Lichens and Mycorrhiza

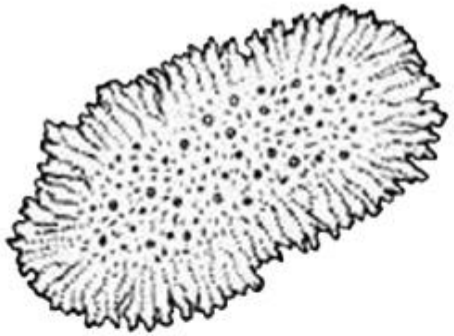
Dr. Aditi Chatterjee

Dept. of Botany

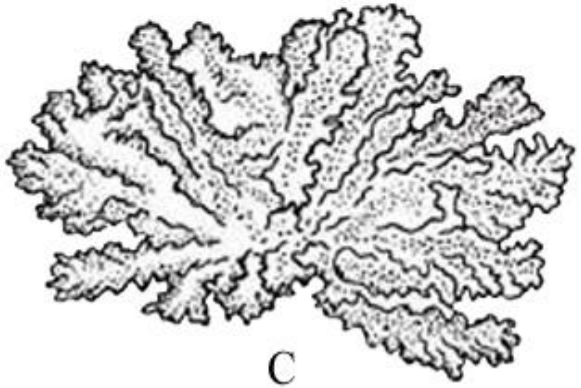
VJR College

Lichens:

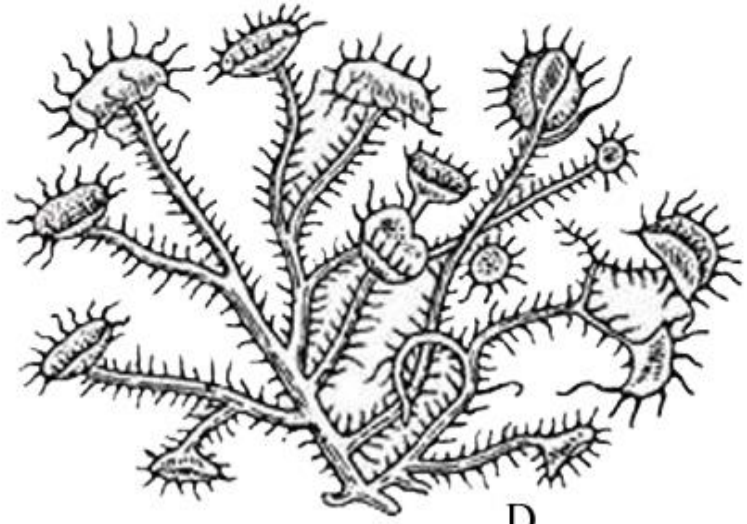
A



B

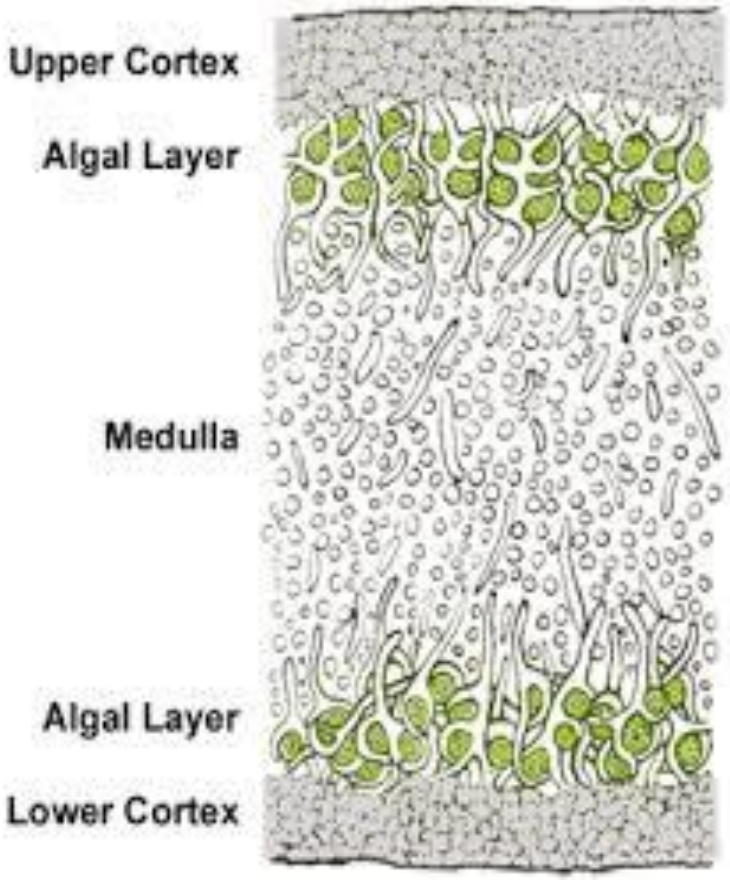


C



D

Fig: Different types of Lichens. (A) Leprose, (B) Crustose, (C) Foliose and (D) Fructose.



