Pinnularia

Class: Bacillariophycaea
Order: Naviculales
Family: Pinnulariaceae
Genus: Pinnularia

Occurrence: fresh water alga found in pond and also on the moist soil, unicellular.

Cell wall: Its cell is elongated and elliptical. Cell wall is chiefly composed of **pectic** substances. **Silica** is impregnated in it. Therefore, their wall becomes very hard and has mucilage. wall is composed of two halves called valves.

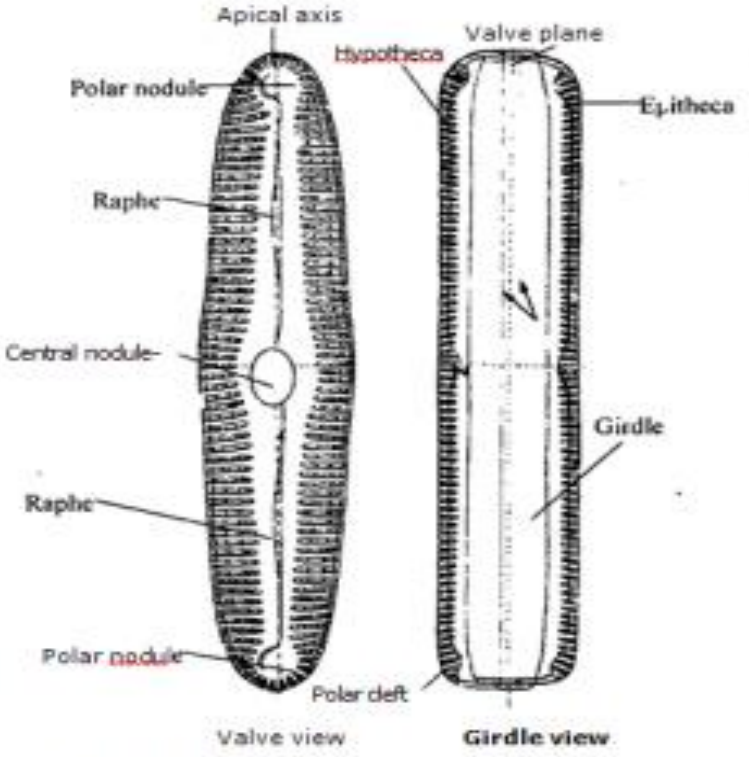
These halves overlap like Petridish. The margins of the two valves are covered by a connecting band called **cingulum.** The two valves with their inner protoplasts are called **frustule**.

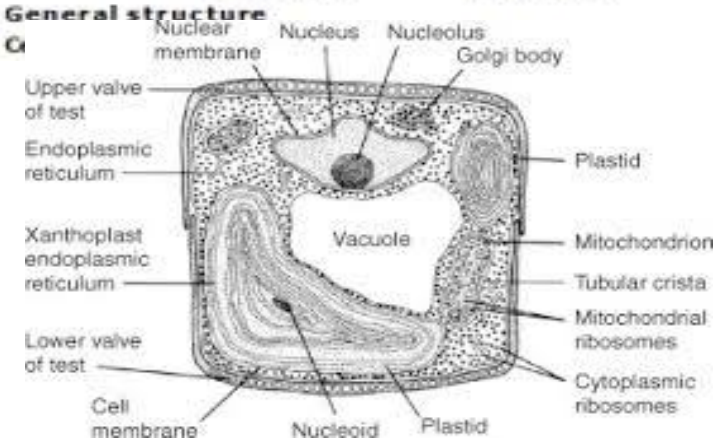
The frustule has two views. The surface view is called valve **view** and band view is called **girdle view.** The outer larger valve is called **epitheca.** The smaller inner valve is called **hypotheca.** The surface of valve has minute pores or pits. It produces characteristic markings on the surface of valves. These markings are bilaterally symmetrical. The marking free area is called **axial field.** The markings are arranged in linear rows. The axial field contains a longitudinal slit called **raphe.** The raphe is not continuous throughout the length of the valve. The raphe is wedge shaped in transverse section. It has circular thickening called **central nodules** in the centre. Similar thickening also present at the outer ends of raphe. These are called **polar nodules.** These nodules open to the external aqueous medium.

Cytoplasm is arranged in parietal layer. It is called **primordial utric1e.** A large central vacuole is present inside the cell. Single nucleus is suspended in the center of vacuole by transverse cytoplasmic bridge. Two chloroplasts are present along the two sides of the cells. They contain chlorophyll a, c, beta-carotene and **diatomin or fucoxanthin** pigment. Fucoxanthin gives the alga characteristic color. One or two pyrenoids are present in the chloroplast. But they do not synthesize starch.

Food stored: Their storage compound is oil or **chrysolaminarin.**

Locomotion: It moves by chmacteristic gliding movements. Circulation of the streaming cytoplasm within the raphe causes this movement. Mucilage helps in this gliding.





Reproduction

Vegetative reproduction

It is the most common method of reproduction. It produces daughter cells slightly different in sizes. Vegetative reproduction in diatoms occurs by simple cell division. The protoplast expands. It causes slight separation of epitheca and hypotheca. Nuclear division occurs by mitosis and cell divides into two parts. Each half receives one half of the parent cell. It synthesizes new valve. New valve is fit into the parent valve. Thus new valves are always smaller than the parent halves. Thus one generation gradually become smaller in size. It reacted to minimum size. Then its size is restored by **auxospore formation**. But 2nd generation remains of same size.

