CHAPTER 3

Plant Kingdom

NCERT FOCUS

ANSWERS

Topic 2

1. Fritsch (1935), has classified algae considering phylogeny, affinities and inter-relationships of various forms. He classified algae mainly on the basis of the characters like structure of plant body, nature of the pigments, reserve food material, number and position of flagella, chemistry of cell wall and methods of reproduction, etc. Algae is divided into 11 classes but among them 3 main classes are Chlorophyceae, Phaeophyceae and Rhodophyceae.

2. The occurrence of two kinds of spores in the same plant is called as heterospory. Among them the smaller spore is called microspore and the larger spore is called megaspore. Heterospory first evolved in pteridophytes.

Significance of heterospory :–

(i) Heterospory is associated with the sexual differentiation of gametophyte *i.e.*, a microspore develops into a male gametophyte whereas a megaspore develops into a female gametophyte.

(ii) In homosporous pteridophytes spores have to germinate on soil thus face more environmental problems. In heterosporous pteridophytes, spores germinate within the sporangium and the gametophytes are retained inside for variable periods of time. Hence, germinating gametophyte has better chances of survival. This lays the foundation of complete retention of gametophytes within sporophytes in angiosperms and gymnosperms.

(iii) Heterospory is the basis of development of seed habit in higher plants.

3. (i) Protonema : It is the first, usually branched, green and filamentous structure produced by a germinating moss or fern spore. The protonema of mosses bears buds that develop into the gametophyte plant. In fern the protonema becomes the prothallus.

(ii) Antheridium : The male sex organ of cryptogams (algae, fungi, bryophytes and pteridophytes) is known as antheridium. It produces the male gametes or antherozoids. It may consist of a single cell or it may have a wall that is made up of one or several layers forming a sterile jacket around the developing gametes.

(iii) Archegonium : The multicellular flask shaped female sex organ of bryophytes, pteridophytes and many gymnosperms is known as archegonium. Its dialated base called the venter contains the female gamete or egg or oosphere. The cells of the narrow neck of archegonium liquify to allow the male gametes to swim towards the oosphere.

(iv) Diplontic : It is the kind of life cycle in which the diploid sporophyte is dominant and this diploid phase is photosynthetic. The gametophytic phase is represented either by gametes only, that are formed through meiosis or by a highly reduced few celled gametophyte. *E.g.*, all seed-bearing plants (gymnosperms and angiosperms).

(v) Sporophyll : It is a type of leaf bearing sporangia. In ferns, the sporophylls are the normal foliage leaves, but in other plants the sporophylls are modified and arise in specialised structure such as the strobili of club-moss, gymnosperms and the flower of angiosperms. In most plants sporophylls are of two types – microsporophylls and megasporophylls.

(vi) Isogamy : It is a type of sexual reproduction where fusion takes place between two identical gametes. The gametes are similar in size and structure and they show equal motility during sexual reproduction, *e.g., Spirogyra* (algae).

4. **(i)** The differences between red algae and brown algae are as follows :

S. No.	Red algae	Brown algae
(i)	The major pigment of red algae are chlorophyll *a,d* and phycoerythrin.	The major pigment of brown algae are chlorophyll *a, c* and fucoxanthin.
(ii)	In red algae, floridean starch is the stored food material.	In brown algae, mannitol and laminarin are the stored food materials.
(iii)	In red algae, cellulose is present in cell wall.	In brown algae, cellulose and algin are present in cell wall.

(iv)	Flagella are absent.	The number of flagella is 2, they are unequal in size and lateral in position.
(v)	Thylakoids are unstacked.	Thylakoids occur in groups of three.

(ii) The differences between liverworts and mosses are as follows :

S. No.	Liverworts	Mosses
(i)	The gametophytic plant body may be thallose (*e.g., Riccia)* or foliose.	Gametophytic plant body is differentiated into prostrate, branched filamentous, thalloid protonema and leafy erect gametophore.
(ii)	On the ventral surface of the thallus, unicellular rhizoids and simple multicellular scales are present.	The rhizoids are multicellular, branched with oblique septa.
(iii)	Sex organs are present on dorsal surface of the thallus and develop from superficial cells.	The sex organs develop from the superficial cells at the apex of leafy gametophyte.
(iv)	Elaters are generally present but absent in *Riccia.*	Elaters are absent.
(v)	Stomata are absent in the wall of the capsule.	Stomata are present in sporophyte for gaseous exchange.
(vi)	Dehiscence of capsule is irregular.	Dehiscence is regular.

