SEMESTER – I

PAPER – I

VIRUSES, PROKARYOTES, ALGAE & BIOFERTILIZERS

Unit-III: Algae:

Life cycles in Algae:

Chara,

Vaucheria,

Ectocarpus and

Batrachospermum.

CHARA

It is a submerged aquatic alga, which grows attached to the soft mud at the bottom, along the margins of fresh water pools, lakes and slow-flowing streams forming thick masses. Generally it prefers clear, fresh, hard and still shallow water. It is represented by 27 species in India. The species growing in water charged with calcareous materials become encrusted with calcium carbonate; hence it is also called as ‘***stoneworts***’.

Thallus structure

The plant body is attached in the mud by multicellular rhozoids. The individual plats generally attain a length of 20-30 cm. The thallus has a slender, flexuous upright branched main axis which is differentiated into a well-marked series of alternating short nodes and long internodes. The internode consists of a single, elongated, multinucleate and cylindrical cell, several times longer than broad. In some species, intermodal cell is surrounded by a jacket of narrow, elongated cells constituting the cortex.

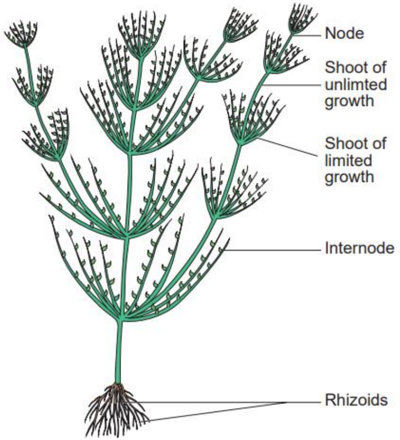


Figure 2.8: *Chara* Habit

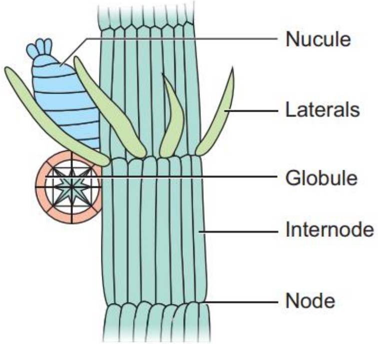


Figure 2.9: *Chara* sex organs

Half of the cortical cells investing the internode are derived from the node below. They grow in the opposite directions to form an investment around the intermodal cell. The node remains short and is made up of a cluster of several, small isodiametric cells. There are tow central cells surrounded by 6-20 peripheral cells in the cluster. From each node arise the following four types of appendages:

Branchlets or branches of limited growth

A whorl of short branches of limited growth arises from each node of the central axis. These are called as branchlets. Some authors call them primary laterals. They alternate with one another at the successive nodes. Each branchlet arises from the peripheral cell of the node which functions as its apical cell. The short brances or branches of limited growth consist of a particular species. Usually the number varies from 5 to 15. The primary laterals in turn often develop much shorter, one celled, spine-like branches called secondary laterals at their nodes.

Long branches or branches of unlimited growth

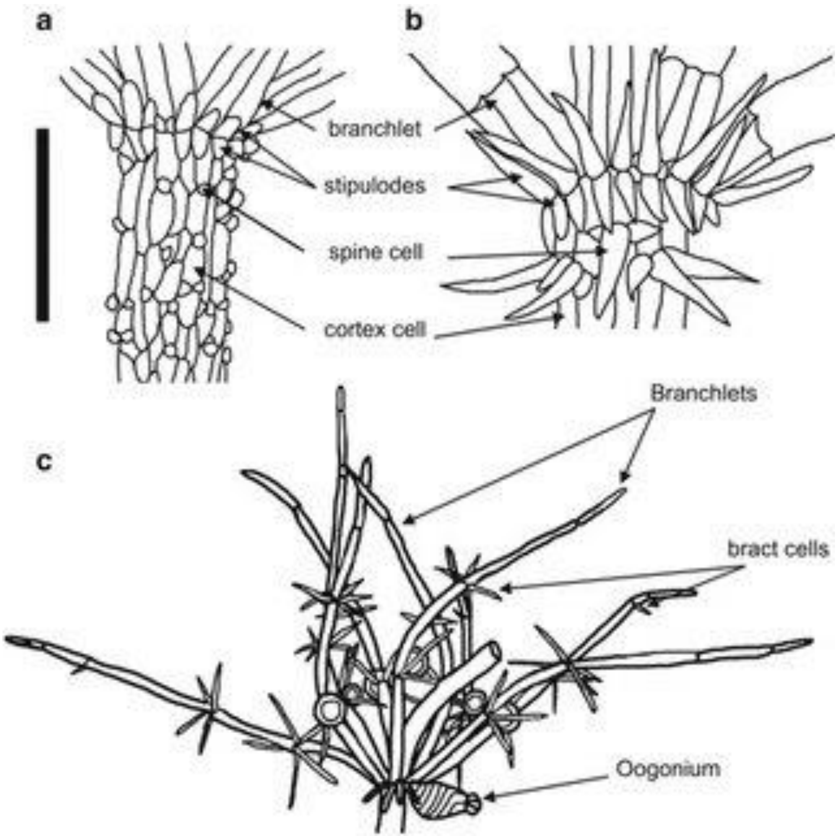
In addition, the stem node may bear one or more branches of unlimited growth. They arise usually singly at some of the older nodes of the main axis on the inner side of the oldest primary lateral in the whorl. Being apparently axillary in position they are often called the axillary branches. The axillary branches continues the growth of the thallus ans h as the same structure as the main axis. It takes its origin from the primary intermodal cell which lies below the basal node of the oldest branchlet in the whorl.

Stipulodes

These are unicellular outgrowths that arise from the basal node of each branchlet. In the majority of species of *Chara* there are two stipulodes at the base of each branchlet, one on either side. They are arranged in a single row or circle at the stem node. Such species are named bistipulate. But in some species one of the two stipulodes is absent hence they are known as unistipulate. The specie with single whorl of stipulodes are called haplostephanous while that of two whorled are called diplostephanous. In some species stipulodes are altogether absent.

Rhizoids

The *Chara*, thallus is fixed to the substratum by multicellular, branched rhizoids. The septa between the cells are oblique. The rhizoids arise from the lower nodes of the main axis and may not show any differentiation into nodes and internodes. They mainly function as organs of attachment but also take a prominent part in the absorption of salt solutes. Production of bulbils and secondary protonema are their subsidiary functions.


a
b
branchlet
stipulodes
spine cell
cortex cell
c
Branchlets
bract cells
Oogonium

Cell Structure

The nodal and unelongated intermodal young cells are small in size and have similar structure. They filled with dense granular cytoplasm which lacks conspicuous vacuoles. The single nucleus is centrally located. The numerous, small discoid chaloroplasts lacking pyrenoids are distributed evenly throughout the cytoplasm. The cell protoplast at its periphery is differentiated into a thin, delicate plasma membrane. It lines the inner surface of the cell wall. The cell wall is made up of cellulose and possesses a superficial gelatinous layer of doubtful composition. Ultrastructurally the cellulose of microfibrils embedded in a homogeneous matrix.

As the young intermodal cell elongates to the length of the mature internode, the single nucleus in it divides to form several nuclei. The mature intermodal cell thus becomes multinucleate. It is long and cylindrical about 2 to 5 cm in length. There is a single large vacuole delimited by a thin membrane, the tonoplast in the centre of the cell. It is filled with cell sap containing membrane enveloped inclusions. The cytoplasm is bounded by the plasma membrane in the mature intermodal cell. It is distinguishable into distinct zones, the outer ectoplasm and the inner endoplasm. The ectoplasm is also denoted by the term cortex or exoplasm. The ectoplasm contains *microtubules* and numerous *chloroplasts*. Ultrastructurally each chloroplast is bounded by a double membrane envelope.