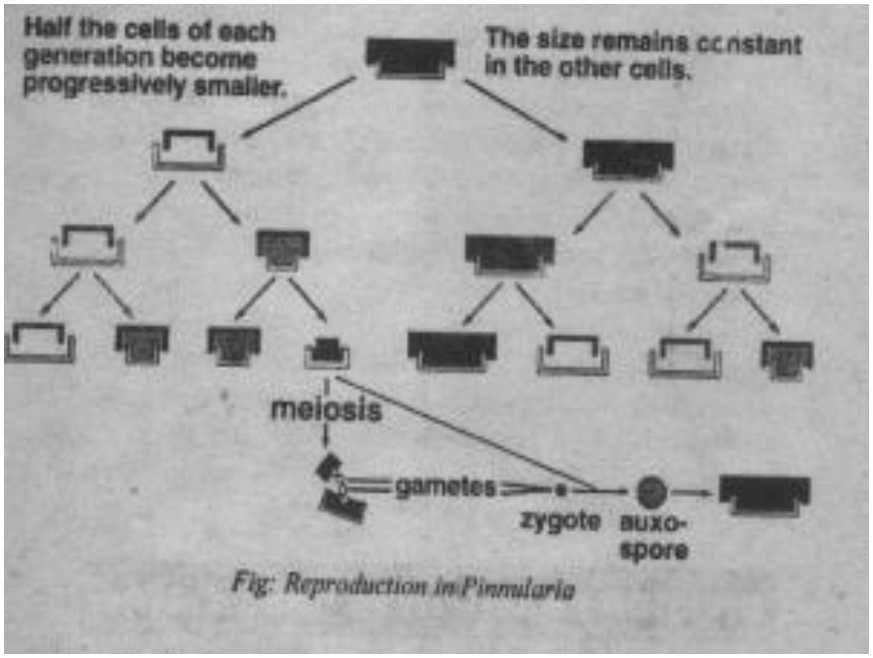
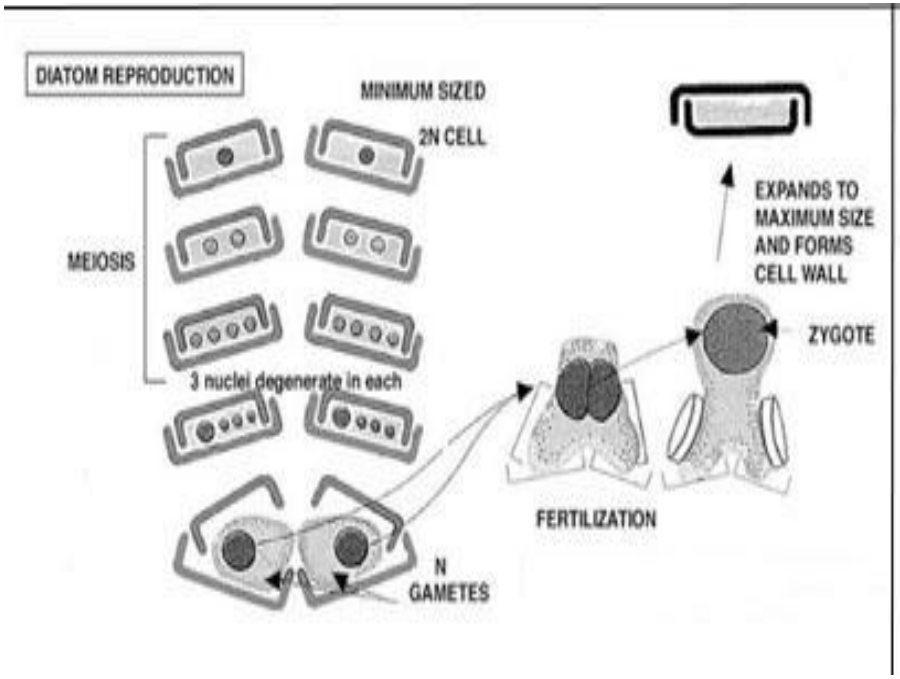


Fig: Reproduction in Pinnularia

Sexual reproduction (Auxospore formation)

Gamete formation: In some spp of Pinnularia, two cells from common parent or different parents envelope in a common mucilaginous sheath. The nuclei of both cells divide by meiosis to form four nuclei. Three nuclei disintegrate. The fourth one enlarges. Its protoplast metamorphosed into gamete. The gametes are liberated from the parent frustules. They fuse to form zygote. The zygote enlarges to form auxospore. The auxospore secretes new valve and become adult.



Parthenogenesis: The protoplast of cell secretes a large amount of mucilage. Therefore, two valves are separated from each other. It separates the inner protoplast. The protoplast grows to its maximum size. It secretes silica rich pectic membrane. New valves are secreted inside the membrane. Nuclear division does not occur. Therefore, auxospores are formed by parthenogenesis.

Ectocarpus (Brown algae)

Class: Phaeophycaea
Order: Ectocarpales
Family: Ectocarpaceae
Genus: Ectocarpus

It is a marine brown alga, distributed throughout the temperate and tropical seas of the world.

Plant body is filamentous, much branched and heterotrichous, having basal rhizoids and well-developed branched erect system.

The prostrate system is profusely branched and attached with the substratum. Some species develop multicellular hairs from the prostrate system. The prostrate system serves the function of anchorage with the substratum or on other plants and the erect system is photosynthetic and bears reproductive organs. The apical part of each filament generally terminates into hairs.

