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PLANT KINGDOM

Basis of classification

1. Artificial system of classification

The earlier system of classification given by Linnaeus is considered artificial system because:

(i) It used only gross superficial morphological characters like habit, colour, number and shape of leaves etc.

(ii) The system was based on vegetative characters or on the structure of androecium.

2. Natural system of classification

(i) It is based on natural affinities among the organisms.

(ii) It considers not only the external features but also internal features like ultrastructure (structures visible under higher magnification and with electron microscope) and anatomy.

3. Phylogenetic system of classification

In the present system of classification the phylogeny of organisms is also taken into account along with the natural classification. At present we follow the phylogenetic system of classification.

(i) It is based on the evolutionary relationships between various organisms.

(ii) It assumes that the organisms belonging to the same taxa have a common ancestor.

Numerical taxonomy:

It is based on all observable characteristics. It is now easily carried out using computers. Numbers and codes are assigned to all the characters and data is fed into the computer.

Cytotaxonomy:

It is based on the cytological information available about the organisms. It considers information like chromosome number, structure, behavior etc.

Chemotaxonomy: It uses the chemical constituents of the plants to classify or group them.

Algae

Algae are chlorophyll-bearing, simple, thalloid, autotrophic and largely aquatic (both fresh water and marine) organisms. They occur in a variety of other habitats: moist stones, soils and wood. Some of them also occur in association with fungi (lichen) and animals.

Reproduction

Algae reproduce by vegetative, asexual and sexual means.

Vegetative reproduction is by fragmentation.

Each fragment develops into a thallus.

Asexual reproduction is by the production of different types of spores, the most common being the zoospores. They are flagellated (motile) and on germination gives rise to new plants.

Sexual reproduction takes place through fusion of two gametes. These gametes can be flagellated and similar in size (as in Ulothrix) or non-flagellated (non-motile) but similar in size (as in Spirogyra).

Such reproduction is called isogamous.

Fusion of two gametes dissimilar in size, as in species of Eudorina is termed as anisogamous.

Fusion between one large, non-motile (static) female gamete and a smaller, motile male gamete is termed oogamous, e.g., Volvox, Fucus.

Economic importance

1. Algae are the main producers in marine water. At least half of the total carbon dioxide fixation on earth is carried out by algae through photosynthesis.

2. Being photosynthetic, they increase the level of dissolved oxygen in their immediate environment.

3. Many species of Porphyra, Laminaria and Sargassum are among the 70 species of marine algae that are used as food.

CHLOROPHYCEAE:

The members of chlorophyceae are commonly called green algae.

The plant body may be unicellular, colonial or filamentous.

They are usually grass green due to the dominance of pigments chlorophyll a and b.

The chloroplasts may be discoid, plate-like, reticulate, cup-shaped, spiral or ribbon-shaped in different species.

Most of the members have one or more storage bodies called pyrenoids located in the chloroplasts.

Pyrenoids contain protein besides starch. Some algae may store food in the form of oil droplets.

Green algae usually have a rigid cell wall made of an inner layer of cellulose and an outer layer of pectose.

Reproduction

They reproduce vegetatively, asexually and sexually.

(a) Vegetative reproduction usually takes place by fragmentation.

(b) Asexual reproduction is by flagellated zoospores produced in zoosporangia.

(c) Sexual reproduction show considerable variation in the type and formation of sex cells and may be isogamous anisogamous or oogamous. Examples: Chlamydomonas, Ulothrix, Spirogyra, Volvox,

PHAEOPHYCEAE

The members of phaeophycean or brown algae are found primarily in marine habitats.

They show great variation in size and form. They range from simple branched, filamentous forms to profusely branched forms as represented by kelps, which may reach a height of 100 metres.

They possess chlorophyll a, c, carotenoids and xanthophylls.

They vary in colour from olive green to various shades of brown depending upon the amount of the xanthophyll pigment, fucoxanthin present in them.

Food is stored as complex carbohydrates, which may be in the form of laminarin or mannitol.

