Course: B.SC.Botany
Semester: II
Paper Code: BOT CC-204
Paper Name: Archegoniate
Topic: Sphagnum
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SPHAGNUM

Systematic Position: **KINGDOM PLANTAE**
DIVISION BRYOPHYTA
CLASS SPHAGNOPSIDA
ORDER SPHAGNALES
FAMILY SPHAGNACEAE
GENUS SPHAGNUM

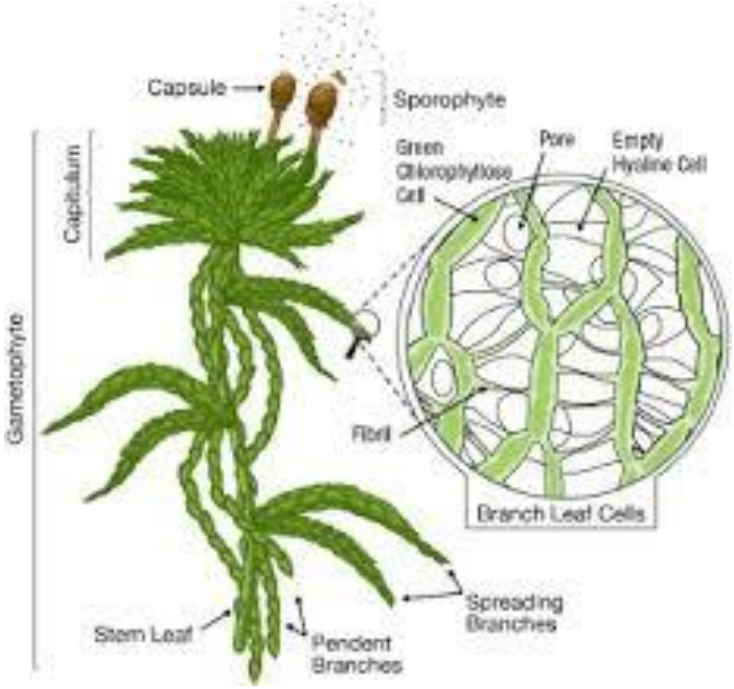
Description

Sphagnopsida comprise of a single order **Sphagnales** of a single family **Sphagnaceae** with a single and very distinct genus **Sphagnum.** It is commonly called **bog moss**

or peat moss. About 350 species of Sphagnum are distributed all over the high, cool and very wet regions of the earth. Common species are S.*ovatum*, S.f*imbriatum*, S.*cuspidatulum*, etc.

The plants are perennial and of aquatic and subaquatic habit growing in extremely moist situation. They encroach under water bodies and may completely cover up the bottom and form a bog. Angiospermic plants then encroach the bog and topographical feature gradually changes. The water of the bog becomes acidic, a condition when Sphagnum thrives. In this condition there is little decay of the old basal part of gametophyte so it accumulates, years after years, followed by compression from plants on top leads to the development of dark colored peat (later on forms coal). When dried it becomes handy fuel (bog/peat moss).

Due to water absorbing capacity of Sphagnum, they are favored as a packaging material for transporting living things and as a water retaining constituent for preparing seed beds. After proper treatment it can replace absorbent cotton used for dressing wounds. So Sphagnum has much economic importance.



The Gametophyte

The shoots of the mature gametophytic plant are of whitish or brownish green in color. They do not bear rhizoids. They are perennial and are of unlimited growth, They are differentiated in stem (1-2mm in diameter) and leaf. The stem is well branched. Near the apex the branches are short and are of limited growth . Very young gametophyte show delicate rhizoids.

Branchings are of two types:

1 Divergent branches -- These branches grow out laterally from the stem and extend outwards in a horizontal position.

2 Drooping branches – These branches grow out laterally from the stem, droop or hang very close to stem.

Growth is by means of apical cell with three cutting faces. Each segmental cell cut off by this gives rise to a single leaf, portion of stem and one remains meristematic for another division.

At intervals on the stem a leaf bears an axillary cluster of lateral branches.

The small leaves are of a typical construction. Each dividing leaf cell gives rise to two asymmetrical cells, one small towards the margin and one large. Eventually the small cells mature into elongated green cells while the large cell enlarges in all direction and becomes spirally thickened, develops pits on the walls and becomes hyaline by losing its protoplast.

