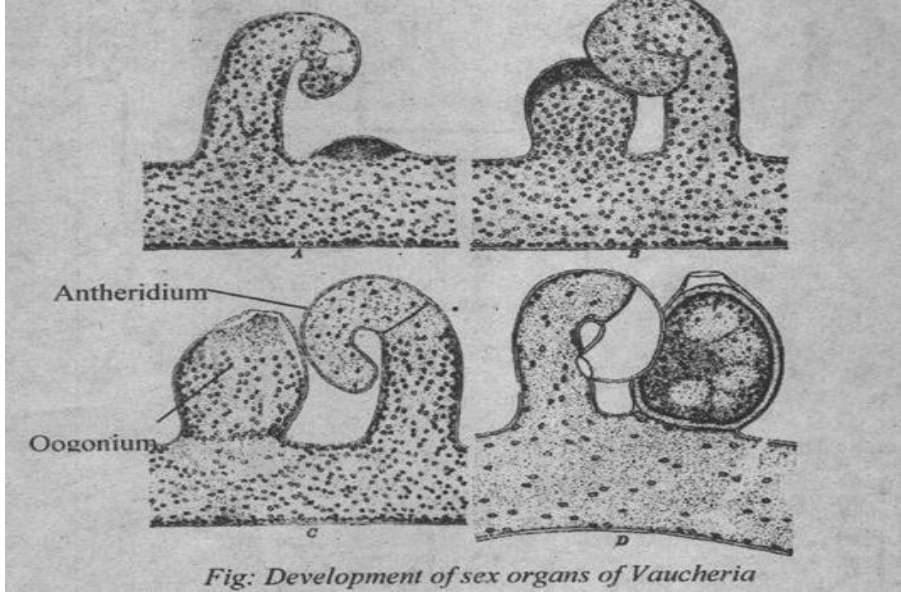


Fig: Development of sex organs of Vaucheria

All other nuclei are degenerated. A pore is produced in the wall of oogonium.