They are mainly classified on the basis of their morphology and size into 3 major categories namely:-

1. **Crustose**

- They are crust like.
- Tightly attached to the substrate.
- Have only upper surface.
- They are microlichens.

2. Foliose

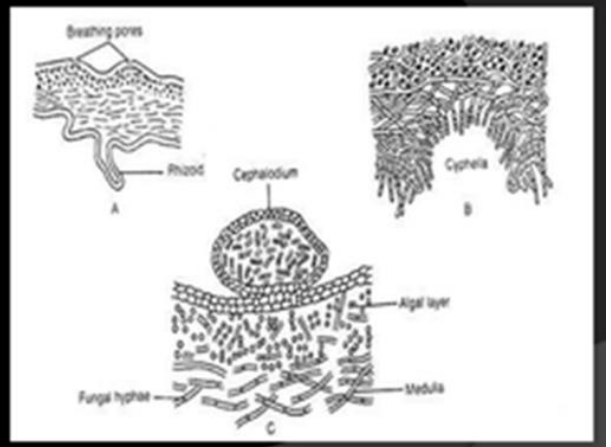
- They are usually flat and leaf like and can be loosely to tightly attached.
- They have an upper and lower surface.
- They are called macrolichens.

3. Fruticose

- They are shrubby or bushy, sometimes they hang down.
- Most of them don`t have any upper and lower surface but are often round in cross section.
- They are also called macrolichens.

STRUCTURES ASSOCIATED WITH THE LICHEN THALLUS:

- **1. Breathing Pores-** In some foliose lichen (e.g., *Parmelia*), the upper cortex is interrupted by some opening, called breathing pores, which help in gaseous exchange
- **2. Cyphellae** -On the lower cortex of some foliose lichen (e.g., *Sticta*) small depressions develop, which appears as cup-like white spots.
- **3. Cephalodium-** These are small warty outgrowths on the upper surface of the thallus. They contain fungal hyphae of the same type as the mother thallus, but the algal elements are always different. They probably help in retaining the moisture.



2.Cyphellae

- They are aerating organs
- Seen in lower cortex of foliose lichens as circular cavities
- Example:- *Sticta sylvatica*

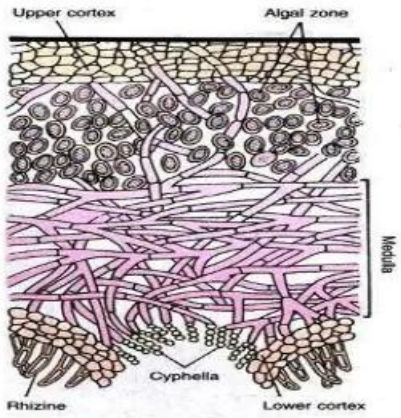


Fig. 20.4. *Lichens.* V. S. thallus passing through a *Cyphella.*

Sticta sylvatica bearing cyphellae

4. cephallodia

- They are externally or internally gall like outgrowths, generally of dark color on the lichen thalli
- They consists of same fungal hyphae as in the thallus but the algal component is different

