

PLANT KINGDOM

“The ‘cure,’ it seemed, had once again been proven to be ‘worse than the disease.’”

“R.H. WHITTAKER (1920-1980)”

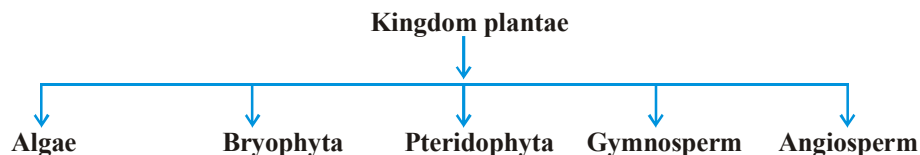
INTRODUCTION

In this chapter we will discuss about the classification of Plant kingdom. The broad classification of living organisms was given by Whittaker (1969) where in he suggested five kingdom classification i.e. Monera, Protista, Fungi, Animalia and Plantae.

Fungi and members of Monera and Protista having cell walls have now been excluded from Plant though earlier classification placed them in same kingdom. So, the cyanobacteria that are also referred to as blue green algae are not ‘algae’ any more. This chapter will also include Plantae under Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

PLANT KINGDOM

All the multicellular eukaryotic plants are placed in Kingdom-Plantae. They are autotrophic i.e. they manufacture their food by photosynthesis.



ALGAE

Term "Algae" was given by **Linnaeus**.

Phycology - Study of algae.

Father of Phycology - **Fristch** → Book → "**Structure & Reproduction of algae**"

Father of Indian phycology - **M.O.P. Iyengar**

NATURE

- (1) Algae are found in both fresh and marine water.
- (2) Algae are found in many forms like filamentous, colonial.
- (3) Algae are surrounded by mucilagenous sheath and below the sheath cell wall is present which is made up of cellulose and pectin but mainly made up of cellulose, galactans, mannans and mineral like calcium carbonate.
- (4) On the basis of structure, algae are thalloid i.e. plant body is not differentiated into root, stem and leaves. **Tissue system** is also absent in algae.
- (5) On the basis of nutrition, algae are photoautotrophic. They have chloroplast in which photosynthetic pigments are present. Classification of algae is mainly based on pigments. **Chl-a** and β **carotene** are **universal pigment** of algae.

REPRODUCTION

(1) Vegetative

Vegetative reproduction :

- (i) **Binary fission** - Cell is divided into two parts and nucleus is also divided into two parts by mitosis.
eg. Found only in unicellular algae
- (ii) **Fragmentation** - Filaments break down into small pieces & form new filaments.
eg. All filamentous algae

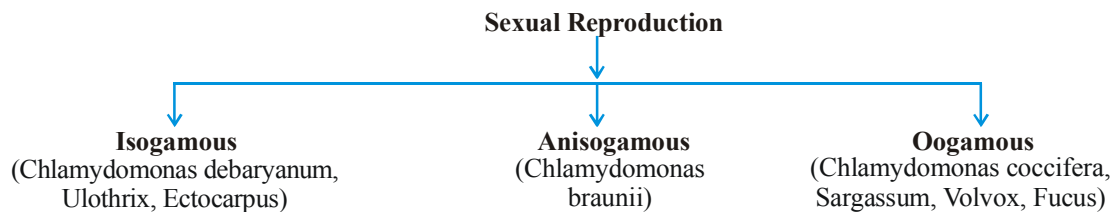
(2) Asexual

(3) Sexual

Asexual reproduction : It is a method of protection in all unfavourable conditions.

Sexual reproduction :

- (i) Male sex organ is called **antheridium** and female is called **oogonium**. The sex organs of algae are **unicellular & jacketless**. But exceptionally sex organs of green algae **Chara** (Chara - green algae - known as stone wort) are multicellular and Jacketed. The male sex organ of **Chara** is known as **globule** and female is known as **nucule**.
- (ii) Plant body of algae is haploid so sexual reproduction take place through **zygotic meiosis**. So their life cycle is **haplontic**. But exceptionally brown algae are diploid so that sexual reproduction takes place through gametic meiosis in them. So their life cycle is **diplo haplontic**.
- (iii) Algae reproduce by **zygotic meiosis** i.e. first division in zygote is meiosis so embryo is not formed. Sexual reproduction is of three types



Check Point :

- (1) **Chlamydomonas** exhibits complete evolution of sexual reproduction.
- (2) **Ulothrix** exhibits origin of sexual reproduction

The classification of algae is mainly based on the photosynthetic pigments. In addition to this, cell wall composition and stored food are also the base of classification.