The vegetative cells have a cellulosic wall usually covered on the outside by a gelatinous coating of algin.

<u>Reproduction</u>

Vegetative reproduction is by fragmentation. The fragment develops into a new plant.

Asexual reproduction in most brown algae is by biflagellate zoospores that are pear-shaped and have two unequal laterally attached flagella.

Sexual reproduction may be isogamous, anisogamous or oogamous. Union of gametes may take place in water or within the oogonium (oogamous species). The gametes are pyriform (pear-shaped) and bear two laterally attached flagella. The common forms are Ectocarpus, Dictyota, Laminaria, Sargassum and Fucus

RHODOPHYCEAE

The members of rhodophyceae are commonly called red algae because of the predominance of the red pigment, r-phycoerythrin in their body.

Majority of the red algae are marine with greater concentrations found in the warmer areas. They occur in both well-lighted regions close to the surface of water and also at great depths in oceans where relatively little light penetrates.

Reproduction

They reproduce by fragmentation.

Asexually, they reproduce by non-motile spores.

Sexual reproduction is oogamous and accompanied by complex post fertilization developments. The common members are: Polysiphonia, Porphyra , Gracilaria and Gelidium.

BRYOPHYTES

Bryophytes are also called amphibians of the plant kingdom because these plants can live in soil but are dependent on water for sexual reproduction.

They usually occur in damp, humid and shaded localities. They play an important role in plant succession on bare rocks/soil.

The plant body of bryophytes is more differentiated than that of algae. It is thallus-like and prostrate or erect, and attached to the substratum by unicellular or multicellular rhizoids.

The main plant body of the bryophyte is haploid. It produces gametes, hence is called a gametophyte.

The sex organs in bryophytes are multicellular.

Reproduction

The male sex organ is called antheridium.

They produce biflagellate antherozoids.

The female sex organ called archegonium is flask-shaped and produces a single egg.

The antherozoids are released into water where they come in contact with archegonium.

An antherozoid fuses with the egg to produce the zygote.

Zygotes do not undergo reduction division immediately. They produce a multicellular body called a sporophyte.

The sporophyte is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it.

These spores germinate to produce gametophyte.

Economic importance

1. Mosses bind soil and hence prevent erosion .

2. Moss is used in the houses as a moss stick to absorb and hold water for the plant .

3. Mosses along with lichens are the first organisms to colonise rocks and hence , are of great ecological importance. They decompose rocks making the substrate suitable for the growth of higher plants .

Liverworts

The liverworts grow usually in moist, shady habitats such as banks of streams, marshy ground, damp soil, bark of trees and deep in the woods.

The plant body of a liverwort is thalloid, e.g., Marchantia. The thallus is dorsiventral and closely appressed to the substrate.

The leafy members have tiny leaf-like appendages in two rows on the stem-like structures.

Asexual reproduction in liverworts takes place by fragmentation of thalli, or by the formation of specialized structures called gemmae .

Gemmae are green, multicellular, asexual buds, which develop in small receptacles called gemma cups located on the thalli.

The gemmae become detached from the parent body and germinate to form new individuals.

sexual reproduction, male and female sex organs are produced either on the same or on different thalli.

The sporophyte is differentiated into a foot, seta and capsule. After meiosis, spores are produced within the capsule. These spores germinate to form free-living gametophytes.

Mosses

The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages.

The first stage is the protonema stage, which develops directly from a spore. It is a creeping, green, branched and frequently filamentous stage.

The second stage is the leafy stage, which develops from the secondary protonema as a lateral bud.

They consist of upright, slender axes bearing spirally arranged leaves. They are attached to the soil through multicellular and branched rhizoids.

This stage bears the sex organs

Reproduction

Vegetative reproduction in mosses is by fragmentation and budding in the secondary protonema.

In sexual reproduction, the sex organs antheridia and archegonia are produced at the apex of the leafy shoots. After fertilisation, the zygote develops into a sporophyte, consisting of a foot, seta and capsule.