Directly within and surrounded by the ectoplasm is the more fluid and less denser flowing endoplasm. It forms a thin sleeve around the large central vacuole. Several nuclei with distinct nucleoli are uniformly dispersed in the endoplasm which, in addition, contains ribosomes, mitochondria, endoplasmic reticulum, dictyosomes and many other particles. Normally the endoplasm is in constant state of rotation known as cyclosis.

Reproduction

Chara reproduces by means of vegetative and sexual methods only. Asexual reproduction by spores is entirely absent in it.

Vegetative Reproduction

It involves the separation of parent plant of various kinds of regularly produced vegetative outgrowths. Each of these develops into a new plant. the common vegetative methods are:

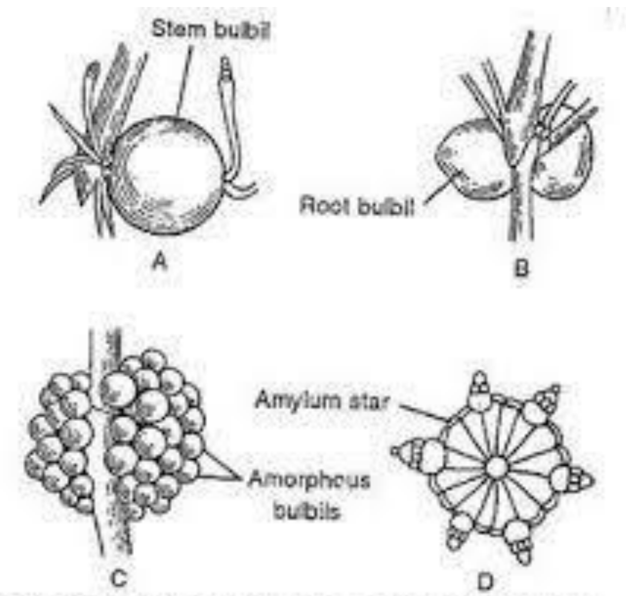


Fig. 3.93 : *Chara* sp. : A. Stem bulbil, B. Root bulbil, C. Amorphous bulbil, and D. Amylum star

Amylum stars

These are star-shaped aggregations of cells developed on the lower nodes of the main axis. The cells of the amylum stars are laden with amylum starch. The detached amylum star grows into a new plant.

Bulbils

These are small, rounded tuber-like structures developed upon the rhizoids. Unilateral stembulbils are developed on the stem nodes of some species. The bulbils are perennating bodies which carry on vegetative propagation. The detached bulbil forms a new plant.

Amorphous bulbils

These are clumps of several small cells laden with food materials. They are produced on the lower stem nodes or nodes of rhizoids as lateral outgrowths.

Secondary protonema

Sometimes naked, adventitious protonema-like branches arise from the surviving nodes of the older plants after hibernation or some of the nodes of the parent plants. They may also develop from the primary rhizoid ring or dormant apices. The secondary protonema give rise to new plants like the primary protonema.

Sexual Reproduction

In *Chara*, sexual reproduction is oogamous. The sex organs show a high degree of specialization and are for more complicated than among any other thallophytes. The male sex organ is a large, round, bright yellow or red structure. It is commonly known as antheridia or globule. The female sex organ or the oogonium is a large, oval body covered with a multicellular envelope. It is also known as nucule. In homothallic species both sex organs develop in pairs at the nodes of the primary laterals amidst the secondary laterals. The oogonium always lies above the antheridium at the same node.

Globule

It is large, hollow, spherical, bright yellow or red body about a millimeter in diameter. It is attached to the node with an inconspicuous pedicel and regularly has the oogonium above it. (**Fig. 3.**). The gobule or antheridium has a wall composed of eight closely fitting large, hollow, curved plate-like cells, known as ***shield cells*** which are filled with red or yellow pigment giving characteristic colour ot the globule. The shied cells enclose an internal cavity. From the centre of each shield cell arises a rod-shaped cell, the ***manubrium***.

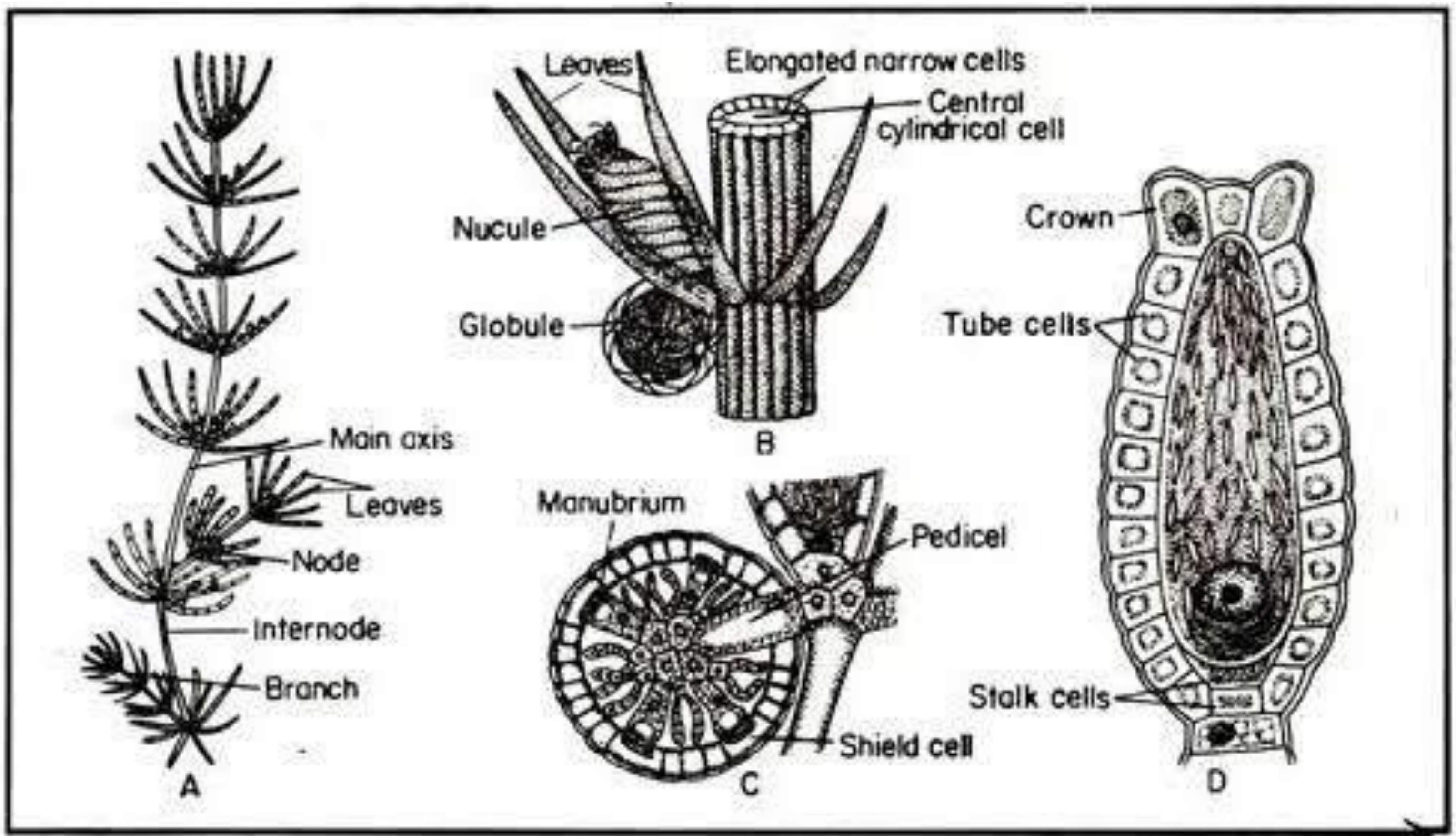


Fig 2.28. Chara Sp. A – Thallus, B, C & D – Reproductive structures – Globules (C) and Nucules (D).