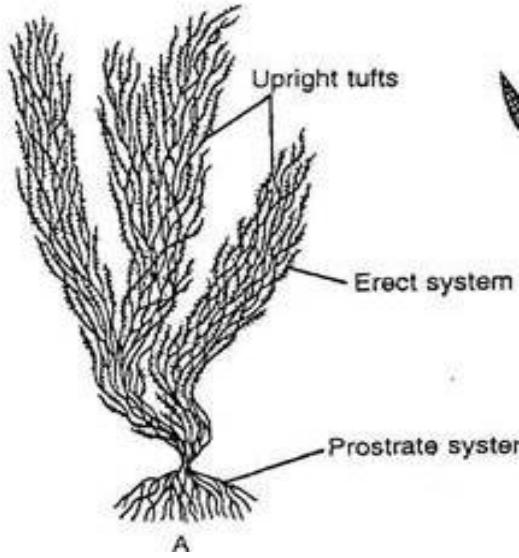
Two types of plant bodies are differentiated genetically, one is haploid and other one is diploid. Both haploid and diploid plants are morphogically identical.

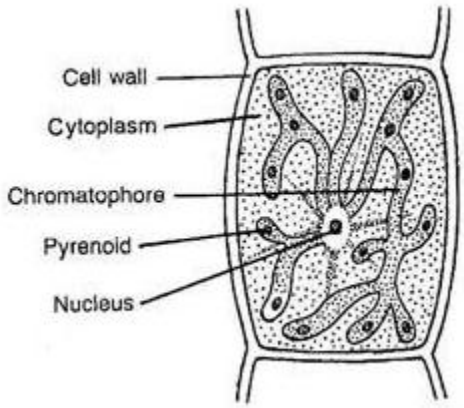
Cell Structure The cells are rectangular or cylindrical. Cell wall is differentiated into **outer pectic** and **inner cellulosic** layers. The characteristic gelatinous substance present in the cell wall is composed of algin and fucoiden. Inner to the wall, cell membrane is present which encircles the protoplast.

The protcplast contains one **central nucleus** and many chromatophores. The number and shape of chromatophore varies with species. They may be ribbon-shaped, band-shaped, discoid etc. and are associated with pyrenoids.

The photosynthetic pigments are chlorophyll a, chlorophyll c, β-carotene and fucoxanthin. The **fucoxanthin** masks the chlorophyll and gives the characteristic brown coloration.

The cytoplasm contains many vacuoles, which are called physodes. Morphologically, haploid and diploid vegetative filaments are almost alike, but the cells of haploid filaments are comparatively shorter in length than the diploid filaments.





Asexual Reproduction:

It takes place by zoospores. The zoospores are biflagellate having one whiplash and other tinsel-type of flagellum. The diploid plant (2n) develops two types of sporangia. unilocular sporangia and plurilocular or neutral sporangia. The unilocular sporangia develop haploid zoospores (zoomeiospores) & plurilocular sporangia develop diploid zoospores.

Unilocular Sporangia: The unilocular sporangia develop from the apical cell of short lateral branches. The cell enlarges and functions as sporangial initial. The diploid nucleus of the initial first undergoes meiosis followed by several mitotic divisions, thus **32-64 haploid nuclei** are formed. These nuclei accumulate some cytoplasm and develop individual units. Each unit metamorphoses into a pyriform, uninucleate, biflagellate zoospore also called **zoomeiospor**e. The flagella are unequal and laterally inserted. During liberation the apex of the sporangium wall gets dissolved and the haploid zoospores are liberated in a gelatinous mass. After some time they get free from the gelatinous mass and swim freely in water. They remain motile for about 30 minutes. On contact with suitable substratum, the zoospore withdraws its flagella and forms a new cell wall around it. Within short time a germ tube is formed, which divides many times and form prostrate filament. Some cells of the prostrate filament become active and form erect filaments. Thus the plants developed on germination of haploid zoospores (zoomeiospores) are **gametophytic**.

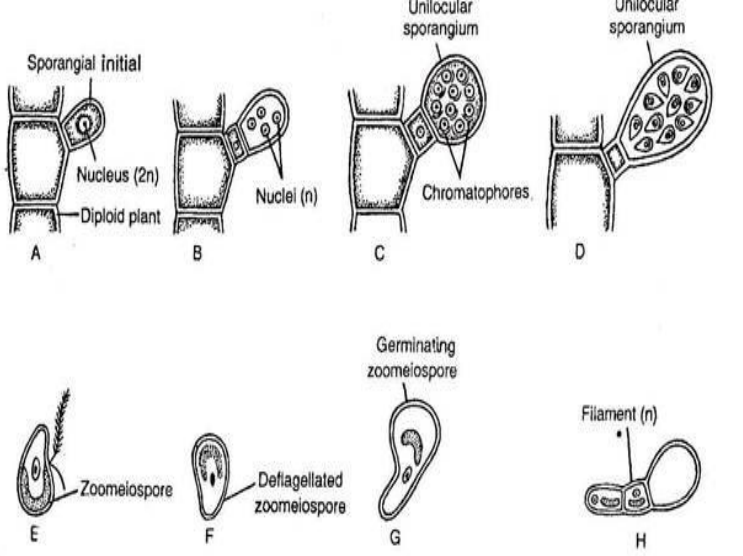
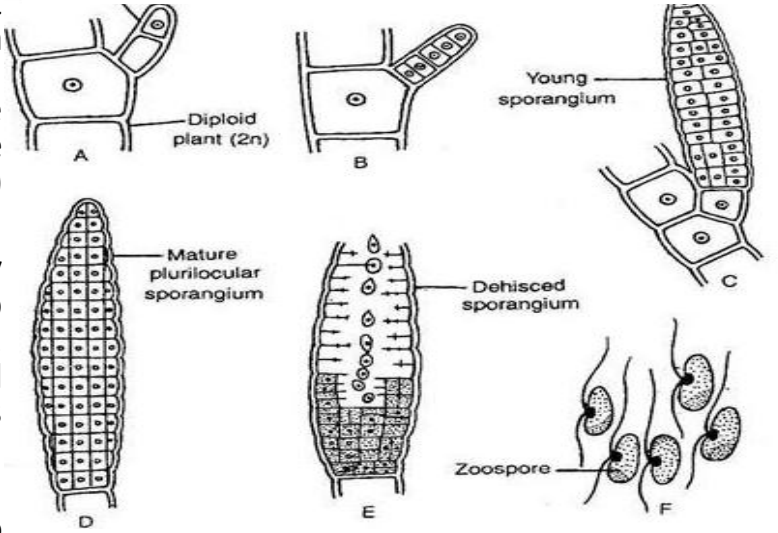


