3. Plant Kingdom

POINTS TO REMEMBER :

CLASSIFICATION :

Artificial System of Classification :

- Used superficial morphological characters.
- Based on a few characteristics like habit, colors, number and shape of leaf.
- Mainly based on vegetative characters.
- Such system developed by Linnaeus.

Natural System of Classification :

- Based on natural affinities among organisms
- Included external as well as internal features like anatomy, embryology and phytochemistry.
- Developed by George Bentham and J. D. Hooker

Phylogenetic System of Classification :

- Based on evolutionary relationships between the various organisms.
- Organism belongs to same taxa have a common ancestors.
- Developed by Hutchinson.

***Numerical Taxonomy* :**

- Carried out using computers
- Based on all observable characteristics
- Data processed after assigning number and codes to all the characters.

***Cytotaxonomy* :**

- Based on cytological information.
- Gives importance to chromosome number, structure and behaviour.

Chemotaxonomy :

- Based on chemical constituents of the plants.

ALGAE :

- Chlorophyll bearing, simple, thalloid, autotrophic and mostly aquatic organisms. Moist stone, soils and wood are the other habitat.
- The size ranges from microscopic unicellular forms like *Chlamydomonas*, to colonial forms like *Volvox* and to filamentous forms like *Ulothrix* and *Spirogyra.* A few marine forms such as kelps, form massive plant bodies.
- Reproduce vegetatively by fragmentation.
- Reproduce asexually mostly by producing motile spore called **zoospores.**
- Reproduce sexually by producing gametes.

- ***Isogamous*:** both gametes are same size and motile
- ***Anisogamous*:** both gametes are dissimilar in size but motile.
- ***Oogamous*:** male gamete is smaller but motile, female gamete is large and non- motile.

Importance of Algae :

- At least half of the total carbon dioxide fixation on earth carried out by them.
- Increase oxygen level in the environment.
- Many species like *Laminaria*, *Sargassum* etc. are used as food.
- **Agar** obtained from *Gelidium* and *Gracilaria* is used in ice-creams and jellies and also used to culture bacteria.
- **Algin** obtained from brown algae and **carrageen** from red algae used commercially.
- *Chlorella* and *Spirullina* are unicellular algae, rich in protein and used as food supplement even by space travelers.

Algae divided into 3 classes :

Chlorophyceae :

- Commonly known as **Green algae**.
- Main pigment is chlorophyll 'a' and 'b'.
- Unicellular, colonial or filamentous.
- Cell wall has inner layer of cellulose and outer layer of pectose.
- Have **pyrenoid** as the storage body for starch and proteins.

e.g., *Chlamydomonas, Volvox, Spirogyra*.

Phaeophyceae :

- Commonly known as **Brown algae** and mainly found in marine habitat.
- They possess chlorophyll a, c, **carotenoid**, **xanthophylls** and **fucoxanthin**.
- Cell wall has cellulose and lignin or gelatinous coating of **algin.**
- Has **mannitol** and **laminarin** as reserve food material.
- Body divisible into **holdfast**, **stipe** and **frond**.
- Reproduce asexually by biflagellate pear-shaped zoospores.

e.g., *Ectocarpus, Fucus, Laminaria*.

Rhodophyceae :

- Commonly known as **red algae**.
- Red color is due to predominance of red pigment r-phycoerythrin in their body along with chlorophyll a, d.
- Found on surface as well as great depths in oceans.
- Cell wall made of cellulose, pectin and **polysulphate esters**.
- Reserve food material is **floridean starch** similar to amylopectin and glycogen in structure.
- Reproduce asexually by non motile spores and sexually by non motile gametes (**Oogamous** type)

e.g., *Polysiphonia, Porphyra, Gelidium*.

BRYOPHYTES : Amphibians of plant kingdom

- Occur in damp, humid places.

- Lack true roots, stem or leaves.
- Plant body attached to the soil by unicellular or multicellular rhizoids.
- Main plant body is haploid (n), or **gametophytic**.

REPRODUCTION IN BRYOPHYTES :

- Vegetative reproduction by **fragmentation**.
- Asexual reproduction by **gemmae** formed in **gemma cups**.

Sexual reproduction :

- Main plant body is **gametophyte**.
- The sex organs in bryophytes are multicellular.
- Male sex organ is called **antheridium** which produces biflagellate **antherozoids** as male gamete.
- Female sex organ is **archegonium** is flask shaped and produces a single egg.
- Fertilization takes place in water results in formation of zygote.
- The zygote developed into a multicellular body called **sporophyte** which remains **parasitic** on female gametophyte.
- The sporophyte differentiated into **foot**, **seta** and **capsule**.
- Some cells of the capsule undergo meiotic division to produce haploid spores. These spores germinated into an independent gametophyte.
- Moss gametophyte consists of two stages
- First stage is called **protonema stage** which developed from the spore and is creeping, green, branched.
- Second stage is **leafy stage** which developed from the protonema stage as a lateral bud. They consist of upright, slender axes bearing spirally arranged leaves.