The eight manubria project towards the centre of the antheridial cavity. Each manubrium bears at its inner end one or more rounded cells, known as ***primary capitula*** or head cells. Each primary capitulum cell has budded off a group of about six ***secondary capitula*** on its inner side. The secondary capitulum cells bear terminally long, whip-like, branched or unbranched, many-celled sperm producing threads called the ***antheridial filaments***. The number of cells in a fully grown antheridial filament varies from 5 to 200. Each of these small thin walled discoid cells functions as a spermatozoid mother cell. The nucleus of the spermatozoid mother cell elongates to form a spirally coiled, band shaped ***spermatozoid***. At maturity the shield cells fall apart exposing the antheridial filaments to the water. The mature sperm is an elongated spirally coiled (helical) structure with two flagella, which freely swim in water after the liberation from the male sex organ i.e. globule.

Nucule

It is a female sex organ of *Chara*, which is a large ovoid structure about 7 mm long at maturity. It consists of an oogonium containing a single egg. It is whole surrounded by an envelope of five long cells. These cells are spirally wound in a clockwise direction and form a flask-shaped protective sheath or jacket enclosing the oogonium. Each sheath cell terminates in a small erect cell. Together the small cells from a tier or a crown of five closely fitting cells capping the mature oogonium. It is the ***corona***. The protoplast of the oogonium produces a single large ovum which is packed with starch and oil. The single nucleus in the ovum lies at its base. The apex of the ovum is occupied by a colourless finely granular cytoplasm constituting the receptive spot. The presence of sheath around the oogonium in *Chara* distinguishes it from all green algae.

Fertilization

Shortly before fertilization the tube cells separate slightly from one another below the corona to form five narrow slits. Through these slits the sperms find the entrance into the sheath. One of the sperms makes its way through the gelatinized apex of the oogonial wall. It penetrates the ovum at the receptive spot and fuses with the egg nucleus.

Post fertilization changes

Oospore

After fertilization the zygote secretes a cellulose membrane and becomes an oospore. The nucleus withing the oospore travels to the upper pole. The oospore retained for a time within the oogonium external to which is the sheath. The sheath hardens to form a nut-like dark or white coloured case around the oogonium. The white colour is due to the deposition of carbonates of lime. The oospore falls to the bottom of the pond. There it germinates after a dormant period which may extend over weeks or months.

Germination of oospore

Prior to germination the investing remains of the sheath around the oospore undergo decay. The diploid oospore nucleus migrates to the apical pole. There it divides by two successive divisions as in meiosis, forming four haploid nuclei. Thus the only diploid structure in the life cycle is the oospore. At this stage, cell wall is formed which divide it into two unequal cells. The upper or the distal cell is small and uninucleate. The lower or basal cell is large and contain three nuclei. The three nuclei in the lower cell generally degenearate and the upper cell divides longitudinally into a rhizoidal initial and a protonematal initial. The two grow into knob-like structures in opposite directions. The rhizoidal initial elongates and develops into a colourless, first or primary rhizoid. The protonematal initial forms an erect green filament, the primary protonema which is composed of nodes and internodes. In this way a plant body develops from the oospore.

VAUCHERIA

The genus comprises more than 40 species, most of which occur in abundance in the temperate regions. Of these, nine species have been reported from India. The majority of the species are terrestrial or fresh water aquatics. A few species are only marine. The terrestrial forms occur during winter months frequently on damp soil and drying up of ponds and puddles. The aquatic forms are found in very shallow water of ponds and ditches or near the banks of slow flowing streams.

Thallus Structure

The thallus is composed of yellowish green, cylindrical or tubular rather coarse filaments branched at irregular intervals. In the terrestrial species the thallus is often attached to the substratum by small tufts of colourless rhizoids or a lobed hapteron. The aerial, erect green filaments exhibit monopodial branching and apical growth. Cross walls are not present to separate the cell of the filament and the branches. Thus protoplast is continuous along its entire length and extends without a break into the branches. Septa however, appear in connection with the formation of reproductive structure or sealing of an injury.

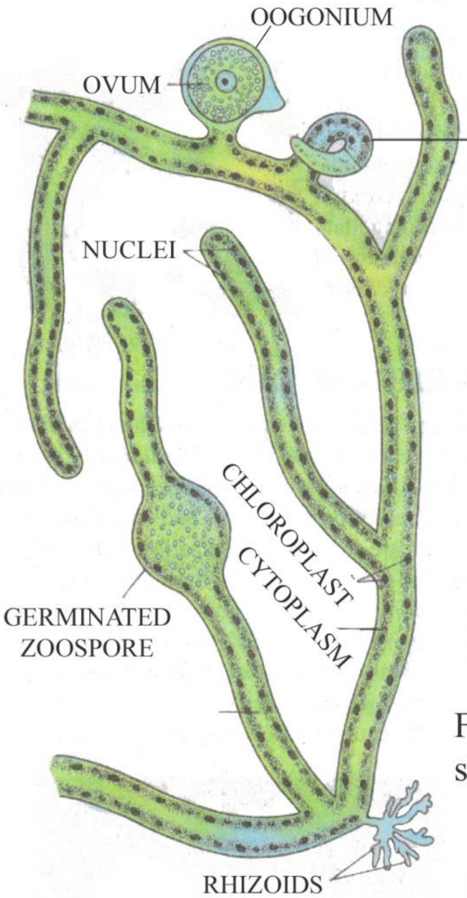


Fig : Filament showing rhizoids
and reproductive structures

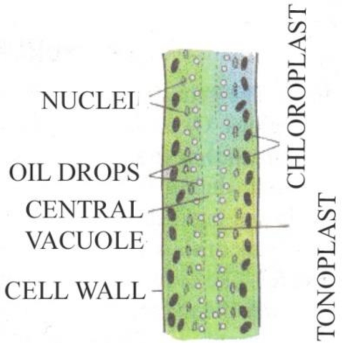


Fig : A portion of filament
showing internal compositio

Genus

Vaucheria

Tahir Shahzad (02)
B.S Botany 5th (Reg)

The filament wall is relatively thin and weak. It consists of an inner layer of cellulose and an outer of pectic substances. Close to the cell wall a thin plasma membrane is present towards the inner side which encloses the cytoplasm. The cytoplasm contains the usual membrane bound organelles such as the mitochondria, small vesicles and chromatophores. The chromatophores are numerous, very small oval, circular or elliptical arranged in an outer layer. Internal to the chromatophores contain are innumerable, minute nuclei forming an inner layer. The pigments found in chromatophores are chlorophyll *a*, chlorophyll *e*, and more than the normal amount of the carotenoid pigments and one unknown xanthophyll. The chlorophyll *b*, is absent which is the characteristic of green algae. The pyrenoids are also found to be absent in *Vaucheria*. Oil rather than starch is the principal reserve food. A large central vacuole filled with sap occupies the cnetre of the filament. The cytoplasm and nuclei, however, are not partitioned into distinct cells. Such a condition is known as coenocytic.

Reproduction

Vaucheria reproduces by all the methods; vegetative, asexual and sexual.

Vegetative Reproduction

It is secured through fragmentation in which the thallus accidently breaks up into short segments, each of which becomes thick-walled. It is, however, not common.

Asexual Reproduction

It takes place in a variety of ways depending upon the habitat in which the alga lives. In the aquatic species it occurs by the formation of zoospores. The terrestrial species form zoospores only when flooded.

Zoospores

The multiflagellate compound zoospores also known as ‘synzoospores’ or ‘coenozoospores’ are developed in this genus usually in aquatic forms. Any distal branch of the thallus may convert into a zoosporangium. Much of the food reserves, chloroplasts and nuclei accumulate in the distal end of the branch of the thallus. This distal end is comparatively swollen. Very soon septum appears at the base of this swollen end.

The central vacuole disappears, the nuclei and chloroplasts reverse their position i.e., chloroplasts shift inwards and nuclei towards periphery just beofe the cell wall. The protoplast retracts from the zoosporangial wall and opposite to each nucleus two flagella are developed.