Fig. 3.111 : *Ectocarpus* sp. : A-D. Development of unilocular sporangium, E. Zoomeiospore, F-H. Germination of Zoomeiospore



Plurilocular Sporangia: These are elongated, multicellular body developed on diploid (2n) i.e., sporophytic plant body They develop initially like the unilocular sporangia, at the tip of short lateral branches. The apical cell enlarges and functions as sporangial initial. This sporangial initial becomes enlarged and undergoes repeated mitotic division, thus 6-12 cells are formed. The cells are arranged in vertical row.

The cells then undergo several vertical divisions thus a multi- chambered structure is formed i.e., the plurilocular sporangium. There is no reduction division during the formation of zoospore in plurilocular sporangium. So, each small cubical cells of plurilocular sporangium contains single diploid nucleus. Each unit then metamorpho se into a single, uninucleate (2n) and biflagellate zoospore.

. The zoospores formed from plurilocular sporangia are alike with the zoomeiospores developed in unilocular sporangia but are diploid. The zoospores of plurilocular sporangia liberate through apical or lateral aperture and on germination they produce the sporophytic (2n) plant

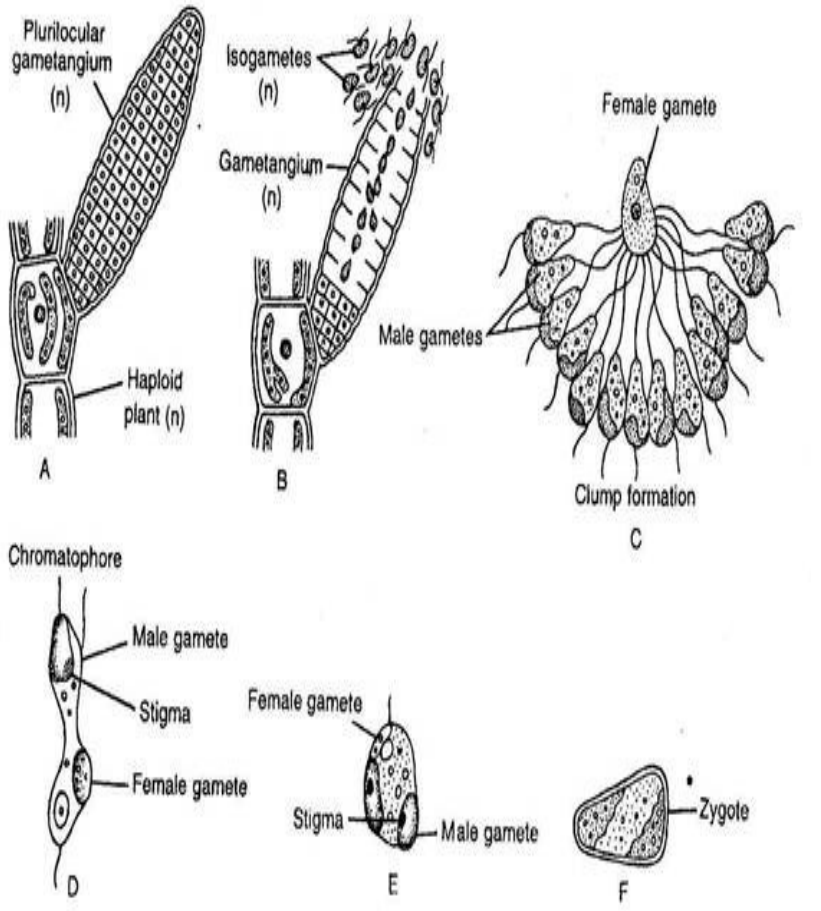
Sexual Reproduction: isogamous and anisogamous type. Anisogamy is very common. morphological anisogamy and physiological anisogamy . The gametes are produced inside the plurilocular gametangia, developed on haploid plants.

Plurilocular Gametangia: large, elongated, sessile or short stalked, multicellular structures. Morphologically, both plurilocular gametangia and plurilocular sporangia are alike. The plurilocular gametangia produce haploid gametes; on the other hand plurilocular sporangia produce diploid zoos-pores. Though both are morphologically more or less alike, the gametes are slightly smaller in size than the zoospores. The development of plurilocular gametangia is alike with the development of plurilocular sporangia. The gametes are liberated from the gametangia following the same procedu - re as that of zoospore liberation from the plurilocular sporangia

Fertilisation: In physiological anisogamy both the uniting gametes are morphologically similar but in morphological anisogamy female gamete is larger than the male gametes.

During fertilization, many male gametes encircle the female gamete and get entangled by the anterior large flagellum. This stage is called clump formation . Out of many, only one male gamete fuses with the female gamete and the remaining gametes go astray and gradually get destroyed.

The uniting gametes then form zygote through plasmogamy and karyo- gamy.



. 3.113 : *Ectocarpus* sp. : A. Portion of gametophytic (n) plant with plurilocular gametangium, B. Liberation of gametes from gametangium, C. Male gametes around a female gamete before fertilisation (clump formation), D-E. Fusion of male and female gametes and F. Zygotes

Germination of Zygote

The zygote undergoes germination without any reduction division and rest. On germination it develops into a sporophytic (2n) plant. The sporophytic plant again develops unilocular and plurilocular sporangia.

