THALLUS ORGANIZATION IN THE RHODOPHYCEAE

UNICELLULAR ORGANIZATION – COCCOID FORMS.

Unicells are the ones where a non-motile state predominates and where motility is either entirely absent or restricted to reproductive stages.

In the Rhodophyceae this habit is rare and limited to members of Porphyridiales, eg. *Porphyridium*. This genus is characteristic in having a stellate plastid.

FILAMENTOUS ORGANIZATION – BRANCHED FILAMENTS:

Thallus construction in the Florideophycidae is based entirely on a filamentous organization. Both uniaxial and multiaxial growth occurs. Single apical cell occurs in a uniaxially constructed thallus whereas a group of apical cells occurs in a multiaxially constructed thallus. Growth is always by apical cells.

Simple heterotrichous forms of Florideophycidae are represented by *Audouinella* where the basal attachment ranges from a single holdfast cell to a creeping or coalesced prostrate system.

The thalli of *Batrachospermum* consists a uniaxially constructed thallus, in which the axial cells produce determinate branches in whorls. In addition, the pericentral cells may also produce down-growing rhizoidal filaments that form a covering of corticating cells. These may produce secondary whorls of branches.

Uniaxially constructed foliose thalli are found in Delesseriaceae. They have conspicuous apical cells throughout their growth (*Platysiphonia*), although in some (eg. *Nitophyllum*) the apical cell is obscured in older plants.

Four pericentral cells are formed and the lateral pair continues to divide, producing the monstromatic membranous expansion of the leafy thallus. The dorsal and ventral pericentrals develop to form midrib.

In some the reduced upright filaments are heavily calcified. The calcified species possess irregularly spreading thallus with smooth surface as in *Phymatolithon*, or bearing short branched or unbranched uprights eg. *Lithothamnion* sp.

Majority of the members of the Ceramiaceae (Ceramiales) are uniaxially constructed. This is ranging from uncorticated thallus as in *Antithamnion*, to those with large called axial filaments that are partially or completely invested with bands of determinate corticating filaments as in *Ceramium* and *Centroceras* and those which are heavily corticated throughout as in *Ptilota*.

The simple multiaxial construction is exhibited by *Liagora*, which has soft dichotomously branching, calcified, gelatinous thalli. The central axial filaments are colourless and readily separable by gentle pressure. The determinate branches, terminating in a hair, comprise small photosynthetic cells. In *Galaxura* the apical cells of the axial filaments are grouped in an apical depression. The thallus here is heavily calcified, giving it a rigid structure.

Much specialized multiaxial thalli are found in heavily calcified articulated corallines (Cryptonemiales) such as *Jania*, *Amphiroa* and *Arthrocladia*. In these forms the determinate branches are formed in interrupted series, between which the lightly calcified axial filaments from the articulating points of the thallus.

Highly complex multiaxial types include terete, fleshy or foliose species of dense construction. In these types the apical cells can be distinguished only during their young stages. Terete forms include species of *Gracilaria* (where thallus is

further specialized with cortex and medulla) and *Agardhiella*, while large foliose forms include *Gigartina* (which may reach 1 m in length).

In Rhodymeniales, growth occurs characteristically, in which the hollow, tubular thalli are chambered. The chambers are separated by transverse medullary hyphae (diaphanous) eg. *Champia* and *Gastroclonium*.

Parenchymatous construction is seen in *Porphyra* and *Smithora*.

REPRODUCTION IN THE RHODOPHYCEAE

VEGETATIVE REPRODUCTION:

Multicellular asexual structures termed gemmae are described from the freshwater rhodophyte *Hildenbrandia rivularis*.

Propagules resembling spermatangial branches occur on male, female and tetrasporangial branches of *Polysiphonia ferulacea*. Hook like propagules (tendrils) and stellate propagules are produced by *Hypnea muciforms* and *H. valentiae* respectively.

ASEXUAL REPRODUCTION in these members is effected by the formation of Monospores (neutral spores), bispores, paraspores and polyspores.

Monospores are the commonest axeual spores of the Rhodophyceae. Presence of plastids and larger size distinguish these from spermatia. These are the only reproductive cells in the simpler filamentous members of Bangiales. In *Porphyra* monospores occur on both the conchocelis phase and macroscopic phase. In the latter these are actually freed vegetative cells. Monospores are also reported from *Audouinella* and *Pseudogloiophloea confusa*.

Bispores are produced by bisporangia which are usually occur on tetrasporophytes. Sometimes these may be stages in the development of tetrasporangia. These are reported from members of Corollinaceae and Ceramiales (-*Callithamnion*). Production of bisporangia is considered as a mechanism for the asexual reproduction of the tetrasporophyte. These sporangia also occur in the following genera: *Acrochaetium* (Nemalionales), *Amphiroa* (Corollinales), *Aglaothamnion furcellariae, Crouania attenuata* (Ceramiaceae).

Paraspores are regarded as masses of monospores and are considered as accessory diploid sporangia. These are usually found in the Ceramiaceae (eg. *Ceramium strictum*, *Callithamnion hookeri*). In *Plumaria elegans* and also in *Ceramium strictum* they are found in asexual triploid generation.