The leaf remains one-cell thick. The hyaline cells play important role in absorption & retention of water. Due to this they don't need rhizoids when mature.

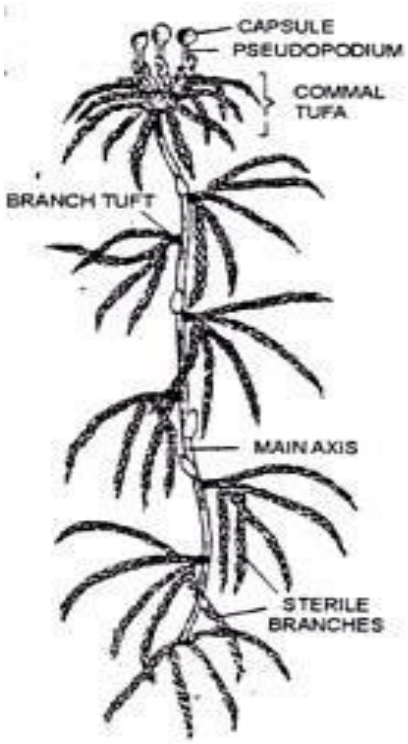


Fig. 2. *Sphagnum*. An adult leafy gametophore showing the comal tuft.

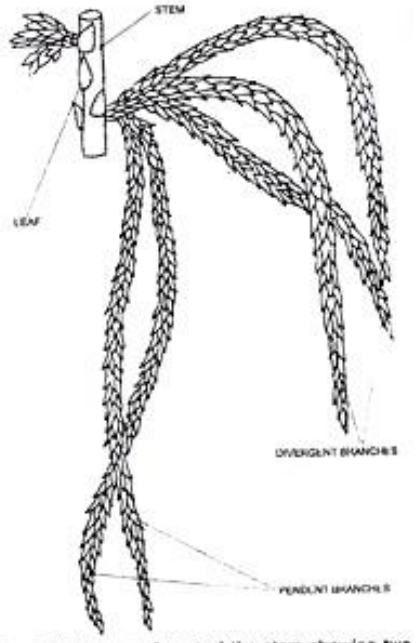


Fig. 3. *Sphagnum*. A part of the stem showing two types of branching.

Leaves

Leaves are borne on the main stem as well as on the branches where they are overlapping. Leaves are arranged in a spiral manner with a phyllotaxy of 2/5, sixth leaf will come above the first leaf. They are thin, small, fleshy, oblong with a broad base. The margin is entire with acute apex. Mid rib is absent. The leaf consists of two types of cells – Small photosynthetic cells containing chlorophyll and Large hyaline rhomboidal cells having small pores. They are concerned with intake of water.