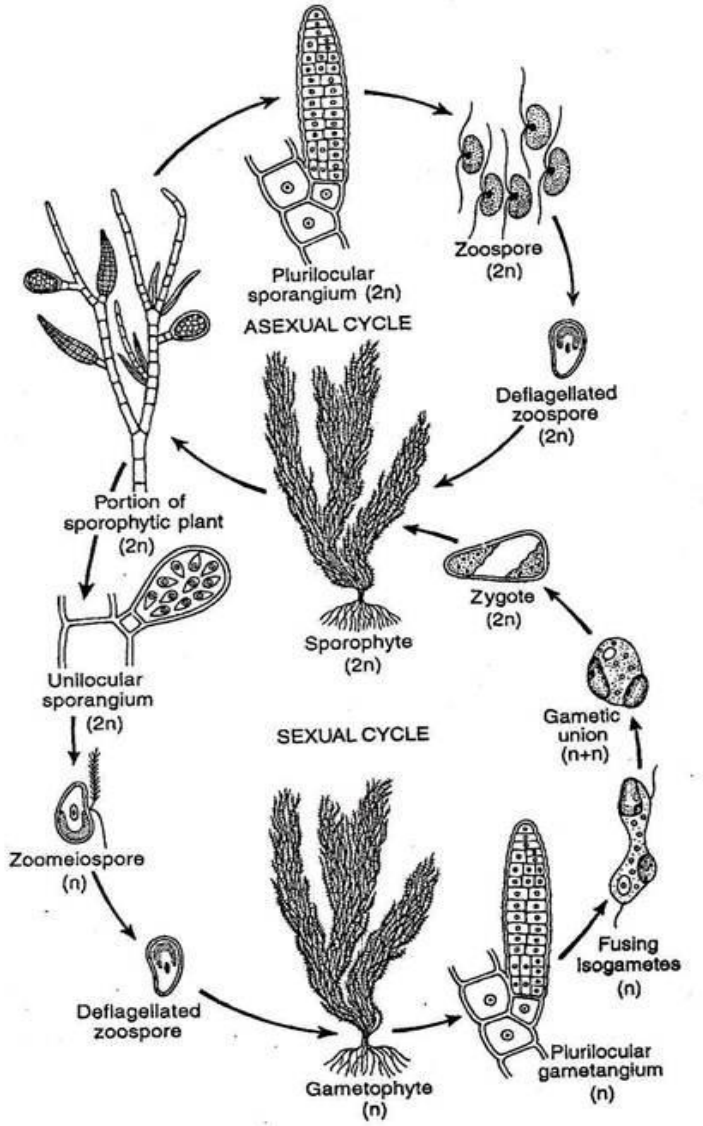


Fig. 3.114 : Life cycle of *Ectocarpus* sp.

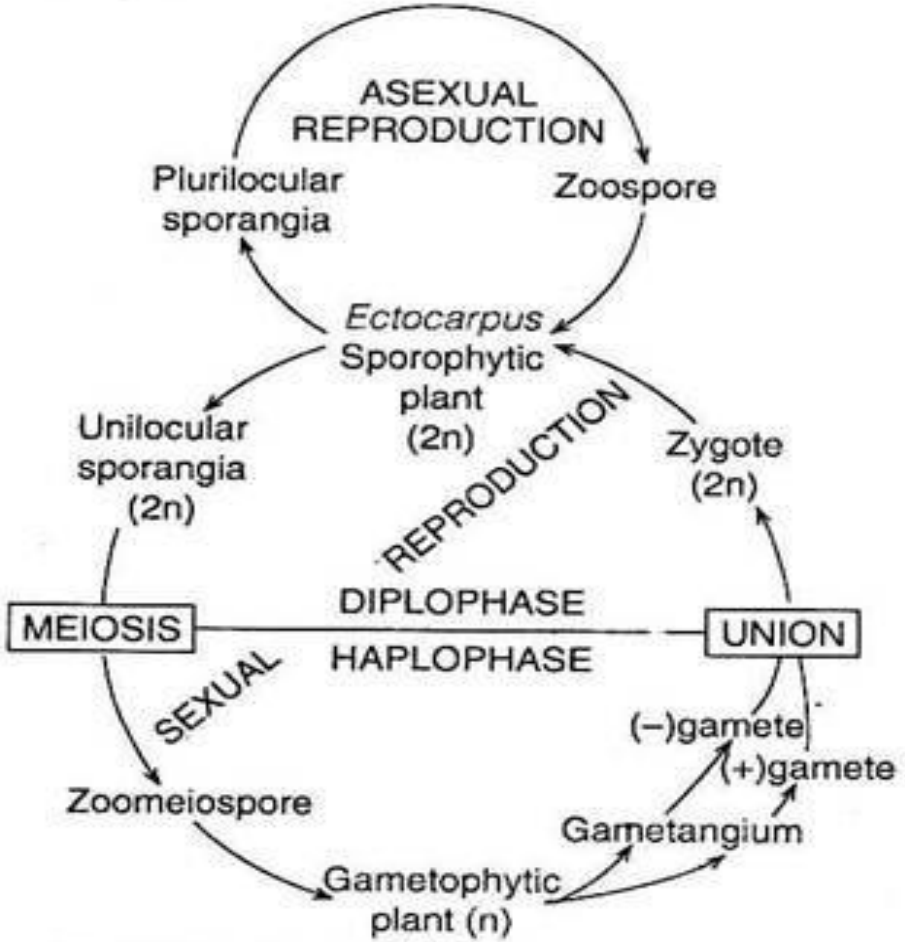


Fig 3.115 : Graphic life cycle of *Ectocarpus* sp.