(iii) The differences between homosporous and heterosporous pteridophytes are as follows :

S. No.	Homosporous pteridophytes	Heterosporous pteridophytes
(i)	In these pteridophytes only one kind of spore is produced.	In these pteridophytes two kinds of spores are produced.
(ii)	The spores are equal in size.	The smaller spores are called microspores and the larger spores are called megaspores.
(iii)	The spores are produced from the same sporangia.	The microspores are produced from the microsporangia and the megaspores are produced from the megasporangia.
(iv)	The spores develop one kind of gametophyte.	The microspore develops into male gametophyte whereas the megaspore develops into female gametophyte.
(v)	Spores germinate in soil and produce independent gametophyte.	Spores germinate within sporangia and produce dependent gametophyte.
(vi)	*E.g., Lycopodium*	*E.g., Selaginella, Salvinia*

Topic 3

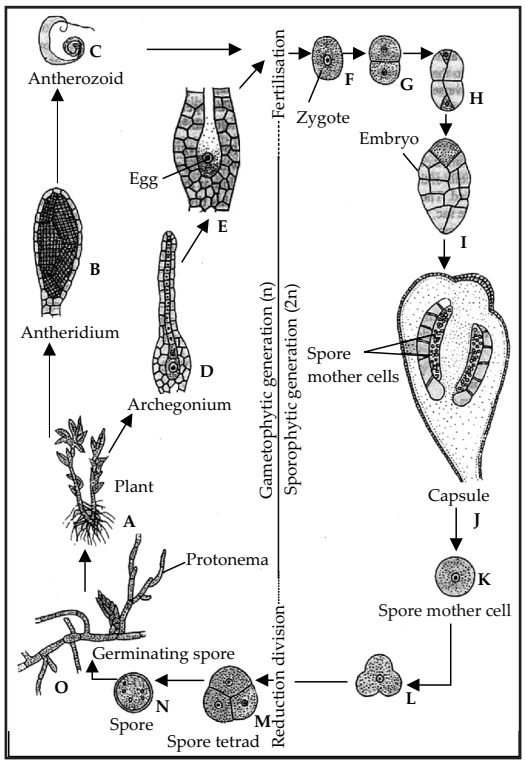
1. The three groups of plants that bear archegonia are bryophytes, pteridophytes and gymnosperms.

Life cycle of a bryophyte is as follows : The main plant body of bryophyte is gametophytic (n), which is independent and may be thallose (no differentiation in root, stem, leaves) *e.g., Riccia*, or may be foliose (having leafy axis) *e.g., Funaria*. The dominant phase in the life cycle of *Funaria* is the gametophyte, which occurs in two stages, the protonema stage and the erect, leafy gametophytic plant.

The leafy gametophyte consists of an upright, slender axis (stem-like) that bears spirally arranged leaves and is attached to the substratum by multicellular, branched rhizoids. Vegetative reproduction takes place by fragmentation; by the buds formed in secondary protonema etc. The sex organs, antheridia and archegonia are produced in clusters at the apices of the leafy shoots. Antheridia produces antherozoids and archegonia produces egg. Antherozoid (male gamete) and egg (female gamete) fuses and form zygote.

Zygote develops into a sporophyte; which is differentiated into foot, seta and capsule and spores are produced in the capsule.

Spores on reaching a suitable substratum germinate to produce a filamentous juvenile stage, called the primary protonema, which later produces secondary protonema that forms erect leafy plants. Diagrammatic representation of life cycle of *Funaria* is shown here.



2. Economic importance of algae is as follows:

The group algae plays both economically beneficial as well as harmful roles.

Beneficial roles :

(i) People of coastal countries have been using sea weeds and certain other algae as source of food, *e.g., Porphyra, Ulva, Laminaria,* etc.

(ii) Some algae are used as food for marine as well as domestic animals, *e.g., Sargassum, Macrocystis.*

(iii) Algae are useful source of many commercial products like agar, a jelly like substance (complex polysaccharide) is extracted form species of red algae belonging to the genera *Gelidium, Gracilaria* etc. Agar is also used as base in culture media. Carrageenin occurs as a cell wall polysaccharide, esterified with sulphate. It is extracted from red alga like *Chondrus crispus* etc. and is used in pharmaceutical emulsifier and textile, leather, cosmetic industries. Alginates are salts of alginic acid found in the cell wall of Phaeophyceae (brown algae) like *Fucus, Laminaria,* etc.

(iv) Algae are also useful in medicine industry. Antibiotic chlorellin is obtained from *Chlorella*. Extracts of *Cladophora, Lyngbya* kill strains of *Pseudomonas* and *Mycobacterium* like bacteria. *Nitella* is used to destroy mosquitoes growth in ponds and hence used in control of malaria.

(v) Some sea weeds like *Fucus, Lithophyllum, Lycophyllum,* etc. are rich in K, P, trace elements and growth substances and are used as fertilisers by coastal people.

(vi) Some algae like *Chlorella, Chlamydomonas,* etc. are used in sewage disposal in ponds. These algae help in bacterial decomposition by providing O_2.