The terminal end of the zoosporangium softens and a small pore develops. Through this small terminal aperture the zoospore squeezes out and swims freely in the water. The zoospore is ovoid or elliptical. It is multiflagellate. From each peripheral nucleus, a pair of flagella is given out. There are several chloroplasts arranged inner to the nuclei around the large central vacuole. The nuclei and then chloroplast are embedded in cytoplasm. The zoospore swims for about 15 to 20 minutes and then setttes down to some substratum, withdraws its flagella and secretes a wall around it. Very soon it germinates giving rise to 2 to 3 tubular outgrowths and a new branched thallus develops.

Aplanospores

The aplanospores develop in dry conditions and especially in terrestrial forms. Here the contents of an aplanosporangium develop into a non-motile aplanospore. This aplanospore escapes by the irregular rupture of the aplanosporangium. On the approach of favourable conditions, the aplanospore germinates producing tubular outgrowths. They may germinate after liberation or within the aplanosporangium.

Akinetes or **Hypnospores** or **cysts**

Sometimes in terrestrial species the segmentation takes place in the tubular branches forming man small compartments. Around the protoplast of each segment, a thick wall develops and theyh are called as akinetes or hypnospores. The hypnospores either germinate directly producing new thalli or they divide producing thin-walled cyst. Each cyst germinates in a special way. The cyst breaks and a pore develop at one end of it. The protoplast of this comes out in amoeboid fashion, becomes rounded and develops into a new thallus. The segmented thallus looks like an alga '*Gongrosira'* and hence this stage is called as '***Gongrosira stage***'.

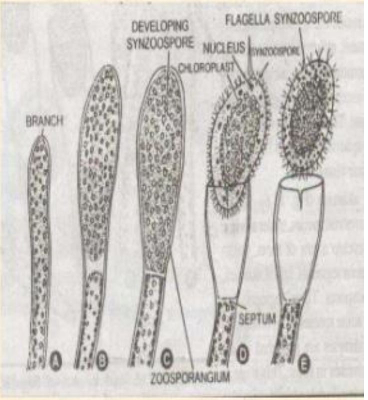
Asexual reproduction

Zoospores (synzoospres):

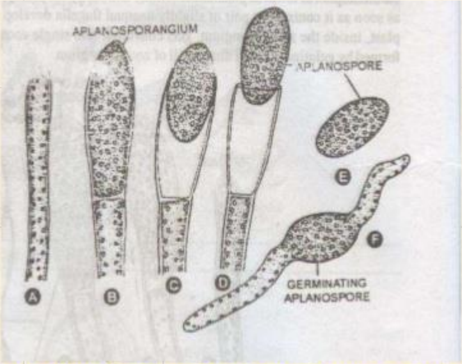
Multiflagellate & multinucleate, produced in club shaped sporangium.

During development of zoosporangium, tip portion of side branch starts swelling and becomes club shaped

Dense cytoplasm along with large number of nuclei and chromatophores flow into the swelling followed by appreance of septum.



Development & liberation of synzoospores



Development, liberation & germination of synzoospores

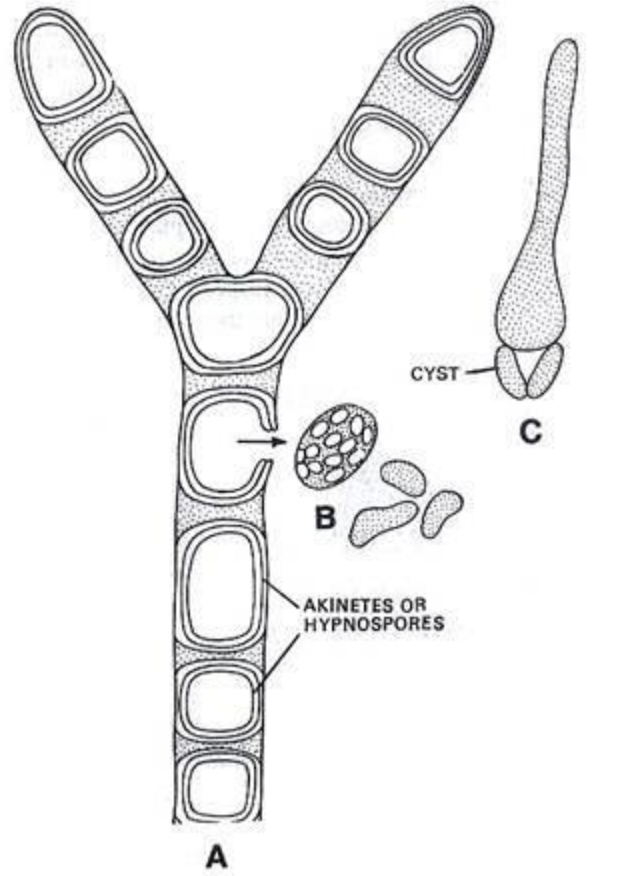


Fig. 5.5. *Vaucheria* sp. Asexual reproducion. A, formation of thick walled akinetes or hypnospores (Gongrosira stage); B, liberation of contents from hypnospore and three amoebae; C, germination of cyst.

Sexual Reproduction

The sexual reproduction is oogamous. About all the species reproduces by this method. All the fresh water species are homothallic. The sexual reproduction takes place in the forms growing in damp soil or still waters. It does not take place in running water species. In monoecious species the oogonia and antheridia develop on the same thallus and in dioecious species these organs develop on two different thalli. Here we will consider the sexual reproduction of fresh water forms i.e., homothallic.

Antheridia

Mostly the species of *Vaucheria* are protandrous, i.e., antheridia develop before the oogonia.

The antheridia develop on the lateral branches at their ends shortly before the thallus giving rise to antheridium possesses abundance of cytoplasm, chloroplasts and nuclei. In most of the fresh water species, slender hook-like antheridium develops having a pore at its distal end. A septum develops just beneath the curved portion of the antheridium. The nuclei of the antheridium divide mitotically again and again and around each nucleus cytoplasm is deposited.

Each such small bit metamorphoses in a biflagellate antherozoid. These antherozoids are liberated through the apical round opening of the antheridium. Each is spindle-like and the insertion of flagella on it is, lateral.

Oogonia

In fresh water species, oogonium develops on the same filament just near the antheridium after some time. At the time of the development of oognium, a small mass of colourless multinucleate cytoplasm is called ‘***wanderplasm***’. The wanderplasm moves in the apical part of the oogonium developed by the lateral outgrowth of the filament. Gradually the oogonium outgrowth becomes globular and sufficiently large in size. Enough of cytoplasm, many nuclei and numerous chloroplasts migrate in this young globular oogonium. A septum develops at the base of the oogonium which separates the oogonium from the rest of the plant body. A colourless beak-like structure develops at the upper end of the oogonium. All the nuclei except one degenerate and round uninucleate egg develops inside the oogonium. At maturity, the beak gelatinizes and an opening develops.

As soon as the antherozoids liberates from the apical opening of the antheridium in the morning, they approach the oogonium. Many antherozoids enter through the opening of the oogonium but only most active antherozoid penetrates the egg. The plasmogamy is followed by karyogamy. The small nucleus of antherozoid enlarges and becomes of the size of female nucleus and only then fuses with the large nucleus of the egg. After fusion, the large diploid nucleus again shifts in the centre of the zygote. The zygote secretes a multilayered wall around it and called the oospore.

Germination of oospore

The thick walled zygote (oospore) undergoes a resting period. This resting period may be of several months. On the approach of favourable conditions, the zygote germinates producing tubular structure which develops into a new thallus. Gross (1937) has given an inconclusive data of the meiotic division of the zygote nucleus during germination.