Batrachospermum

Phylum: Rhodophyta
Class: Florideoophycaea
Order: Batrachospermales
Family: Batrachospermaceae
Genus: Batrachospermum

Occurrence: fresh water alga found in clear, cool and running streams. Deep water plants are dark violet or reddish in color. But the shallow water species are olive green. The intensity of light changes the color of pigments. The thallus is attached to the substratum.

Vegetative structure

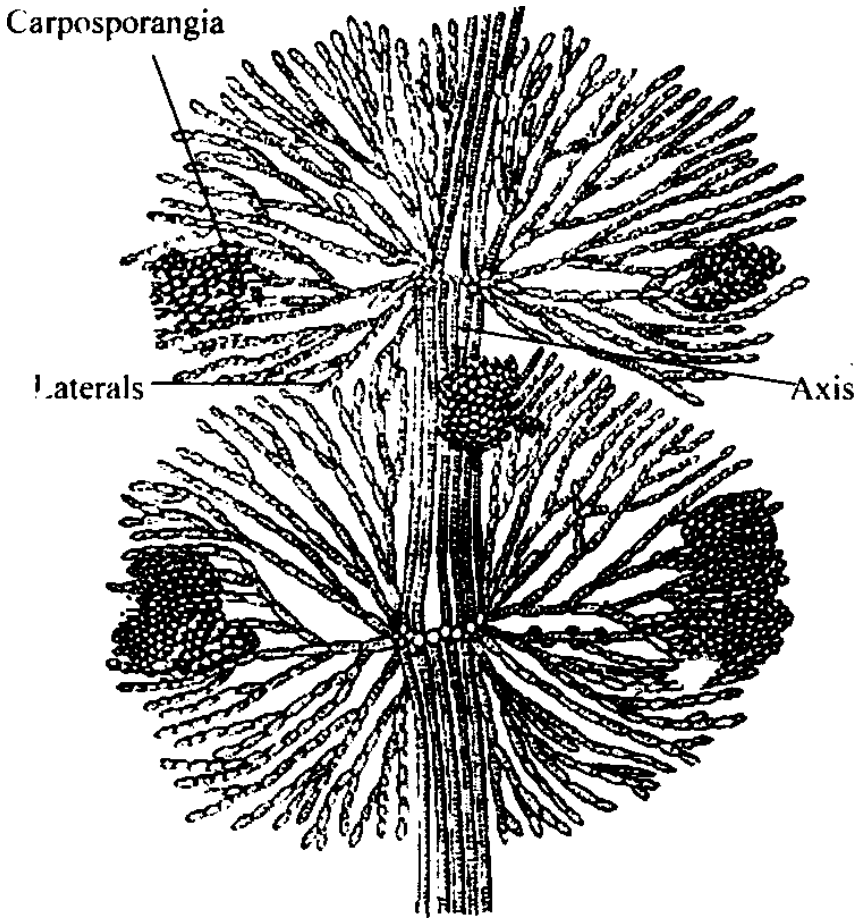
Thallus is soft, thick, filamentous. It is freely branched and gelatinous. The central axis is made up of single row of large cell. Whorls of branches of limited growth are developed on this axis. These branches are filamentous and dichotomously arranged. The main axis is corticated. It consists of a row of **elongated** cylindrical cells. It is differentiated into nodes and **internodes.**

Branches of limited growth: These arise in whorls from the nodes. These grow for sometime, and then these end in long hairs. Their cells arranged like beads. All of the branches of a whorl are equal in length. Therefore, they form globose structure cal led **glomerule.**

Branches of unlimited growth: These are also differentiated into nodes and intemodes and are corticated. Branches of limited growth arise from their nodes. Their cells are comparatively longer.

Cell structure The cells are uninucleate. two layered cell walls. Outer layer is composed of **pectic compounds** and inner layer is composed of **cellulose**. **Pit** connections are present between cells. Cell has many irregular c**hromatophores**. Its pigments are **phcoerythrin, phycocyanin** and other photosynthetic pigments like chlorophyll a, chlorophyll b, Carotene and Xanthophyll. Each chromatophore has single pyrenoid.

Reserved food material is **floridean starch.**



Reproduction

Asexual reproduction Non-motile asexual spores called **monospores** are produced. They are produced only by juvenile stage or **chantransia stage.**

Sexual reproduction: oogamous, homothallic and heterothallic.

Antheridia (spermatangia): The male sex organs are spermatangia. They are small unicellular structure. Mature spermatanguium is thick walled, colorless and rounded. Spermatangia are produced singly, in pairs or groups of fours. The protoplast of antheridium changes into single non-motile **spermatium.** The antheridial wall ruptures and release spermatium.

Carpogonia: Carpogonia are unicellular. It consists of an elongated cell present at the base. The upper larger portion is called **trichogyne.** The lower globular portion is called **mirophore.** The branch bearing the carpogonium is called **ascocarp.** Ascocarp consists of four cells. The terminal cell form carpogonium. Egg nucleus is present in mirophore. Egg nucleus is surrounded by some cytoplasm and it changes into egg. frichogyne is separated from the mirophore by a constriction. Trichogyne is used for receiving sperm.

Fertilization The spermatium falls on the surface of trichogyne. The wall of trichogyne dissolves and spermatium nucleus enters into carpogonium. It fuses with the female nucleus to form zygote.