The mosses have an elaborate mechanism of spore dispersal.

Common examples of mosses are Funaria, Polytrichum and Sphagnum

PTERIDOPHYTES

The Pteridophytes include horsetails and ferns. Pteridophytes are used for medicinal purposes and as soil-binders. They are also frequently grown as ornamentals. Evolutionarily, they are the first terrestrial plants to possess vascular tissues – xylem and phloem.

In pteridophytes, the main plant body is a sporophyte which is differentiated into true root, stem and leaves .

These organs possess well-differentiated vascular tissues. The leaves in pteridophyta are small (microphylls) as in Selaginella or large (macrophylls) as in ferns.

The sporophytes bear sporangia that are subtended by leaf-like appendages called sporophylls.

The sporangia produce spores by meiosis in spore mother cells. The spores germinate to give rise to inconspicuous, small but multicellular, free-living, mostly photosynthetic thalloid gametophytes called prothallus.

These gametophytes require cool, damp, shady places to grow. Because of this specific restricted requirement and the need for water for fertilization.

The gametophytes bear male and female sex organs called antheridia and archegonia, respectively.

Water is required for transfer of antherozoids – the male gametes released from the antheridia, to the mouth of archegonium.

Fusion of male gamete with the egg present in the archegonium result in the formation of zygote.

Zygote there after produces a multicellular well-differentiated sporophyte which is the dominant phase of the pteridophytes. In majority of the pteridophytes all the spores are of similar kinds; such plants are called homosporous.

Genera like Selaginella and Salvinia which produce two kinds of spores, macro (large) and micro (small) spores, are known as heterosporous.

The megaspores and microspores germinate and give rise to female and male gametophytes, respectively.

The female gametophytes in these plants are retained on the parent sporophytes for variable periods. The development of the zygotes into young embryos take place within the female gametophytes

The pteridophytes are further classified into four classes: Psilopsida (Psilotum); Lycopsida (Selaginella, Lycopodium), Sphenopsida (Equisetum) and Pteropsida (Dryopteris, Pteris, Adiantum)

GYMNOSPERMS

Gymnosperms include medium-sized trees or tall trees and shrubs.

Roots in some genera have fungal association in the form of mycorrhiza (Pinus), while in some others (Cycas) small specialized roots called coralloid roots are associated with N_2 - fixing cyanobacteria.

The stems are unbranched (Cycas) or branched (Pinus, Cedrus). The leaves may be simple or compound. In Cycas the pinnate leaves persist for a few years.

The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind. In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss.

The gymnosperms are heterosporous; they produce haploid microspores and megaspores.

The microspores develop into a male gametophytic generation which is highly reduced and is confined to only a limited number of cells.

This reduced gametophyte is called a pollen grain. The development of pollen grains take place within the microsporangia.

The cones bearing megasporophylls with ovules or megasporangia are called macrosporangiate or female strobili.

The megaspore mother cell is differentiated from one of the cells of the nucellus.

The nucellus is protected by envelopes and the composite structure is called an ovule.

The ovules are borne on megasporophylls which may be clustered to form the female cones.

The megaspore mother cell divides meiotically to form four megaspores. One of the megaspores enclosed within the megasporangium develops into a multicellular female gametophyte that bears two or more archegonia or female sex organs.

The multicellular female gametophyte is also retained within megasporangium.

the male and the female gametophytes do not have an independent free-living existence.

They remain within the sporangia retained on the sporophytes. The pollen grain is released from the microsporangium.

They are carried in air currents and come in contact with the opening of the ovules borne on megasporophylls. The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia. Following fertilization, zygote develops into an embryo and the ovules into seeds. These seeds are not covered

ANGIOSPERMS-THE FLOWERING PLANTS

In angiosperms, the seeds are enclosed in fruits. The angiosperms are an exceptionally large group of plants occurring in wide range of habitats.

They provide us with food, fodder, fuel, medicines and several other commercially important products.

They are divided into two classes: the dicotyledons and the monocotyledons