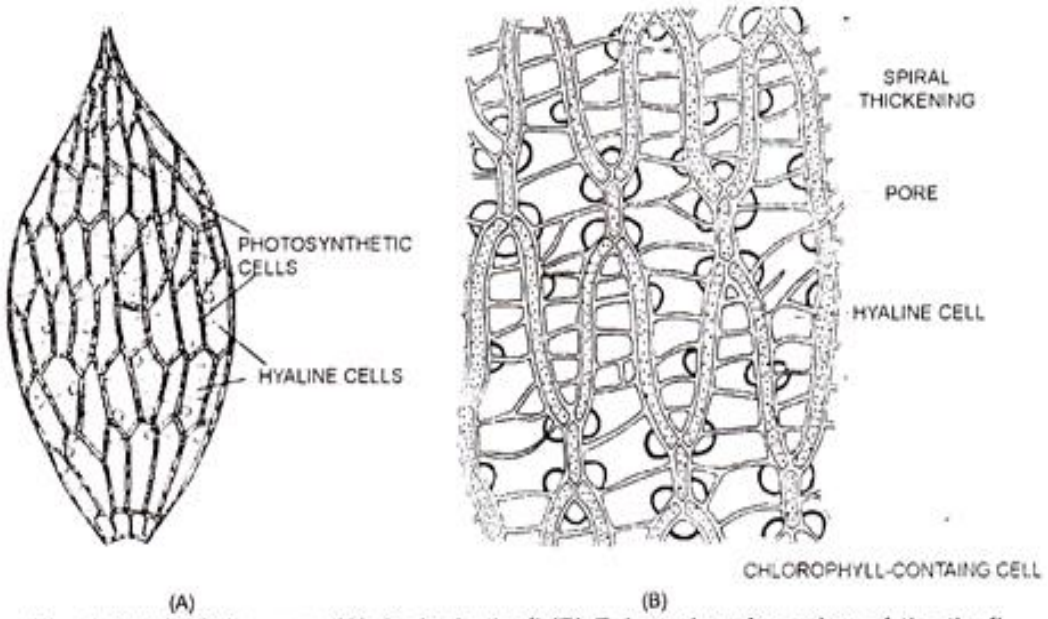


Fig. 4 (A–B). *Sphagnum*. (A) A single 'leaf' (B) Enlarged surface view of the 'leaf'.

Vegetative propagation

As the shoots are perennial the common mode of reproduction is vegetative. Branch shoots get detached from the mother plant by decay of the lower part and they form independent plants.

Sexual reproduction

Sphagnum may be monoecious or dioecious but the antheridia and archegonia are always borne on special separate **antheridial** and **archegonial** branches.

The antheridial branches arise near the apex of the main shoot but later carried downwards by the eventual growth of the apex. The leaves on the antheridial branch are closely imbricate and resembles foliage leaves, are shorter and more brightly colored.

The antheridia develops acropetally. Each antheridial initial is a superficial cell of the stem. This develops a short filament, the top cell forms **antheridium** with a jacket of one layer of cells enclosing a large number of androcytes formed from sperm mother cell. The androcytes contain the **antherozoids** which are coiled structure with two long cilia of equal lengths.

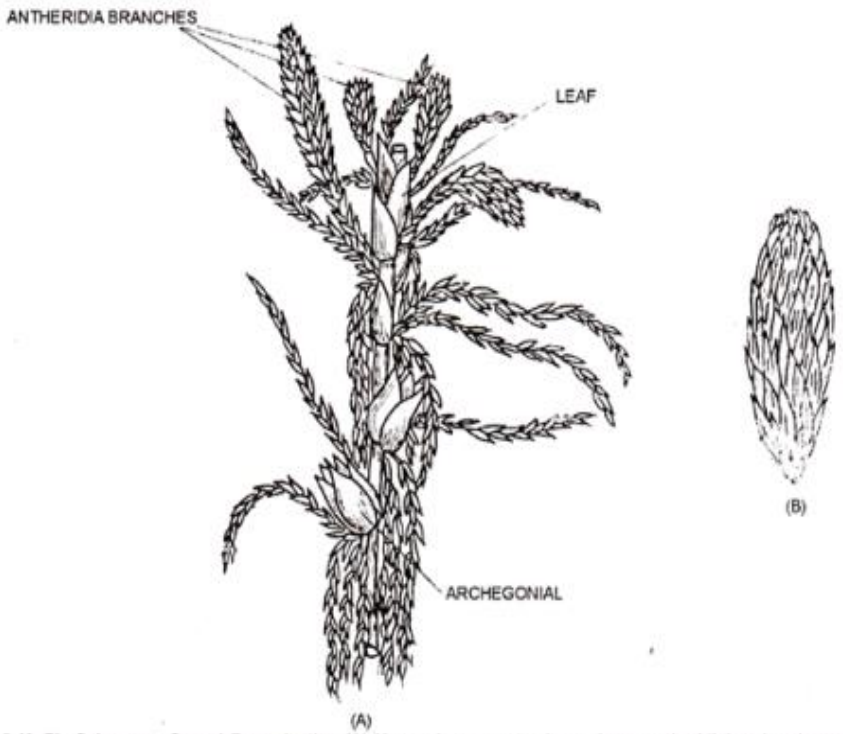


Fig. 8 (A–B). *Sphagnum*. Sexual Reproduction (A) Monoecious gametophore shows antheridial and archegonial branches; (B) An antheridial branch.