(vii) Some algae like *Chlorella, Synecoccus,* etc. are used in space travels. A person inside a spaceship will need a device to get rid of CO_2 and other body wastes and will require sources of O_2 and food. These algae are very useful for this purpose.

(viii) A large amount of iodine (mineral element present in thyroxine hormone of thyroid gland) is extracted from kelps (brown sea weeds or members of phaeophyceae) like *Laminaria, Fucus, Ascophyllum* etc. Similarly red algae like *Rhodomela, Polysiphonia, Rhodymenia* are sources of bromine.

Harmful roles:

(i) Some green algae like *Chroococcus,* grow over the surface of water bodies in abundance and cause water bloom. On death and decay these algae give off bad smell. Some algae secrete poisonous or toxic substances.

(ii) Parasitic algae like *Cephaleuros virescens* causes red rust of tea, coffee, etc.

Economic importance of gymnosperms is as follows :

(i) Some species of *Cycas* like *C. revoluta, C. rumphii* look like palm tree and are used for decoration purposes as they remain fresh for long period.

(ii) Stem portion of *Cycas revoluta* is a good source of 'sago', a kind of starch used in making bread by poor people. Seeds of some species of *Cycas* are roasted and taken as food. Young succulent leaves of some species of *Cycas* are cooked as vegetable.

(iii) Many gymnosperms have medicinal value. The fresh juice extracted from the *Cycas circinalis* leaves is used as medicine for stomach disorders, blood vomiting and other skin diseases. Pollen grains of some *Cycas* plants are reported to have some narcotic effect.

(iv) Some gymnosperms like *Pinus, Abies, Cedrus* are the chief source of various types of woods. The wood of *Juniperus* is used in making pencils, scales, holders, etc.

(v) Some species of *Pinus* is a good source of turpentine, wood gas, wood alcohol.

3.

Chlamydomonas	–	Algae
Cycas	–	Gymnosperm
Selaginella	–	Pteridophyte
Sphagnum	–	Moss

4. The term gymnosperm is derived from two Greek words: *Gymnos* = naked + *Sperma* = seed, *i.e.*, naked seeded plants. So gymnosperms are a group of plants in which the ovules are freely exposed on open megasporophylls. The important characteristics of gymnosperms are :

– Living gymnosperms are perennial and vary from predominantly medium–sized trees (*Cycas*) to tall trees (*Pinus*) and shrubs (*Ephedra*).

- Plants possess tap root system. Some genera possess symbiotic relationship of N_2 fixing algae in coralloid roots (*Cycas*) and fungi in mycorrhizal roots (*Pinus*).
- The stems are aerial, erect, branched (unbranched in *Cycas*) and woody.
- The leaves may be simple or compound. They are scaly and foliage also. Leaves are well adapted to withstand extremes of temperature, humidity and wind.
- Roots are characterised by the presence of diarch to polyarch vascular bundles. Xylem is exarch.
- Stems are provided with collateral, endarch and open vascular bundles which are arranged in a ring. Secondary growth is present and annual rings are formed.
- Xylem contains xylem parenchyma and tracheids with bordered pits and vessels are absent (except in *Gnetum*, *Ephedra* and *Welwitschia*).
- Phloem contains sieve cells and phloem parenchyma and companion cells are absent (except in *Gnetum*; *Ephedra* and *Welwitschia*).
- Leaves are protected by thick layers of cuticle. Sunken stomata are present. Mesarch xylem and transfusion tissues are found in the leaves. Palisade tissue and spongy parenchyma may be present in mesophyll or it may be undifferentiated.
- The reproductive organs form cones or strobilus except female organs of *Cycas*.
- The male cone is made of overlapping microsporophylls, that bear microsporangia on the abaxial side which produce microspores.
- Female cone is formed by overlapping megasporophylls which bear ovules (megasporangia).
- Ovule is orthotropous, unitegmic with 3 layers *i.e.* outer fleshy, middle stony and inner fleshy.
- The nucellus of ovule contains single megaspore mother cell which undergoes reduction division to form 4 megaspores, out of which 3 degenerate and only one survives.
- So gymnosperm is heterosporous *i.e.* producing microspores and megaspores.
- Single megaspore forms haploid female gametophyte or endosperm before fertilisation.
- At micropylar end of female gametophyte 2 or more archegonia are produced. Archegonium is with reduced neck (with no neck canal cell).
- Microspores are released from microsporangium and are carried in air currents and come in contact with the micropyle of the ovules.
- Pollen tube carrying the male gametes grows towards archegonia and discharges its contents near the mouth of the archegonia.
- After fertilisation zygote or oospore gives rise to embryo proper and the ovules develop into seeds.
- Polyembryony *i.e.*, development of more than one embryo is an usual feature of gymnosperms but only one of them survives at later stage.
- In embryo 2 or many cotyledons are present.
- The seeds of gymnosperms are uncovered.

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