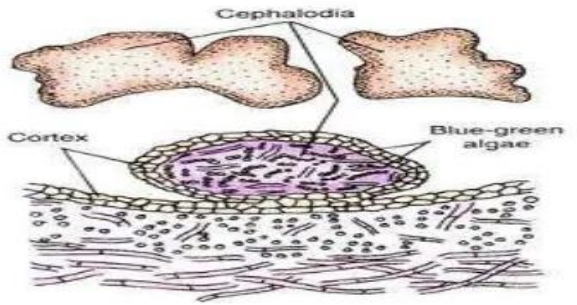
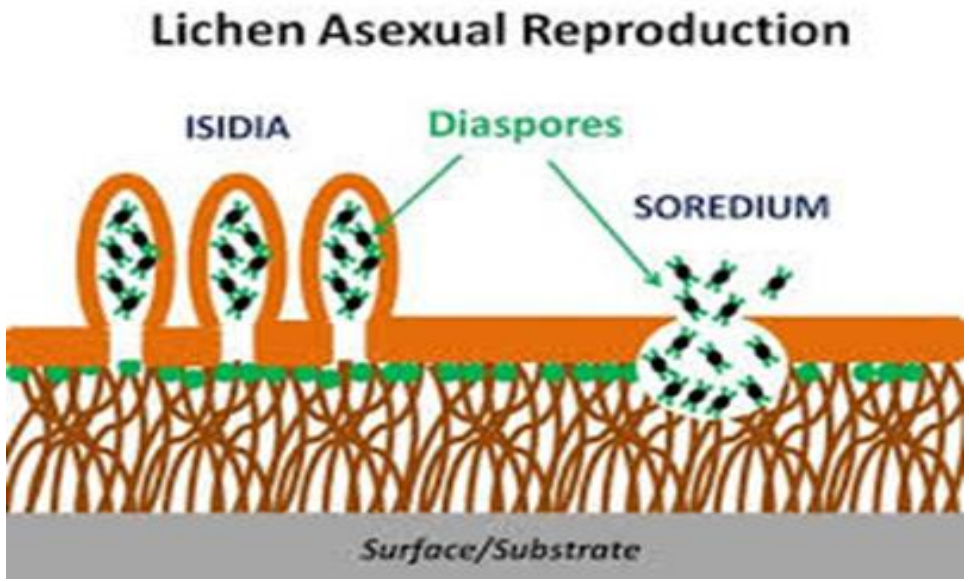


Fig. 20.5 (A–B). *Lichens.* A. Cephalodia in surface view; B. V. S. Thallus passing through the Cephalolium.



3. Isidia

- They are small , stalked coral like outgrowths from the upper surface of lichen thallus
- Function is increase the photosynthetic surface of thallus

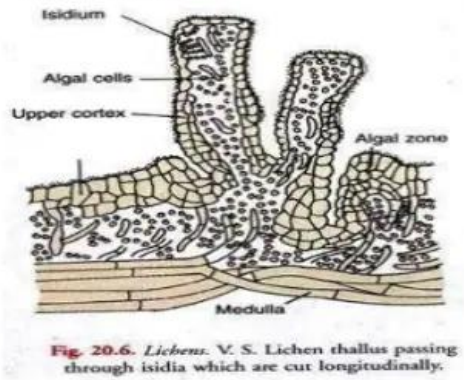
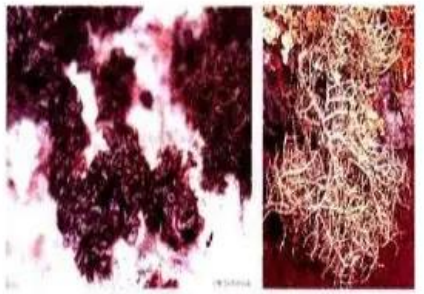


Fig. 20.6. *Lichens.* V. S. Lichen thallus passing through isidia which are cut longitudinally.



Collema *Usnea*

EXAMPLES OF LICHENS HAVING ISIDIA

5.Soredia

- They are small bud like outgrowths on lichen thalli
- Greyish in color
- Soredia sometime produce a pustule like outgrowth is called sorelium