Algae is divided into following divisions

- | | | |
|-----------------|---|----------------------|
| (1) Chlorophyta | - | Green Algae |
| (2) Phaeophyta | - | Brown Algae |
| (3) Xanthophyta | - | Yellow - Green Algae |
| (4) Rhodophyta | - | Red Algae |

CHOLOROPHYTA GREENALGAE

Green algae are the **most advanced** algae. It is believed that green algae are the ancestors of the higher plants.

Habitat : Green algae are cosmopolitan in nature.

Different forms of Green algae (Structure) :

Green algae are found in many forms

(1) **Unicellular :-**

- (i) **Chlamydomonas** - Motile unicellular algae. This algae moves with the help of flagella.
- (ii) **Chlorella** - Non motile unicellular alga.
Calvin discovered "Calvin Cycle" by experimenting on *Chlorella*.
- (iii) **Acetabularia** - Umbrella plant - It is the largest unicellular plant. The diameter of its cell is 10 cm.
Hammerling experimented on *Acetabularia*.

(2) **Coenocytic** - Some green algae are coenocytic i.e. multinucleated.

eg. *Caulerpa*

Check Point : According to five kingdom system the algae described above should be placed in Protista but exceptionally due to their life cycle is similar to green algae. they are placed in Plantae. But now modern scientist place above algae in protista.

(3) **Colonial** - Some green algae are found in colonies. They form colony of cells. The number of cells in a colony is fixed. Colony with fixed number of cells called coenobium.

eg. *Volvox* - Motile colony

Hydrodictyon - Non motile colony (called as water net)

(4) **Multicellular filamentous** - Mostly algae are multicellular filamentous.

eg. *Ulothrix* - (pond wool), *Spirogyra* - (pond silk)

Check Point : some green algae are heterotrichous i.e. two types of branches prostrate and erect - *Fritschella*, *Stigeoclonium*, *Coleochaete* (*Fritschella tuberosa* has approach to the early land plants).

(5) **Multicellular thalloid or Parenchymatous** - Some algae are multicellular in length & width.

eg. *Ulva* - it is also known as sea lettuce.

BIOLOGY FOR NEET & AIMS

Photosynthetic pigments :

Chlorophyll	-	Chl 'a' and Chl 'b'
Carotene	-	β carotene
Xanthophyll	-	Luteaxanthin and Violoxanthin - Yellow coloured

Check Point : The green colour of green algae is due to chlorophyll.

Stored food : In green algae the food is stored in the form of **starch**

Check Point : On the basis of pigments (Chl 'a', Chl 'b', Carotenoids), stored food (starch) & cell wall (made up of cellulose or pectin), green algae are considered similar to higher plants.

Economic Importance :

- (1) **Food-** *Chlorella* is used as food, because after *Spirulina*, *Chlorella* has largest amount of protein.
- (2) **Antibiotics** - Chlorellin antibiotic is obtained from *Chlorella*.
- (3) **Parasitic algae** - *Cephaleuros* algae remains parasitically in the leaves of tea plant and causes disease '**red rust**'.
- (4) **Space research** - In space, *Chlorella* is used as a source of food and O₂.

PHAEOPHYTA

Brown algae or kelps or Sea weeds

- Brown algae are found in marine water.
- Brown algae are multicellular filamentous.
- Brown algae are the largest in size (upto 60 meter in length).
- Largest brown algae - **Macrocystis**
- Thallus of brown algae is divided into two parts :-
 - (i) **Lamina** - Leafy part or photosynthetic part
 - (ii) **Stipe** - Elongated tubes called **trumpet hyphae** are present for food conduction in stipe. Trumpet hyphae are analogous to sieve tubes of vascular plants. Due to lamina and stipe brown algae look like leaf (leafy algae).
e.g. *Fucus*, *Dictyota*, *Ectocarpus*

Pigments :

Chlorophyll	-	Chl 'a', Chl 'c'
Carotene	-	Only β carotene
Xanthophylls	-	Mainly Fucoxanthin

Check Point : The amount of Fucoxanthin is more in brown algae due to which these algae are brown in colour. (Xanthophylls are mostly yellow but fucoxanthin is brown)

Stored food :

Laminarin and mannitol - both are derivatives of carbohydrates.