Polysporangia are homologous with tetrasporangia, because spore formation in these sporangia takes place after reduction division. These are reported from the members of Ceramiaceae (spp. of *Pleonosporium, Aristothamnion, Lophothamnion* and the *Tiffaniella*), Delesseriaceae (*Goniophyllum*) and Champiaceae (*Coeloseira*).

SEXUAL REPRODUCTION IN BANGIOPHYCIDEAE

Except a very few species all others sexually reproducing Rhodophyceae exhibit sporic life-cycles and all are oogamous.

Members of Bangiales (subclass: Bangiophycidae) exhibit a reproductive cycle involving a shell boring alga *Conchocelis rosea* eg. *Porphyra*. The life cycle of *Porphyra* is essentially sexual with the conchocelis phase representing the diploid sporophyte generation.

The gametophytic thallus produces 16 to 256 spermatia per cell, which are also called as β-spores. Carpogonia are the normal vegetative cells found with small protrusions-prototrichogynes. The liberated spermatia fuse with prototrichogynes and this marks syngamy. The fertilized carpogonium divides to produce 4 to 16 carpospres, which are also known as α-spores. These on liberation germinate to produce the filamentous conchocelis phase. The conchocelis phase produces rows of terminally liberated conchospores which are formed after reduction division. Conchospores on liberation germinate to produce the gametophytic thallus.

The division Rhodophycota includes two sub classes under a single class Rhodophyceae. Viz., Bangiophycideae and Florideophycideae.

BANGIOPHYCIDEAE:

The thalli are always of simple construction. Cell division is intercalary and cells are uninucleate often with single plastid which has a pyrenoid. Pit connections are seen only in some genera.

Reproductive structures such as gametangia are not well differentiated. Complex post fertilization development is absent. Asexual reproduction takes place by the formation of monospores. Life-cycle of some genera involves a filamentous stage.

This sub class includes four orders. Viz., Porphyridiales, Bangiales, Compsopogonales and Rhodochaetales.

Bangiales: Plant body is filamentous or parenchymatous. The filamentous thalli have a basal disc, whereas the parenchymatous thalli have secondary development of a basal attaching structure formed by descending rhizoids. Cells are with single, axile, stellate plastids with a pyrenoid. Some have filamentous phases in their life histories.

Asexual reproduction is effected by monospores. Male gametes or spermatia are produced in packets up to 128 per mother cell. Female gametes are undifferentiated or slightly differentiated vegetative cells.

FLORIDEOPHYCIDEAE:

Thalli filamentous, parenchymatous aggregations of filaments of either discoid or crustose or erect, and frondose. Erect fronds are of varied morphology of uniaxial or multiaxial construction. Growth is apical and only in a few it is intercalary. Cells are uninucleate or multinucleate with one or more plastids. Pyrenoids present only in the members of Nemalionales.

Gametangia are well differentiated. Male gametes are non-motile, produced singly from isolated or clustered spermatangia. Female gametes are formed within a carpogonium produced by a transformation of the apical cell of a short filament – carpogonial branch. Post fertilization development consists of a one to many celled tissue which remains attached to the gametangial thallus. The tissue formed during the post fertilization development is called as the carposporophyte. The latter gives rise to carposporangia by transformation of the apical cells and occasionally also intercalary cells. The carposporangia may liberate a single spore – carpospore or four spores-carpotetraspores. The carposporophyte may consist of a few filaments or surrounded by a massive flask shaped tissue with an apical opening and called as a cystocarp.

Asexual reproduction occur through spores formed singly (in monosporangia), in pairs (in bisporangia), in fours (in tetrasporangia) or in large numbers (in parasporangia and polysporangia).

Life histories involve three phases, male and female gametophytes, carposporophyte and tetrasporophyte. Gametophytes and sporophytes are morphologically similar or dissimilar. This subclass includes six orders. Viz., Nemalionales, Cryptonemiales, Gigartinales, Rhodymeniales, Palmariales and Ceramiales.

Nemalionales: in the members belonging to this order, carposporophyte develops directly from the fertilized carpogonium or following transfer to an auxiliary cell which is a cell of the carpogonial branch. Sporophytes are filamentous.

Cryptonemiales: in the members of this order, carposporophyte is formed after the transfer of the zygote nucleus to an auxiliary cell formed in a specialized filament, which may or may not be some distance from the carpogonium.

Gigartinales: Here carposporophyte is formed after the transfer of the zygote nucleus to an auxiliary cell which is always an unspecialized vegetative cell of the thallus. In some the auxiliary cell may be the supporting cell of the carpogonial branch or a cell some distance from it.

Rhodymeniales: Here the carposporophyte is formed after the transfer of the zygote nucleus to an auxiliary cell, which may be produced singly or in pairs from the support cell of the carpogonial branch prior to fertilization.

Palmariales: In these members tetrasporangial thalli arise directly on the female gametophyte.

Ceramiales: Auxiliary cell is always formed after fertilization from the basal cell of the carpogonial branch. Sometimes the basal cell itself functions as an auxiliary cell.