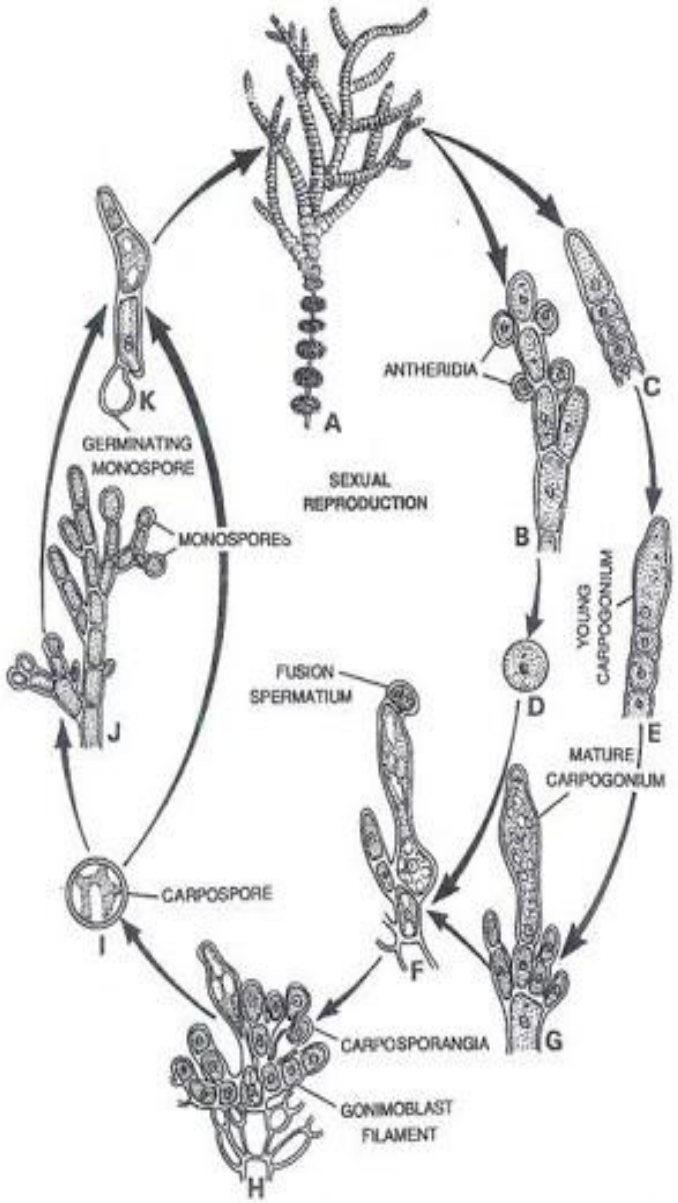


Fig. 7.9. *Batrachospermum*. Life-cycle, A. a portion of plant; B., antheridial branch with antheridia; C and E, formation of carpogonium; D, spermatium; E, young carpogonium; F, fusion of spermatiun; G, mature carpogonium; H. carposporophyte; I, carpospore; J, *Chantransia* stage producing monospores; K, germinating monospore.

Germination The zygote nucleus divides into four nuclei. First division is reduction division.

Post fertilization changes

Cystocarp formation: A protuberance is produced on the carpogonium. One daughter nuclei migrates into this protuberance. Septa separate this protuberance from carpogonium. New protuberances formed on carpogonium. Remaining nuclei migrate to them. These protuberances divide and form gonimoblast filament. The carpogonium with gonimoblast filaments are called **cystocarp.**

Formation of carpospores: The terminal cell of gonimoblast filament produces non-motile carpospore. The carpospore is formed in the form of naked mass of protoplast.

Formation of chantransia stage: Carpospore separates from the filaments and secretes cell wall. It settles on suitable environment. Then it becomes a pod of parenchymatous tissues. A small outgrowth is formed from one side of carpospore. The outgrowth is cut off by the formation of septum. It divides transversely for many times to form prostrate filaments. This stage of thallus resemble to another alga called chantransia. Therefore, this stage is called **Chantransia stage.** It is juvenile stage. This stage reproduces by formation of **monospores.**

Formation of monospores: The terminal cells of filaments form monospore which are non-motile and uninucleate produced in **monosporangia.** Some cells of the Chantransia stage become swollen. They become spherical and oblong to form monosporangia. The content of each monosporangium develop into single uninucleate spore called **monospore.** These spores liberates and again develop chantransia stage. The terminal cells of lower branches of chantransia functions as apical cell which give rise to adult plant.

Alternation of generation

Batrachospermum plant is free living haploid gametophyte It develops spermatangia and carpogonia which produce male and female gametes. These gametes unite to form diploid zygote. The zygote nucleus divides meiotically and gonimoblast nuclei formed. The terminal cells of gonimoblast act as carposporangia. These develop carpospores this plant is called Carposporophyte.