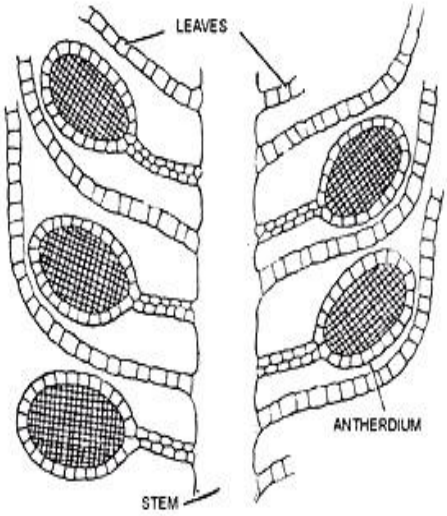


Fig. 9. *Sphagnum*. Sexual reproduction. Longitudinal section (L.S.) of antheridial branch

The Archegonia

The archegonia develops on the tip of archegonial branch which may develop on the apex or laterally. The leaves on this branches are larger than the foliage leaves and hyaline cells are less fibrose. These constitute the **perichetium** enclosing the archegonia. The apical cell of the branch forms the primary archegonium. Two to four archegonia develops from two to four segment cut off by the initial cell. **A mature archegonium** shows a stalk, a twisted **neck** formed by 5 or 6 vertical rows of cells with the **cover cells** (not so distinct) 8-9 **neck canal cells**, a **ventral canal cell** and the **egg** in the **venter** whose wall is multilayered.

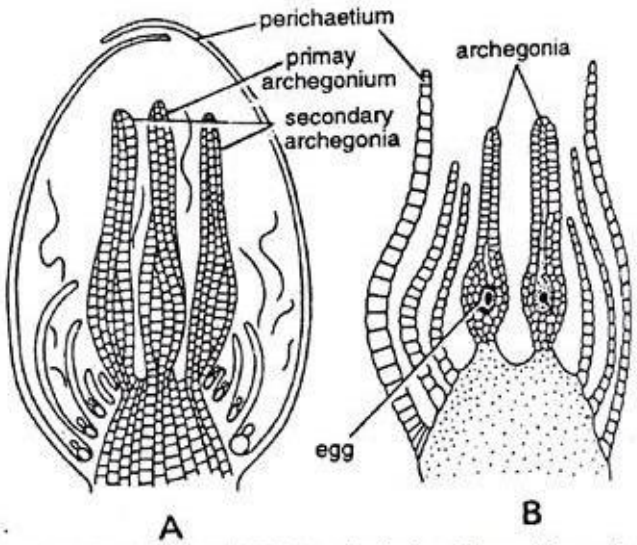


Fig. 11 (A, B). *Sphagnum*. Sexual reproduction (A, B). Longitudinal sections of the archegonial branches showing archegonia (C) Mature archegonium.

Fertilization

The mature antheridium opens at the top, the androcyte mass comes out and the antherozoids are liberatd immediately. The archgonium also opens at the tip, the neck canal cells are disorganized and fertilization takes place which is ultimate fusion of the egg with the antherozoid to form zygote.

The sporophyte

The **zygote** of only on archegonium in an archegonial branch develops an **embryo** while the other archegonia wither early. The zygot forms a transverse wall to divide in two. Transverse division continues until a **filament** of 6-7 cells is formed.

The lower half of the filament divides irregularly forming a **bulbous foot**, the lowest cell is haustorial which helps in absorption of food material from the gametophyte.

The upper cells of the filament divide periclinally. Soon an inner **endothecium** and an outer **amphithecium** are differentiated. Endothecium remains sterile and forms **columella**. The inner layer forms a **jacket** 4-6 layers thick. The jacket cells remain green till the sporophyte matures. There is only a short **neck** and no proper seta connecting the upper capsule and the lower foot. Tissue of the gametophyte just below foot develops into long stalk raising the sporophyte and is called the **pseudopodium**. The archesporial cells form the **spore mother cells** which divide meiotically developing the **spores**.