ECTOCARPUS

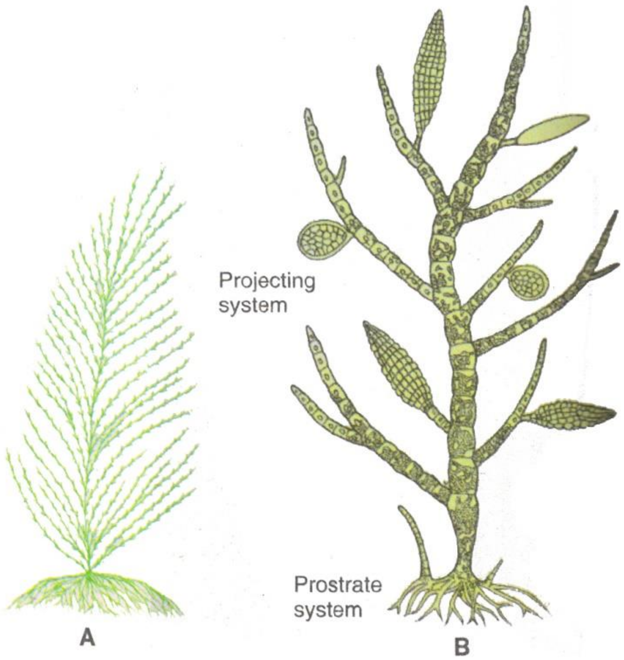


Fig (A-B) : Thallus Showing Habit.

It is world-wide in distribution and possesses many species. This is most primitive of all the brown algae. The species are commonly found in the colder seas of the temperate and polar regions. They are very common along the Atlantica coast. The plants occur attached to the rocks in the littoral and sublittoral zones. Many species are epiphytic upon the members of fucales and Laminariales. About 16 species of this genus have been reported from India. These occur motly along the East and West costs in the supra littoral zone.

Thallus Structure

The plant body is filamentous and heterotrichous. It is differentiated into prostrate and erect thalli. The prostrate portion is found attached to the substratum and remains creeping on it. The braches of the erect system of the plant are given out from the prostrate system. Comparatively, the prostrate portion of the plant is much branched than that of the erect portion. The ultimate branches of the erect portion are generally thin and pointed. The cells of the branches of the erect portion are uniseriately arranged end to end. The branching is always lateral and the branches arise just beneath the septa. In certain species the older branches are ensheathed or corticated by a layer of the branches of the rhizoids.

The cells of *Ectocarpus* are small, cylindrical, uninucleate and with a few band-shaped chromatophores of irregular shape. Sometimes the cells contain many discoid chromatophores. The cell wall is thick and consists of three pectic cellulose layers. The cell wall is mucilaginous. The protoplast is differentiated into a single nucleus and cytoplasm. Naked pyrenoid-like structures are present in the golden-brown chromatophores. The plastids contain chlorophyll *a*, chlorophyll *b*, xanthophylls and a brown pigment fucoxanthin.

Reproduction

The reproduction takes place by menas of asexual and sexual methods.

Asexual Reproduction

The asexual reproduction takes place by means of biflagellate zoospores produced within unilocular and plurilocular sporangia found upon asexual plants i.e., sporophyte, also known as diploid thalli (2*n*).

Unilocular sporangia

Plurilocular sporangia

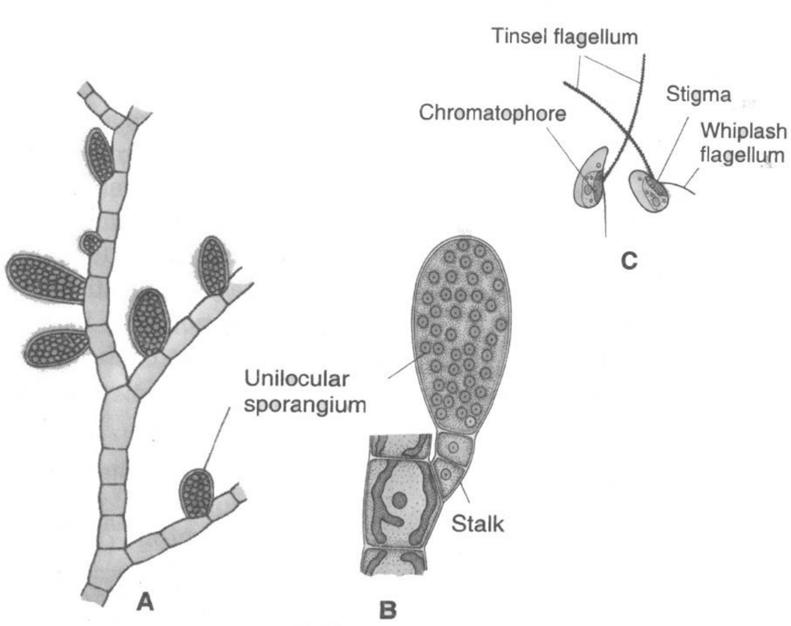


Fig : (A) A portion of thallus bearing Unilocular sporangia,
(B) Stalked Unilocular sporangia,
(C) Liberated Zoomeiospores.

Unilocular sporangia

The terminal cell of a short branchlet enlarges in size and develops into unilocular sporangia. The number of chromatophores increases within the young sporangium. The young sporangium enrage in its size. The single nucleus found within the sporangium first divides by reduction division i.e., meiosis and then redivides by mitosis and ultimately, 32 or 64 nuclei are formed. After the formation of the nuclei, there is cleavage, which results into uninucleate protoplasts. Very soon each uninucleate protoplast metamorphoses into a biflagellate, haploid (n) zoospore.

The zoospores are pyriform in shape. The two unequal flagella are laterally inserted on each zoospore. The longer flagellum is directed forward and the shorter backward. The zoospores are extruded *en masse* through a small opening found at the distal end of the sporangium. The zoospores of the mass remain inactive about for a minute and thereafter, they become motile swim here and there in the water. Ultimately the zoospores come to the rest on substratum and lose their flagella. The protoplast become round and give rise to new haploid plants.

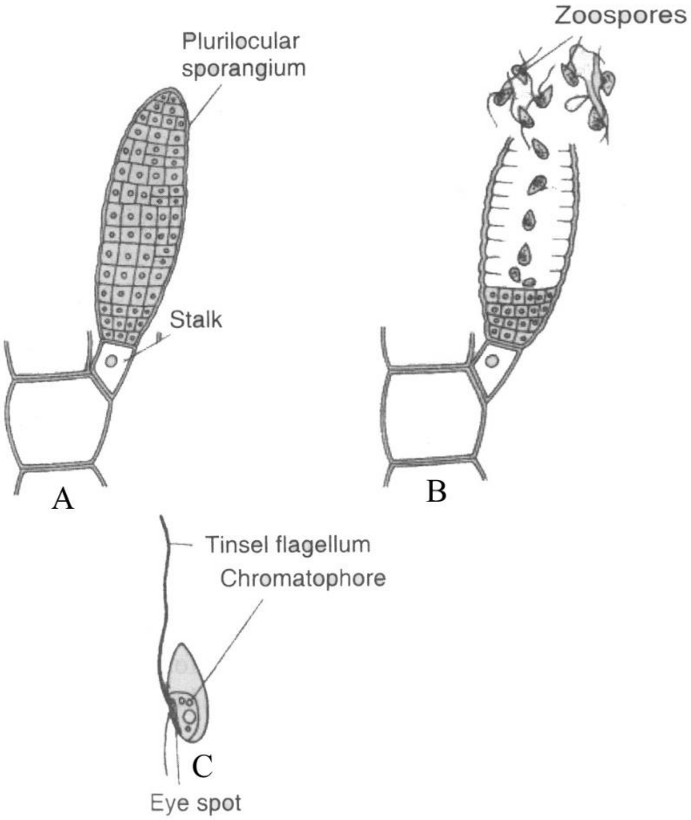


Fig : (A) Multilocular sporangium,
(B) Dehiscence of multilocular sporangium,
(C) Liberated zoospore.

Plurilocular sporangia

The plurilocular sporangium develops from the terminal cell of a lateral branchlet. This cell divides several times repeatedly producing a vertical row of 6 to 12 cells. Several other vertical and transverse divisions take place and ultimately several hundred small cubical cells are formed which are arranged in 20 to 40 transvese tiers. Ther is no reduction division. The protoplast of each diploid cubical cell metamorphoses into a biflagellate neutral zoospore. The zoospores liberate outside to the sporangium by means of apical or lateral pore. The zoospores resemble in shape to the zoospores produced by unilocular sporangia.