Economic Importance :

- Food for herbaceous animals.
- Sphagnum in form of peat is used as fuel and also used for trans-shipment of living material as it has water holding capacity, prevent soil erosion, along with lichens are first colonizers on barren rocks.
- They decompose rocks making substrate for the growth of higher plant.

PTERIDOPHYTES :

- First terrestrial plant possesses vascular tissue like **xylem** and **phloem**.
- The plant body differentiated into true root, stem and leaf.
- The main plant body is **sporophytic**.
- Leaves may be small (**microphyll**) as in Selaginella or large (**macrophyll**) as in ferns.
- Sporangia having spores are subtended by leaf-like appendages called **sporophylls**. (Sporophylls may be arranged to form **strobili** or **cones**.)
- In Sporangia, the spore mother cells give rise to spores after meiosis.
- Spores germinate to form haploid gametophytic structure called **prothallus** which is free living, small, multicellular and photosynthetic.
- Prothallus bears **antheridia** and **archegonia** which bear **antherozoids** and **egg cell** respectively which on fertilization form zygote.
- Zygote developed into multicellular, well differentiated **sporophyte**.
- Most of pteridophytes produce similar kinds of spores hence called **homosporous.**
- Genera like *Selaginella* and *Salvinia* which produce two kind of spores, macro (large) and small (micro) spores are known as **heterosporous**. Microspore and macrospore germinate and gives rise to male and female gametophyte respectively.

- The female gametophytes in these plants are retained on the parent sporophyte for variable period. The development of zygote into young embryo takes place within the female gametophytes. This events is a precursor to the **seed habits** considered an important steps in evolution
- Pteridophytes further classified into four classes: Psilopsida (*Psilotum*), Lycopsida (*Selaginella*), Sphenopsida (*Equisetum*) and Pteropsida (*Pteris*).

GYMNOSPERMS :

- Have naked seeds as the ovules are not enclosed by any ovary wall and remain exposed both before and after fertilization.
- Gymnosperm includes medium-sized trees or tall trees and shrub.
- Root is generally tap root. May be associated with **myorrhiza.**
- Stem is branched (Pinus), or unbranched (Cycas).
- Leaves may be simple or compound.

REPRODUCTIONS :

- Gymnosperms are heterosporous. They produce haploid microspores and megaspores.
- **Male strobili or cone** has **microsporophylls** which bear **microsporangia** having microspores which develop into reduced gametophyte called **pollen grain**.
- **Female cone or strobili** has **megasporophylls** which bear **megasporongia** having **megaspores** which are enclosed within the **megasporangium** (Nucellus). One megaspore develops into female gametophyte bearing two or more**archegonia.**
- Pollen grains carried in air currents reach ovules, form pollen tube which reach archegonia and release male gametes which fertilize egg cell and form zygote which produce embryos. Ovules develop into seeds which are not covered.

ANGIOSPERMS :

- Called flowering plants and have seeds enclosed in fruits.
- Divided into two classes − Dicotyledons (have two cotyledons) and Monocotyledons (have one cotyledon).
- Smallest angiosperm: ***Wolfia*** (microscopic).
- Large tree: **Eucalyptus** over 100 meters.
- Reproductive organs developed in **flowers**.
- Male sex organs in a flower are called **stamens**.
- Stamen has **filament** and **anther**. Anthers on meiosis produce **pollen grains**. Pollen grains have two male gametes.
- Female sex organs are **pistil**.
- Pistil has **stigma**, **style** and **ovary**. Ovary has one or many ovule in which female gametophyte (**embryo sac**) develops by meiosis.
- Embryo sac has 7 cells and 8 nuclei. One **egg cell**, 2 **synergids**, 3 **antipodal** and one central cell having two polar nuclei.
- Pollen grain is carried by wind; water etc. reaches to stigma and produces pollen tube which enters embryo sac.

Double fertilization:

- **Syngamy**: One male gamete fuses with egg cell to form zygote which develops into embryo.
- **Triple fusion**: Other male gamete fuses with secondary nucleus (formed by fusion of two polar nuclei) which forms triploid primary endosperm nucleus (PEN). PEN develops into endosperm which nourishes the developing embryo.
- Ovules develop into seeds and ovaries into fruits.

Alternation of generation: Haploid gametophytic and spore producing sporophytic generation alternate with each other in this process.

- **Haplontic:** Gametophytic phase dominant. e.g., Chlamydomonas
- **Diplontic**: Sporophytic phase dominant. e.g., Angiosperms and Gymnosperms

- **Haplo-Diplontic**: Intermediate like stage where gametophytic and sporophytic stage partially dominates at different stages. e.g., Bryophytes and Pteridophytes.

Exceptions: Ectocarpus, Polysiphonia are Haplo-diplontic algae. Fucus is diplontic alga.