Xanthophyta

25.2 GENERAL CHARACTERS

1. Xanthophyceae differ from Chlorophyceae by the absence of chlorophyll *b*.
2. They differ from other Chromophycota of Parker (1982) by the absence of fucoxanthin and dominance of diatoxanthin as the major carotenoid (Hibberd, 1981; Ott, 1982).
3. Most Xanthophyceae are freshwater members found in free-floating conditions. Some are found attached on the walls or tree trunks and others are soil inhabitants. A few representatives (*Halosphaera*) are also marine. Hibberd (1982) described about 600 species of Xanthophyceae.

4. Plants show a definite range in their thallus structure, and thus exhibit a well-marked parallelism with Chlorophyceae. Similar to Chlorophyceae, the Xanthophyceae also include motile, palmelloid, filamentous and even siphonous forms. However, highly elaborate pseudoparenchymatous and parenchymatous forms are not found in Xanthophyceae.
Some examples are mentioned below:

   Unicellular motile forms: e.g. *Chloramoeba, Heterochloris*.
   Palmelloid forms: e.g. *Chlorosaccus, Chlorogloea*.
   Dendroid forms: e.g. *Mischococcus*.
   Rhizopodial forms: e.g. *Stipitococcus*.
   Coccoid forms: e.g. *Chlorobotrys*.
   Epiphytic forms: e.g. *Ophiocytium, Characiopsis*.
   Filamentous forms: e.g. *Tribonema, Heterococcus*.
   Siphonous forms: e.g. *Botrydium* (Fig. 25.1B).

5. The cell wall in most of the non-flagellated forms is made up of two equal or unequal halves, which generally overlap each other. According to Fritsch (1935) the cell wall is generally "rich in pectic compounds", but Chapman and Chapman (1973) have mentioned that the cell wall contains cellulose. Wall composition is predominantly of randomly arranged microfibrillar cellulose.
6. Flagella are present in motile forms. They are generally two in number and unequal in size. The larger, hairy flagellum being directed forward and the shorter flagellum being directed backwards. Larger flagellum bears tubular hairs while shorter flagellum is smooth. Both the flagella are anteriorly attached. Because of the heterodynamic nature and unequal length of the flagella, the class Xanthophyceae was originally named *Heterokontae* by Luther (1899).
7. Because of the presence of excess of yellow xanthophylls in the chromatophores, the Xanthophyceae are commonly called "*yellow-green algae*."

8. Chief pigments consist of chlorophyll-a, chlorophyll-e, β-carotene, diatoxanthin, diadinoxanthin and heteroxanthin. Guillard and Lorenzen (1972) also reported the presence of chlorophyll-c. Some other xanthophylls reported by different workers are lutein, violaxanthin, neoxanthin, flavacin and flavoxanthin (Prescott, 1969). Chlorophyll-b is absent.
9. Chief food reserves are a β–1, 3-linked glucan, fats and oil. It is never starch. The principal sterol is the ergosterol.
10. Chloroplasts are discoid in shape and surrounded by a double membrane of chloroplast ER, the outer continuous with the outer membrane of the nuclear envelope.
11. Plants reproduce vegetatively or asexually. In a few genera, sexual reproduction has also been reported.
12. Asexual reproduction is brought about by cell-division, motile zoospores, non-motile aplanospores or akinetes (Chapman and Chapman, 1973). Internal cysts or statospores are also produced in some genera of Xanthophyccac.
13. Sexual reproduction, though rare, is generally isogamous (e.g., *Tribonema*), as in siphonaceous genera. Some also show anisogamy and even oogamy.

25.4.4 Reproduction

The plant generally reproduces asexually by forming certain types of spores (zoospores, aplanospores, cysts) and rarely sexually by producing gametes. It rarely reproduces vegetatively by budding.

Asexual Reproduction: It takes place by zoospores, aplanospores and many kinds of cysts.

1. *Zoospores:* Zoospores in *Botrydium* are formed when the plants are submerged. The entire protoplast of the vesicle divides into numerous uninucleate bodies, which ultimately metamorphose into zoospores. They are liberated by the gelatinization of the tip of the vesicle (Fig. 25.2A).

   Each zoospore (Fig. 25.2B) is ovoid or pyriform, uninucleate and biflagellate structure. Two flagella are anteriorly attached and unequal in size. The longer flagellum is *pleuronematic* (bears hair-like appendages) and the shorter one is *acronematic* (without appendages). The liberated zoospores withdraw their flagella, secrete a wall and germinate into new thalli.
2. *Aplanospores:* Aplanospores are produced "when the plants are wet, but not submerged" (Fritsch, 1935). They are produced like zoospores, i.e. by the repeated division of the protoplast of the vesicle into uninucleate daughter protoplasts. But such daughter protoplasts do not develop flagella. They secrete a thin wall (Fig. 25.2C). At the time of germination, the aplanospore gives out a tubular rhizoidal outgrowth (Fig. 25.2D). The upper part develops into the vesicle.

   Under unfavourable conditions the aplanospores develop a thick wall and are now called ***hypnospores***.
3. *Cysts:* Formation of four types of cysts have been reported in *Botrydium*:

   i. *Macrocyst:* Under some adverse conditions, the entire protoplast of the vesicle transforms into a single, large, rounded, multinucleate, thick-walled structure, called *macrocyst*.

ii. *Sporocyst:* The entire contents of the vesicle in *B. wallrothii* divides into many multinucleate thick-walled cysts, variously named as *hypnospores* or *sporocysts* (Miller, 1927).

iii. *Rhizocyst:* During extremely adverse conditions, the protoplasmic contents of the vesicle migrate into the main branches of the rhizoidal portion in *B. granulatum*. The entire contents in the rhizoids now divide into many thick-walled globose cysts, called *rhizocysts* (Fig. 25.2E). These cysts germinate directly into new plants.

iv. *Tuberous Cyst:* Vesicular contents in *B. tuberosum* migrate into the rhizoids and reach

up to their tips, which thus get swollen in the form of tuberous structures (Fig. 25.1C) called *tuberous cysts* (Iyengar, 1925).

All cysts germinate into new plants without undergoing any resting period.

Sexual Reproduction The sexual reproduction is isogamous and has been studied in *B. granulatum* by Rosenberg (1930). It is a monoecious species. Some workers reported anisogamy. The isogametes are uninucleate and biflagellate structures with typical heterokont flagellation (Fig. 25.3A). They are morphologically identical with the zoospores and also formed in the same way, as zoospores. As many as 40,000 isogametes are formed in each vesicle (Chapman and Chapman, 1973).

Biflagellate and uninucleate gametes are generally obpyriform bodies containing one to three chloroplasts (Fig. 25.3A). They fuse through their posterior ends (Fig. 25.3 B, C). In the investigated species, fusion of gametes takes place within the vesicle, even before their liberation, because the plant is monoecious. The gametes which do not fuse may develop parthenogenetically (Fritsch, 1935).

Fusion of two gametes results in the formation of zygote (Fig. 25.3D, E), which is a round structure. It germinates immediately without any resting period. Zygotic meiosis takes place, and four to eight haploid zoospore-like bodies are formed. They develop into new plants.