Phycocolloids :

On cell wall of brown algae some colloid substances like **fucinic acid**, **alginic acid** and **fucoidin** are present which are known as phycocolloids.

Phycocolloids protects brown-algae against dessication and shocks. Phycocolloids are used in ice-cream as thickening agent. Alginates, salts of alginic acid used for dentury measurement.

Special Point : Life cycle of *Ectocarpus* and kelps are diplohaplontic, life cycle of *Fucus* is diplontic.

Special Name :

- (1) **Postelsia** - It is known as Sea palm.
- (2) **Ancyclonema** - It is called Ice bloom because it grows on marine ice.

(3) Sargassum -

It is known as Gulf weed because *Sargassum* is a free floating alga. It grows rapidly in North Atlantic ocean and covers thousands of hectares of area. Therefore this region is called as sargasso sea.

(4) Laminaria (Kelps) - It is called as Devil's Aprin.

Economic Importance :

(1) Alginates or Alginic acid - Obtained from *Laminaria*, *Fucus*, *Macrocystis*.

Alginates are used in the manufacturing of soap, ice-cream, polish, cream and plastic.

(2) Iodine and Bromine - Obtained from *Laminaria*.

XANTHOPHYTA

Yellow Green Algae

Habitat and Structure :

All the algae in this group are **acellular coenocytic** and are found in moist soil.

Pigments :

Chlorophyll	-	Chl 'a' , Chl 'e'
Carotene	-	β carotene
Xanthophylls	-	Many

The yellow colour of these algae is due to the presence of xanthophyll.

Stored food :

Leucosin and Oil (Leucosin is derivative of carbohydrate)

eg. *Vaucheria* , *Botrydium*, *Tribonema*

Check Point : In *Vaucheria* algae some special type of spores are formed which are known as synzoospores.

RHODOPHYTA

Red Algae

(1) Red algae are second most **ancient algae** after blue green algae i.e. they are developed after blue green algae.

eg. **Polysiphonia**

(2) Red algae are multicellular but exceptionally **Porphyridium** is unicellular.

(3) Red algae mainly found in marine water. But exceptionally **Batrachospermum** is found in fresh water (river) and **Porphyridium** is found on land.

(4) There is **no motile stage** found in life cycle of red algae and BGA i.e. cilia & flagella are absent.

(5) Cell wall of red algae is complex and made up of cellulose & pectin.

The cell wall of red algae is also complicated like blue green algae. Their cell wall has many different type of substances such as **xylan, galactose, polyuronic acid, polysulphate esters**.

But in some algae calcium carbonate is also present in the cell wall. Due to which their thallus become stony. These algae form lime stone & coral reefs

e.g. **Corallina** and **Lithothamnion**

Pigments :

Chlorophyll	-	Chl 'a' and Chl 'd'
Carotenes	-	β
Phycobilins	-	R - phycoerythrin (red coloured) and R - phycocyanin (blue coloured)

(1) On the basis of pigments red algae is similar to blue green algae.

(2) Colour of red algae changes according to depth in sea this is called as **Gaudikov's effect**.

(3) **Gaudikov's** effect is also found in Blue - Green algae.

(4) When red algae are present on the surface of the sea then their colour is blue and when they are at the bottom, their colour is red. At the surface of sea the amount of **R - phycocyanin** is more while in depth the amount of **R - phycoerythrin** is more.

BIOLOGY FOR NEET & AIMS

Penetration power is maximum in ultra violet and violet light. R-phycoerythrin is only pigment to absorb ultra violet and violet light. Due to **phycoerythrin** red algae are deepest algae.

- (5) Red algae not always red, it may be blue coloured also.

eg. **Batrachospermum** - This is a blue coloured algae.