The zoospores swim for a short while and then settle down on some substratum, retract their flagella and directly give rise to new sporophytic ($2n$) plants. These plants once again bear unilocular and plurilocular sporangia. These sporophytic plants never produce plurilocular gametangia. The plurilocular gametangia are produced upon the plants which are developed from the zoospores of unilocular sporangia.

Sexual Reproduction

The sexual reproduction ranges from isogamy to anisogamy. Majority of the species are monoecious. The plurilocular gametangia develop from the terminal cell of a lateral branchlet. It divides several times repeatedly producing a vertical row of 6 to 12 cells. This is followed by several other vertical and transverse divisions and ultimately hundreds of small cubical cells are produced arranged in 20 to 40 transverse tiers. As already stated, gametes are produced on haploid plants which develop from the zoospores produced in the unilocular sporangia. The gametophytic plants resemble the sporophytic plants in shape but quite different in behaviour. These gametophytes bear plurilocular gametangia. The plurilocular gametangia are quite similar to the plurilocular sporangia in their shape.

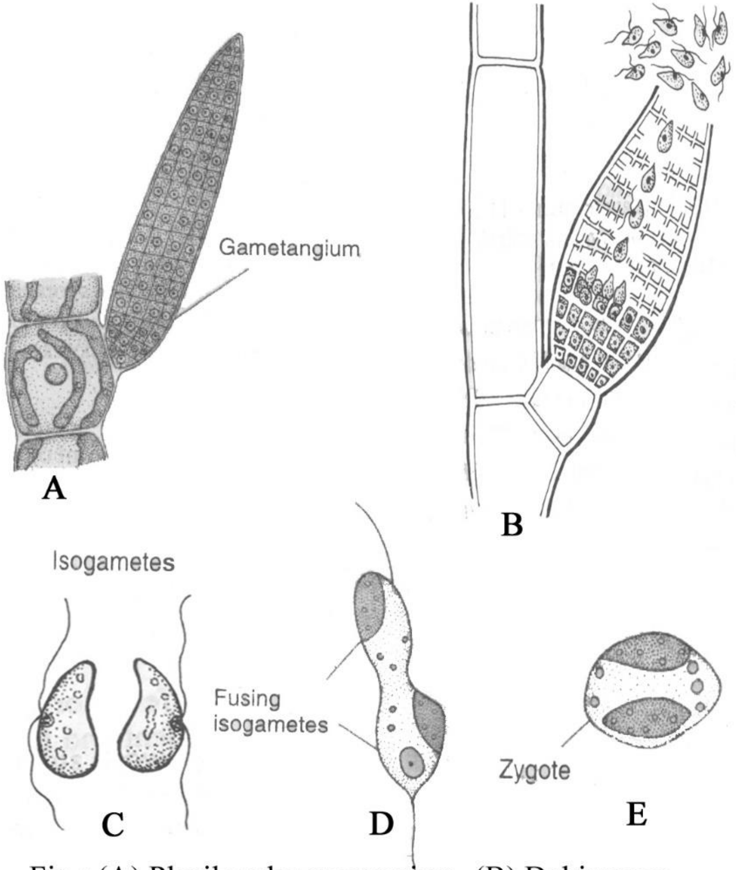


Fig : (A) Plurilocular sporangium, (B) Dehiscence of plurilocular sporangium, (C) Isogametes, (D) Fusion of isogametes, (E) Zygote.

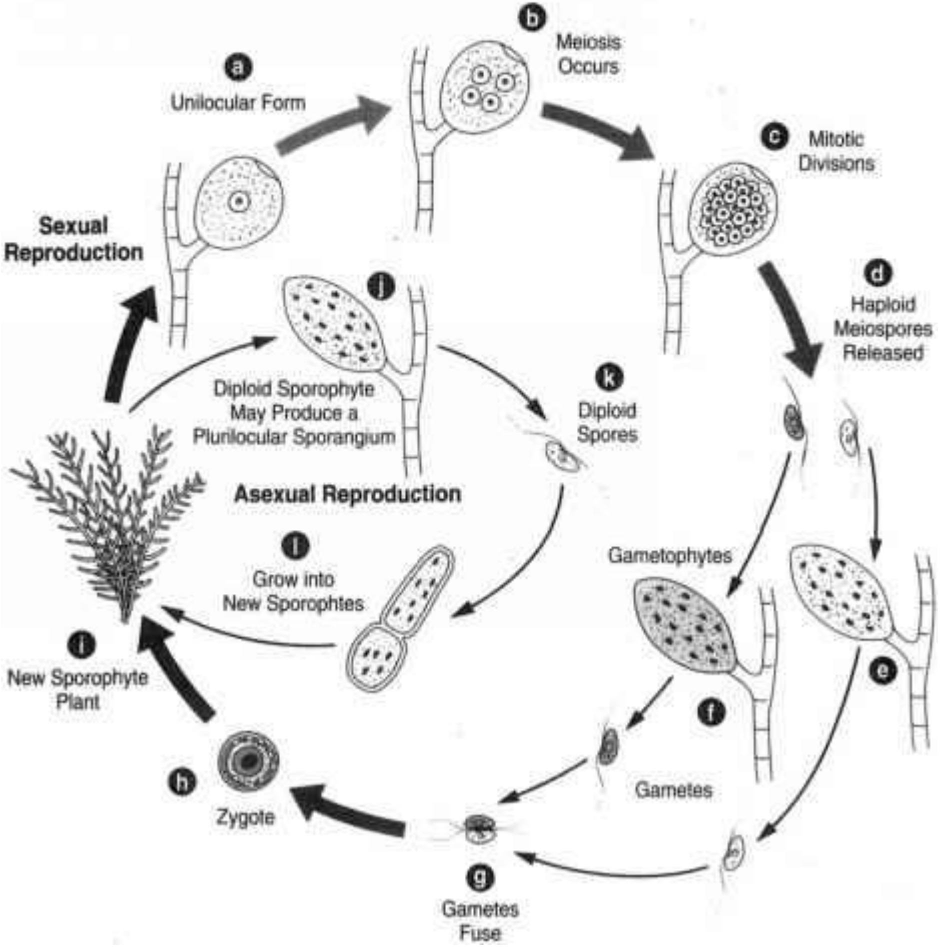
Protoplast of the cubical cells of the plurilocular gametangia metamorphoses into bilagellate gametes which liberates through an apical pore on the gametangium gradually.

Goebel reported isogamy in *E. globifera*. The fusing gametes are similar in every respect. They look alike and behave alike. Fusion occurs between isogametes coming from the same plant or even the same gametangium.

Berthold reported physiological anisogamy in *E. siliculosus*. It is dioecious. Fusion in the dioecious species occurs between gametes from different plants. The fusing gametes are morphologically identical but different in their sexual behaviour. One is less active and often called female gamete. It becomes passive and motionless after a short period.