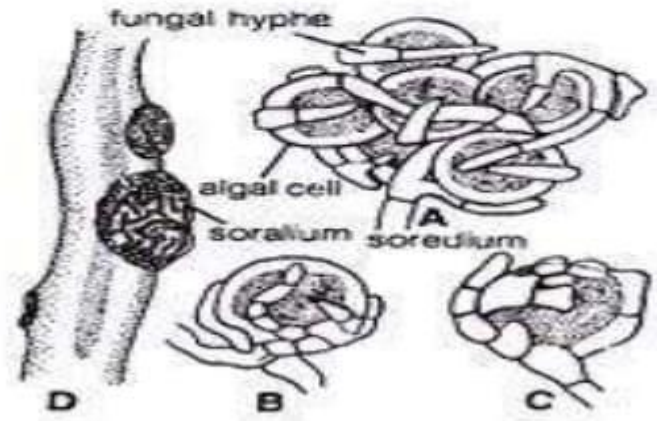
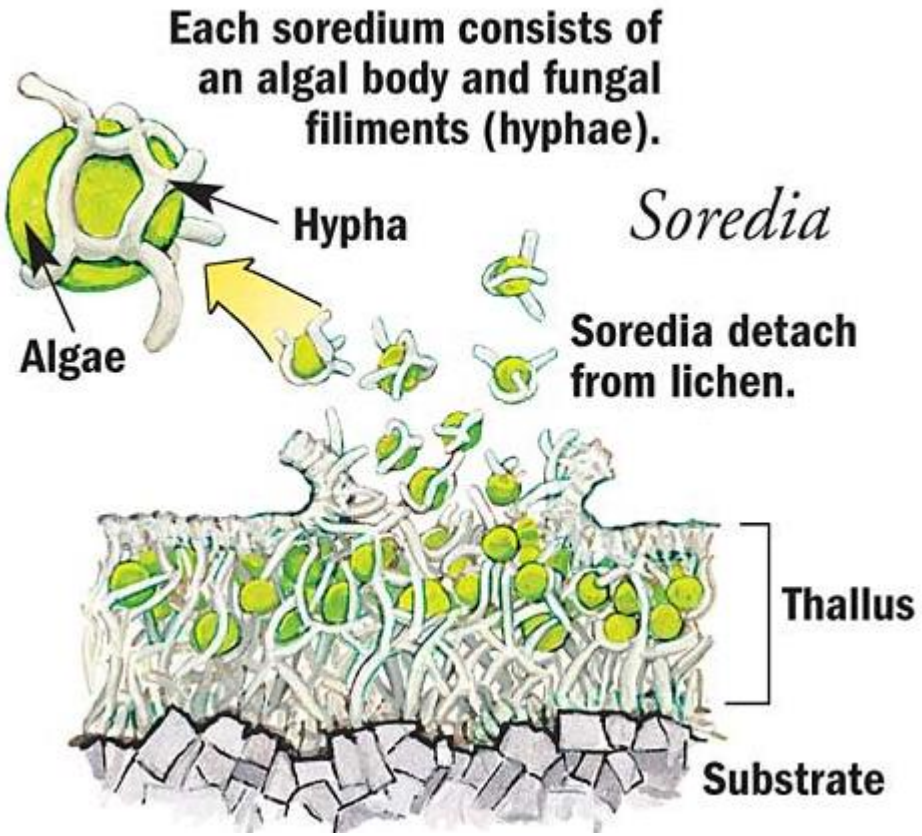


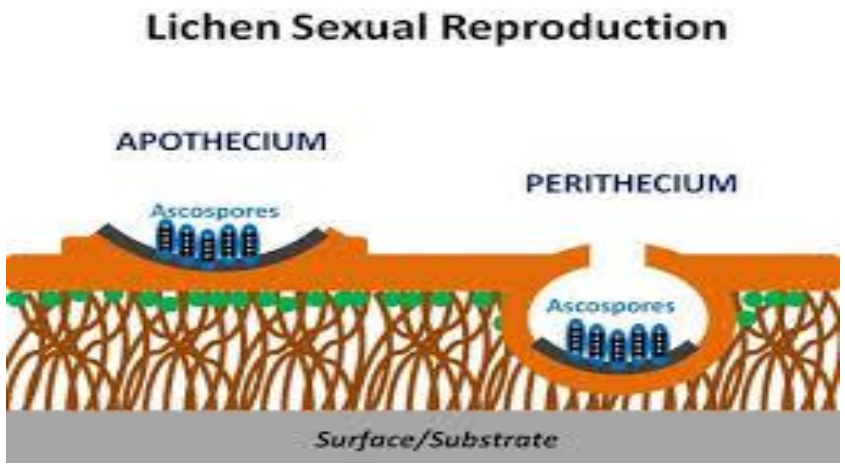
Fig. 10 (A–D). Lichens : Soredia. (A) Single soredium, (B–C) Stages in the formation of soredium, (D) Soredia on thallus.