Stored Food :

Floridean starch - It is a primitive type of starch. Structurally floridean starch is similar to the cyanophycean starch of blue green algae. Starch of higher plants is less branched yet floridean starch & cyanophycean starch is highly branched. Glycogen is also highly branched so that floridean & cyanophycean starch is **structurally** similar to **glycogen** and **amylopectin**

Phycocolloids :

Agar -Agar, carrageenin and funori phycocolloids are found in the cell wall of red algae.

Reproduction :

- (1) **Vegetative** - By fragmentation
- (2) **Asexual** - Non motile spores [By monospore, carpospores, tetraspore]
- (3) **Sexual reproduction** -
 - (I) Sexual reproduction is *oogamous* type.
 - (II) The female sex organs are called **carpogonia**. They are apparently similar to archegonia of bryophyta. Carpogonia is unicellular & jacketless but archegonia is multicellular & jacketed.
 - (III) The male sex organs of red algae are known as **spermatangia**. Non motile spore like gametes are formed in spermatangia which are known as spermatia.
 - (iv) Life cycle of **Polysiphonia** is diplobiontic and **Batrachospermum** is haplobiontic

Key points and Economic importance

- (1) **Harveyella** - It is a colourless parasitic alga. It remains as **parasite** on other alga.
- (2) **Porphyra** - It is an edible algae.
- (3) **Gelidium and Gracilaria - Agar - Agar** colloid is obtained from these. It is used to prepare culture medium
- (4) **Chondrus crispus** - It is also called Irish moss. **Carrageenin** colloid is obtained from this alga. It is used as gelating agent in food industries (i.e. to make the food item viscous)
- Capsule of medicines is also prepared from carrageenin.
- (5) **Haematococcus nivalis** - "Red snow" - It likes to grow on snow and imparts red colour to snow.

Habitat of some important algae

- (1) **Terrestrial** - The algae found in moist soil & wall.
eg. *Terrentofolia*
- (2) **Epiphytes** - Algae which are present on plants
eg. *Protococcus*
- (3) **Endophytes** - Algae which are present inside plants
eg. *Coleochaete nitelum* (in *Nitella* plant)
- (4) **Epizoic** - Algae which are present on animals
eg. *Cladophora* (present on Mollusca shell)
- (5) **Endozoic** - Algae which are present inside the body of animals
eg. *Zoochlorella* and *Zooxenthellae* (inside the Hydra)
- (6) **Parasites** - Algae that live as parasite and causes diseases
eg. *Cephaleuros* (algae remains in the leaves of tea plant)
Cephaleuros causes red rust disease of tea
- (7) **Thermophilic** - Algae found in hot water.

eg. *Chlorella*

(8) **Cryophytes** - Algae which are present in polar regions & Low Temperature.

eg. *Chlamydomonas* (some species)

Haematococcus nivalis (It develops red snow in polar region.)

(9) **Epiphloephytes** - Algae arise on bark of trees.

THALLOPHYTA

(1) The term "Thallophyta" was given by "**Endlicher**". According to two kingdom classification, all the **algae, fungi** and **bacteria** were placed in thallophyta, because their plant body is thallus.

(2) In thallophyta plant is haploid i.e. **gametophyte**

Eg. Green algae, Red algae, Yellow green algae, Dinoflagellate, Cellular slime mold.

Note : Exceptionally in some thallophytes, plant is diploid i.e. **sporophyte**

Eg. Brown algae, Diatoms, Acellular slime molds.

(3) All the thallophytes are non vascular.

(4) In thallophyta the male sex organs are called as **Antheridia** and female sex organs are called as **Oogonia**. Sex organs are unicellular & Jacket less [Jacket - layer of sterile cells]

(5) In thallophyta, sexual reproduction takes place through **zygotic meiosis**, therefore embryo is not formed.

(6) The sexual reproduction in thallophyta is **isogamous, anisogamous** and **oogamous**.

Demerits of Two kingdom classification :

(1) In two kingdom classification Prokaryotes and Eukaryotes placed in the same group.

(2) Two kingdom system takes unicellular and multicellular organism together.

(3) In this system photosynthetic green algae and non photosynthetic fungi are placed in same group i.e. plantae.

(4) On the basis of cell wall bacteria were considered as plant and put in plantae.

(5) Position of Euglena was not fixed.