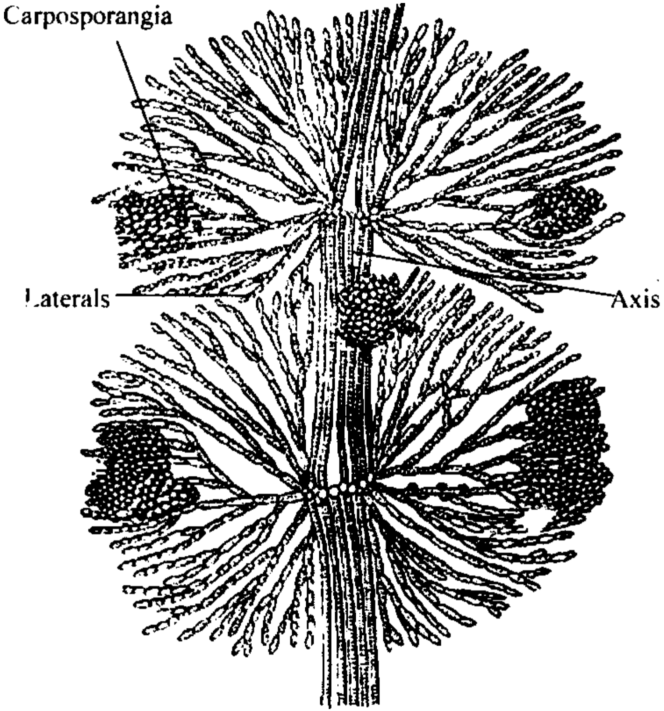
The more active male gametes cluster around female gamete and fix themselves to the body of the female gamete by the forwardly directed flagella. Finally the bodies of the two gametes fuse, nucleus with nucleus and cytoplasm with cytoplasm, to form the zygote. The remaining active gametes swim away. The clustering of the active gametes around the passive female gamete is known as '***clump formation***'. Despite the morphological similarity between the two fusing gametes there exists physiological anisogamy. The less active ones represent female gametes and the more active ones as the males.

The zygote germinates without going into a resting period. There is no zygotic meiosis. The resultant individual is the diploid sporophyte which is morphologically similar to the haploid or gametophytic plants.

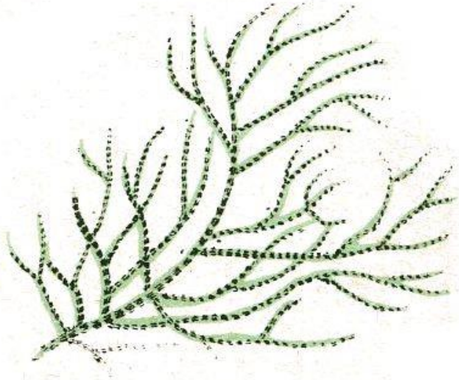

a
Unilocular Form
b
Meiosis Occurs
c
Mitotic Divisions
d
Haploid Meiospores Released
Sexual Reproduction
j
Diploid Sporophyte May Produce a Plurilocular Sporangium
k
Diploid Spores
Asexual Reproduction
l
Grow into New Sporophtes
Gametophytes
e
f
Gametes
i
New Sporophyte Plant
h
Zygote
g
Gametes Fuse

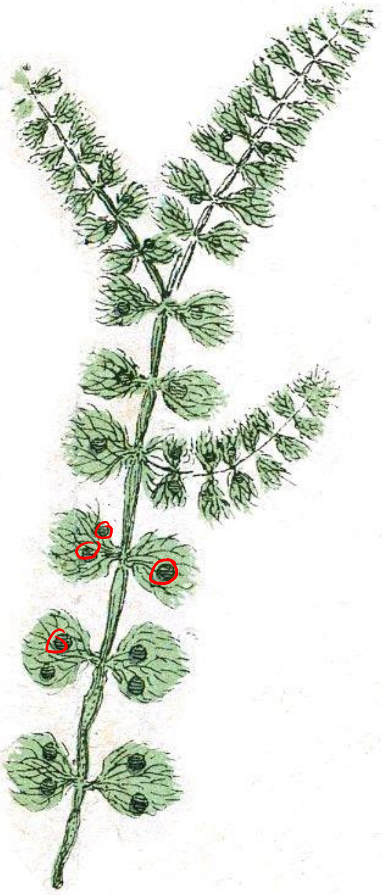
BATRACHOSPERMUM

Occurrence: This is one of the fresh water forms of Rhodophyceae. This alga is found in slow running streams and on the banks of lakes and ponds. It is more commonly found in well aerated waters. The plants are blue-green, olive-green, violet and reddish in colour. The colour varies as a result of the differences in light intensity. The species which grow in deep water are reddish or violet in colour whereas the species growing in shallow water are olive-green in colour. The alga is also known as the ‘frog spawn’. The plants are mucilaginous, moniliform or beaded in appearance to the naked eye. The plants may reach a length of twenty centimetres and may easily be collected from the slow running streams around Dehradun especially in winter season.



Structure: The thallus is filamentous, profusely branched and with a mucilaginous feel. The filament consists of only one axial filament of main axis which has been produced by a single apical cell cutting off the segments parallel to the base. This way, the central filament or main axis consists of a uniseriate row of axial cells. The main axis bears the laterals at various points on its length. These laterals are very short in comparison to the main filament. They are called the branches or the laterals of limited growth. At the nodal point just beneath the septum, usually four basal cells are formed each producing a whorl of the branches of limited growth. The laterals of limited growth possess constricted cells of moniliform or beaded appearance.





The ultimate cells of the branches of limited growth usually terminate in unicellular colourless hairs. The clusters of the laterals at nodes are called the glomerules. In addition to the numerous branches of limited growth, resemble the main filament in structure. The basal cells from which the branches of unlimited growth arise also produce filaments growing downward and ensheathing the main axis. They are called corticating filaments and they form the pseudocortex.

The cell wall of each cell is two layered. The outer layer consists of pectin and the inner one of the cellulose. The cells are uninucleate. Each cell contains many (more than one) parietal chromatophores. The cells of Batrachospermum do not have pit connections which are common in the other members of Florideae. Each chromatophore contains single pyrenoid. Reproductive methods: The reproduction takes place by means of sexual and asexual methods. Sexual reproduction: The sexual reproduction is advanced oogamous and takes place by means of male and female sex organs known as antheridia and carpogonia respectively. The plants may be monoecious or dioecious.

Development of antheridium: The antheridium develops from an uninucleate, colourless antheridium mother cell. From each antheridium mother cell one to four antheridia are developed. The antheridia are produced in clusters at the apical points of the short laterals. In the beginning they appear as protuberances arising sub terminally and successively from different sides of the mother cell. Later on, the small protuberances sub terminally become spherical.

Each antheridium contains a single spermatium on its maturity. The non-motile, spermatium liberates through a slit formed in the wall of antheridium. The spermatia remain floating in the water. In Batrachospermum, the nucleus divides into two as soon as it contacts the trichogyne. So at the time of the fertilization spermatium contains two nuclei and sometimes known as spermatium complex.

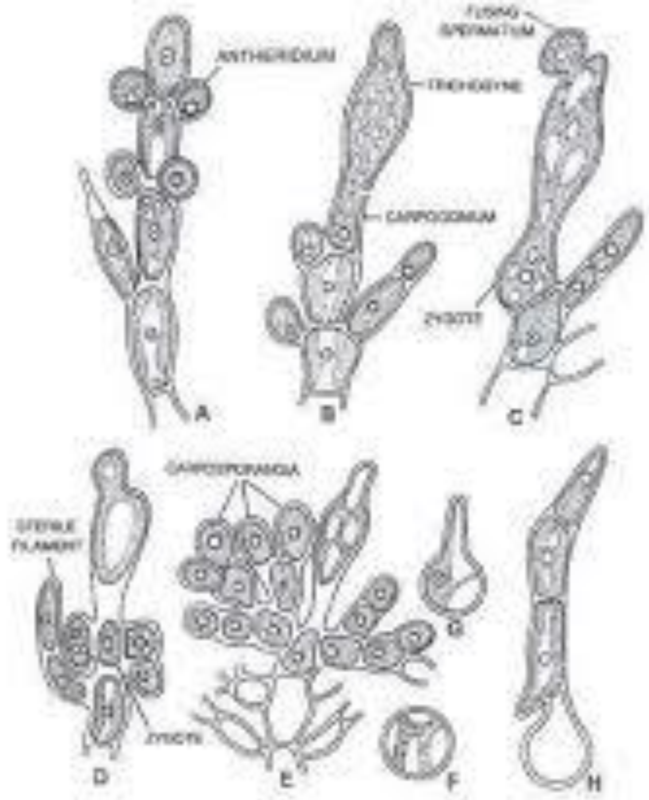


Fig. 7.8. Batrachospermum. A, antheridial branch with globular antheridia; B, carpogonial branch with carpogonium; C, fusion of trichogyne with spermatium; D and E, germination of zygote and formation of carposporangia; F, carpospore; G, germination of carpospore; H, Chantransia Stage

Development of carpogonium: The carpogonia develop on the terminal ends of the short laterals. The terminal cell of the lateral divides into four cells. The uppermost cell develops into the carpogonium. The carpogonium consists of a swollen basal portion which contains an egg and known as carpogonium and an elongated receptive part, the trichogyne. The carpogonium is flask-like. In the majority of Florideae the cytoplasm of the carpogonium is colourless, but in Batrachospermum it bears a pale plastid. Fertilization: The non-motile spermatia float in the water. Many spermatia approach the trichogyne. One of the spermatia attaches itself to the trichogyne. The wall of contact dissolves and one of the two nuclei of the spermatium passes through this hole into the trichogyne, reaching in the basal swollen part of the carpogonium where it fuses with the female egg and develops into the zygote. Thereafter the trichogyne shrivels down upto the constriction in between trichogyne and carpogonium. Simultaneously a cross wall develops at this juncture.