The mature sporophyte shows an almost spherical, black to dark-brown **capsule** and a **bulbous foot** connected by a very short **neck.** The whole sporophyte is covered by the **calyptra**. The lower part of the calyptras surrounding the foot is called the **vaginula**. Below the sporophyte is the **pseudopodium** which is a stalk increasing in length pushing out the sporophyte. The capsule shows a **jacket** of 4-6 layers and the **spore-sac** full of **spores**, overarches over the dome-shaped columella. The outermost layer of the jacket becomes thickened loses chlorophyll and develops non-functional **stomata** in which there are **guard cells** The convex top of the jacket becomes differentiated into an **operculum** which is connected with thin walled **annulus.** The pseudopodium carries up the sporophyte which becomes dark colored. Air enters the spore-sac below which the space increases due to drying up of the columella. The air expanded by heat makes the capsule burst so that the operculum breaks at the annulus and spores are thrown off inches high.

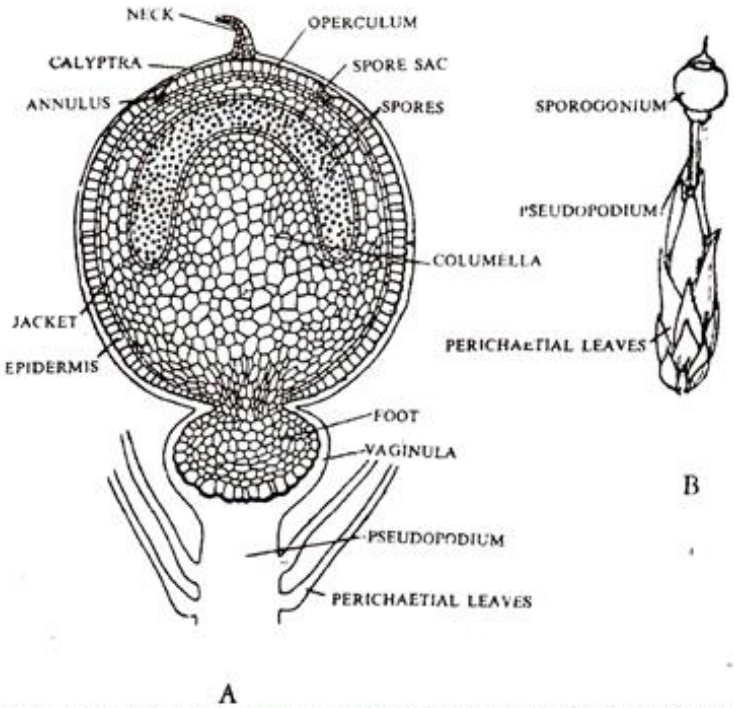


Fig. 12. (A, B). *Sphagnum.* (A) L. S. of mature sporogonium, (B) Female branch with sporogonium.

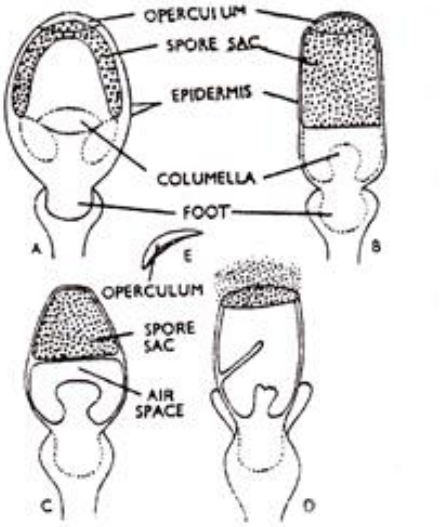


Fig. 13. (A–D). *Sphagnum* : Stages in the dispersal of spores.

Germination of spores

The **spore** falling on a moist substratum germinates developing a small thalloid **protonema**. This develops further forming a prostrate, green irregularly lobed thalloid structure. On this protonema a single **bud** is developed from a marginal cll and this develops the new leafy **gametophyte.**

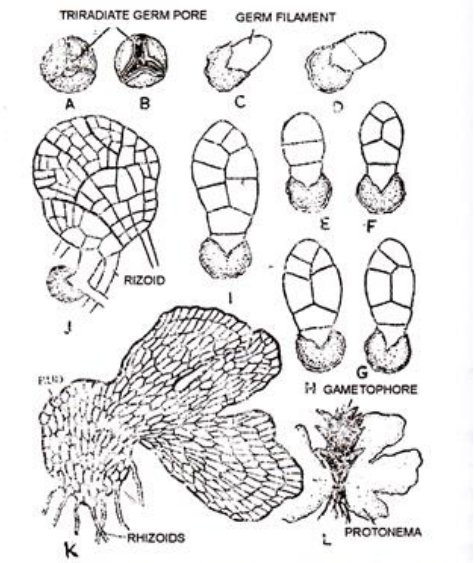


Fig. 14 (A–L) *Sphagnum*. Gemination of spore and formation of leaf gametophore.