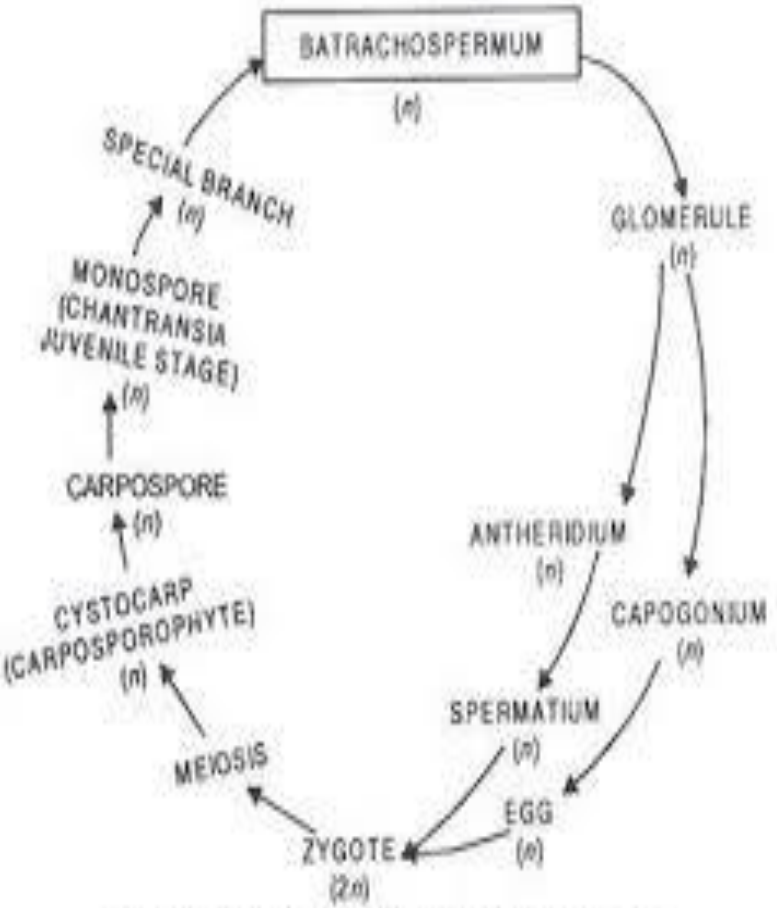


Fig. 7.10 *Batrachospermum*. Graphic life-cycle.

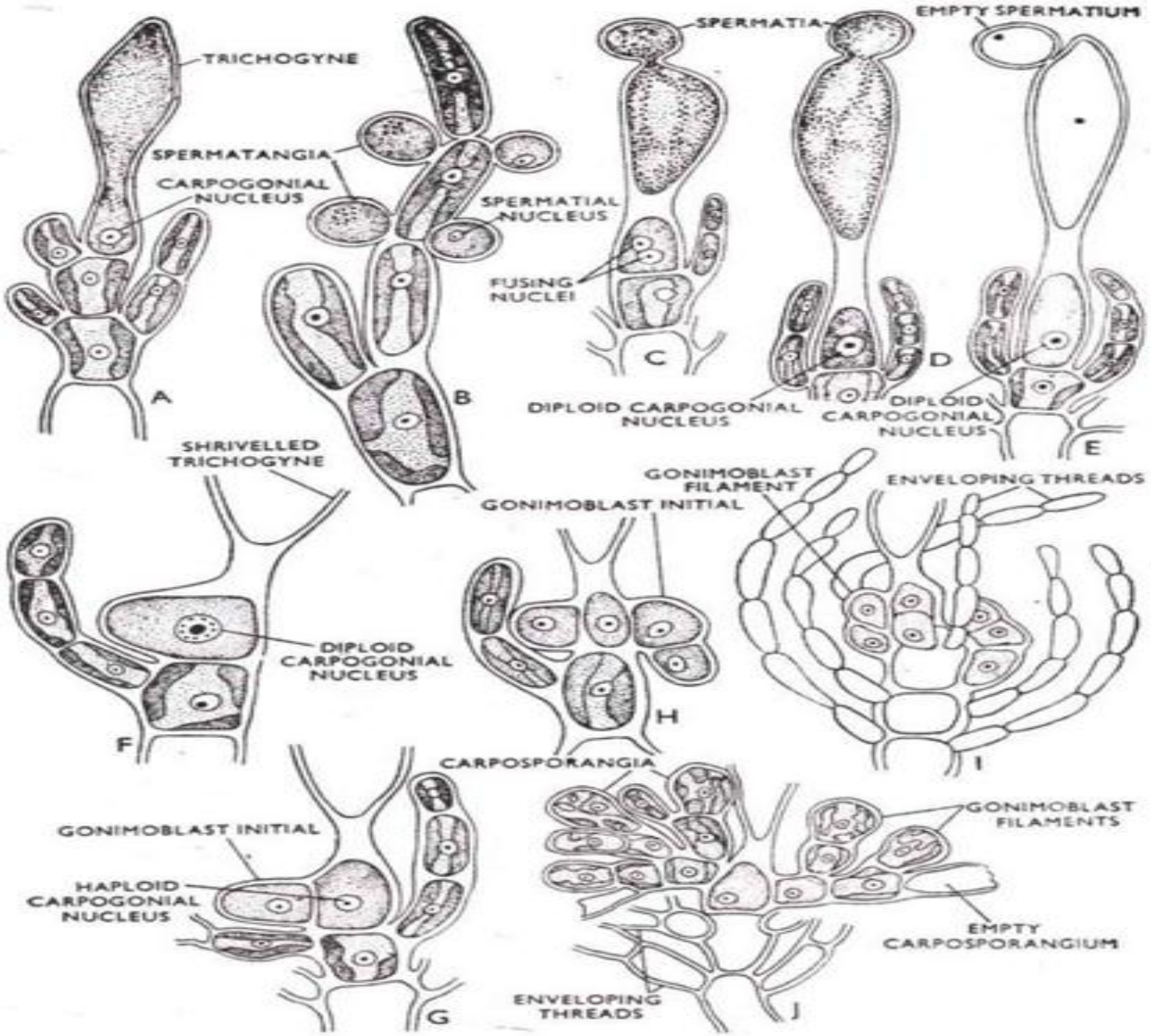


Fig. 120. *Batrachospermum* sp. A. Mature carpogonium. B. Spermatangial branch bearing spermatangia. C–F. Stages in fertilization. G–H. Development of gonimoblast initial. I. Development of gonimoblast filament and enveloping threads. J. Mature gonimoblast filaments, carposporangia and enveloping threads.