Germination of zygote: The diploid nucleus of the zygote divides meiotically producing two haploid nuclei. Thereafter one of the two nuclei migrates into the lateral protrusion of the zygote. A wall separates this protrusion from the rest of the zygote and this way the gonimoblast initial is formed, other daughter nucleus divides repeatedly several times, forming a large number of gonimoblast initials. The gonimoblast initials divide again and again and a gonimoblast filament develops from each initial.

The gonimoblasts become branched and terminal cells of these develop into carposporangia. Each carposporangium produces a single rounded, haploid carpospore. The structure having gonimoblast filaments, carposporangia and carpospores is known as cystocarp or carposporophyte. At maturity of the carposporangia, the walls split off and the carpospores are liberated. Each carpospore gives rise to the juvenile branched filamentous body. The juvenile form of Batrachospermum resembles an alga known as Chantransia, and therefore, known as the Chantransia stage. The terminal cells of these plants act as apical cells and develop into new Batrachospermum plants. Asexual reproduction: In several species of Batrachospermum the short branches of the filaments of Chantransia stage produce monospores. These monospores again produce Chantransia stage, and again the apical cells of this stage produce new plants.

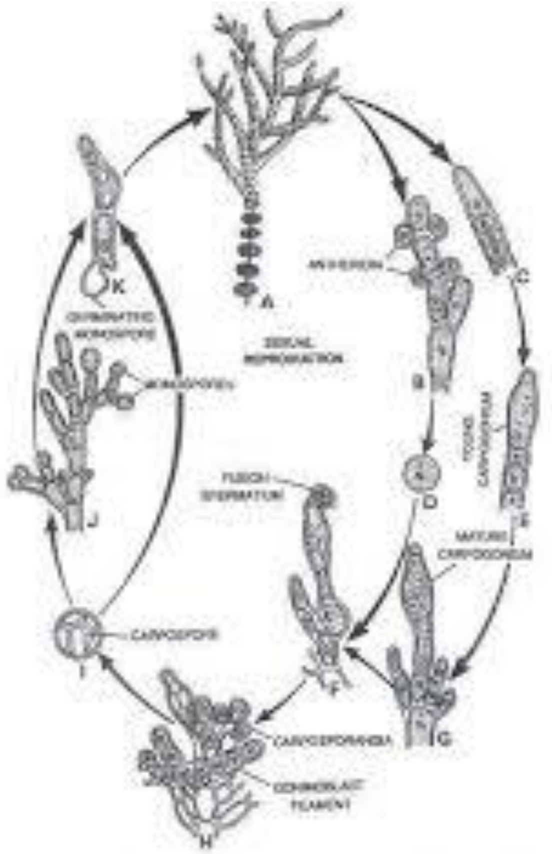
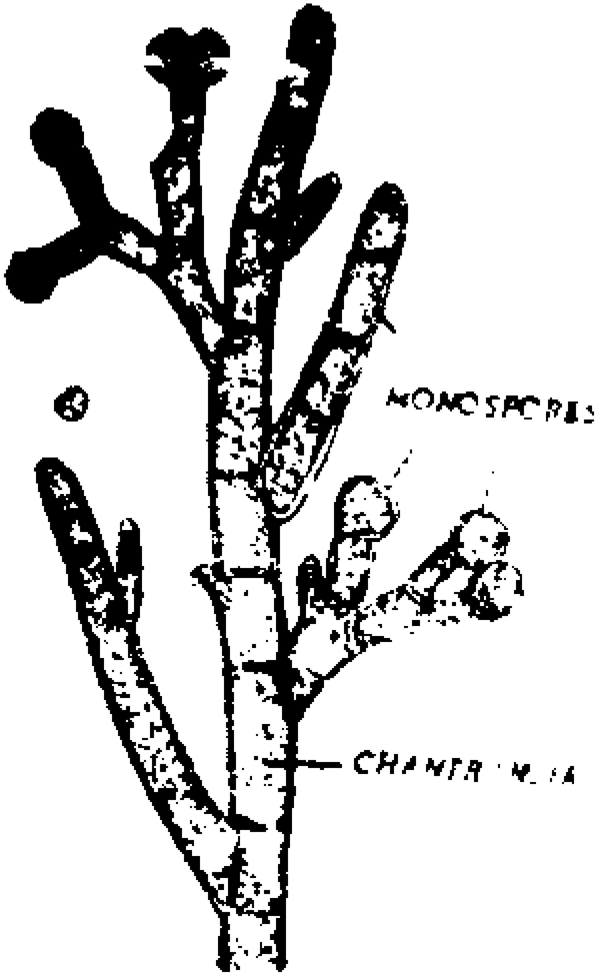
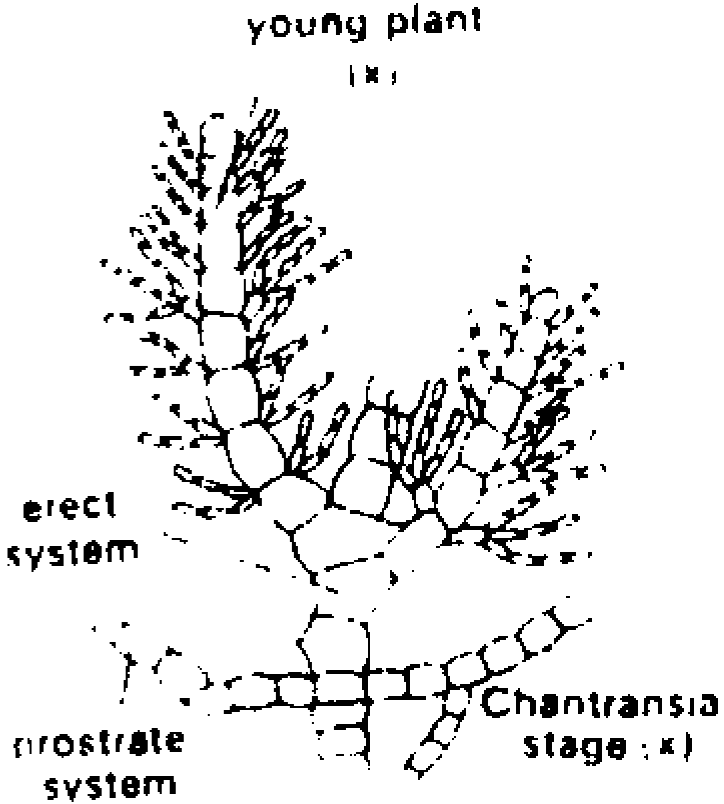


Fig. 7.8. Batrachospermum. Life-cycle. A, a portion of plant; B, antheridial branch with antheridia; C and E, formation of carpogonium; D, spermatium; E, young carpogonium; F, fusion of spermatium; G, mature carpogonium; H, carposporophyte; I, carpospore; J, Chantransia stage producing monospores; K, germinating monospore


MONOSPORES


young plant
erect system
prostrate system
Chantransia stage

THE END