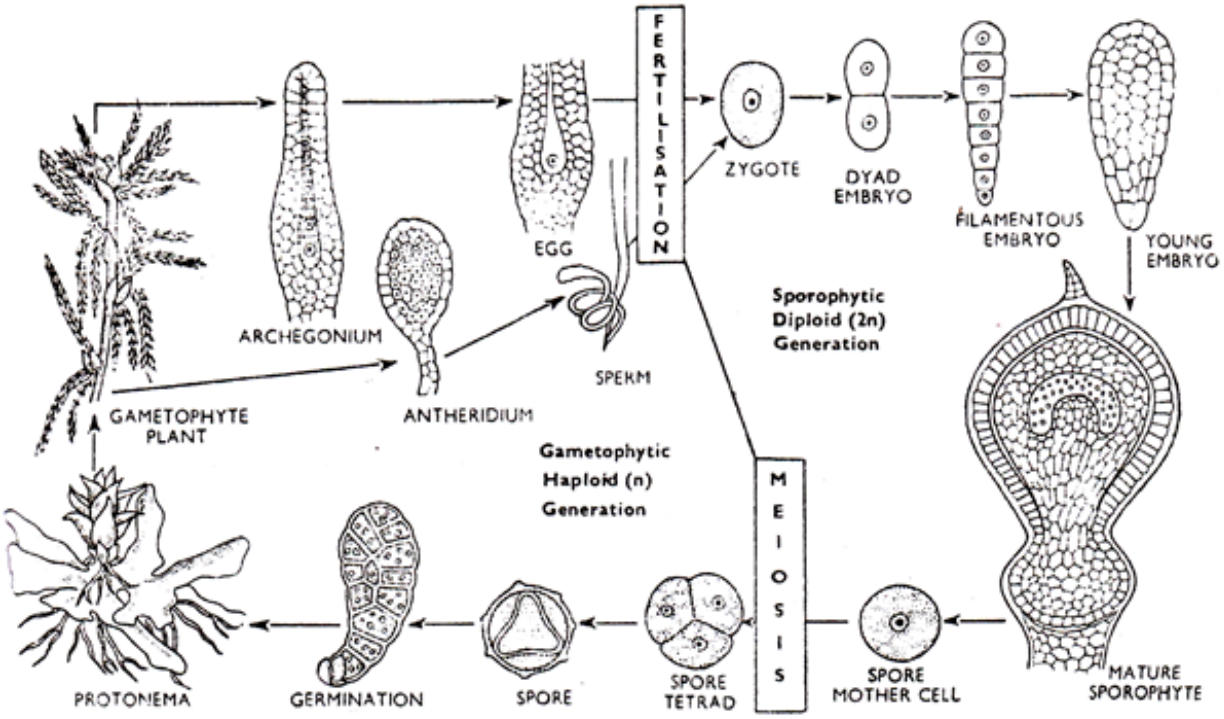


Fig. 16. *Sphagnum*. Diagrammatic life cycle.

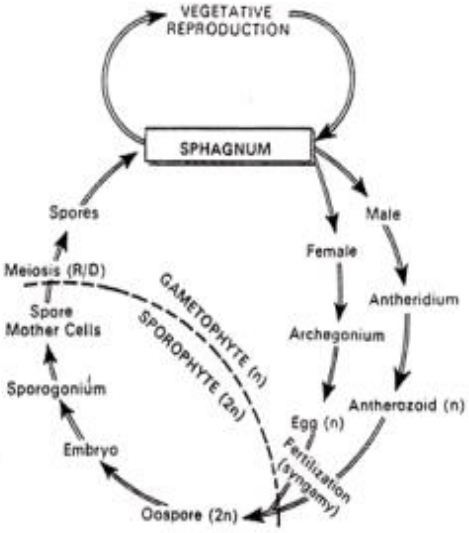


Fig. 15. *Sphagnum*. Graphic life cycle.

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