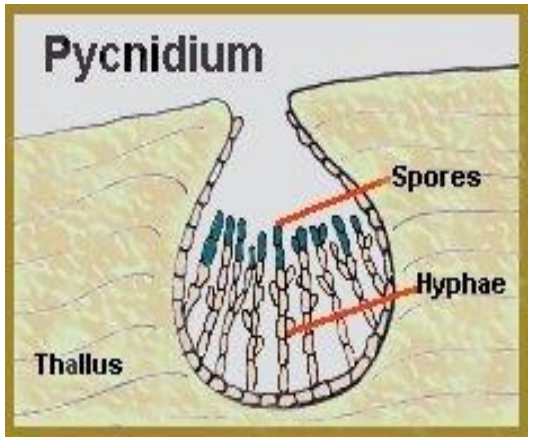


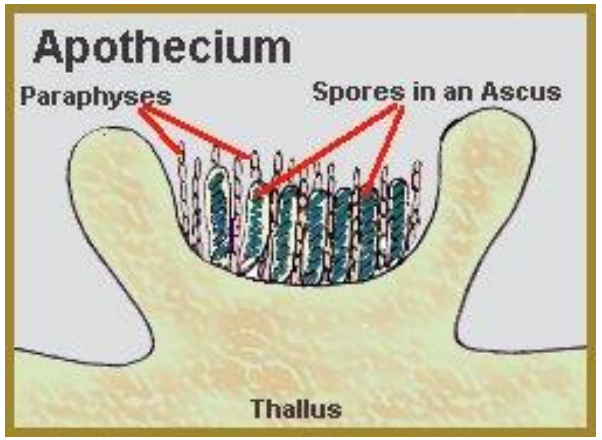
Reproduction of Lichen

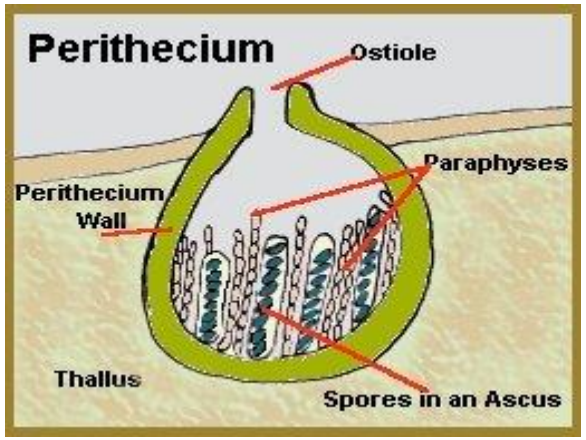
VEGETATIVE MEANS: Occurs via fragmentation and specialized structures like isidia and soredia

SEXUAL MEANS: Occurs via fungal spores like ascospores and basidiospores









SEXUAL REPRODUCTION

- The sexual reproduction in Ascolichens and Basidiolichens is like class Ascomycetes and Basidiomycetes respectively.
- Ascolichens have been studied in more detail from this point of view.
- The male reproductive organ is called the spermogonium and the female is known as carpogonium.
- They develop either on the same hypha or on two different hyphae of the same mycelium.

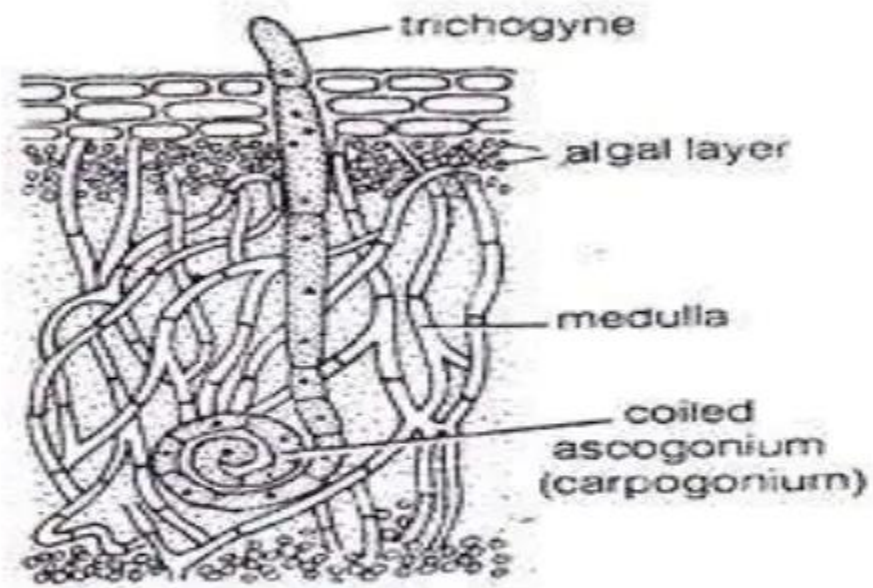
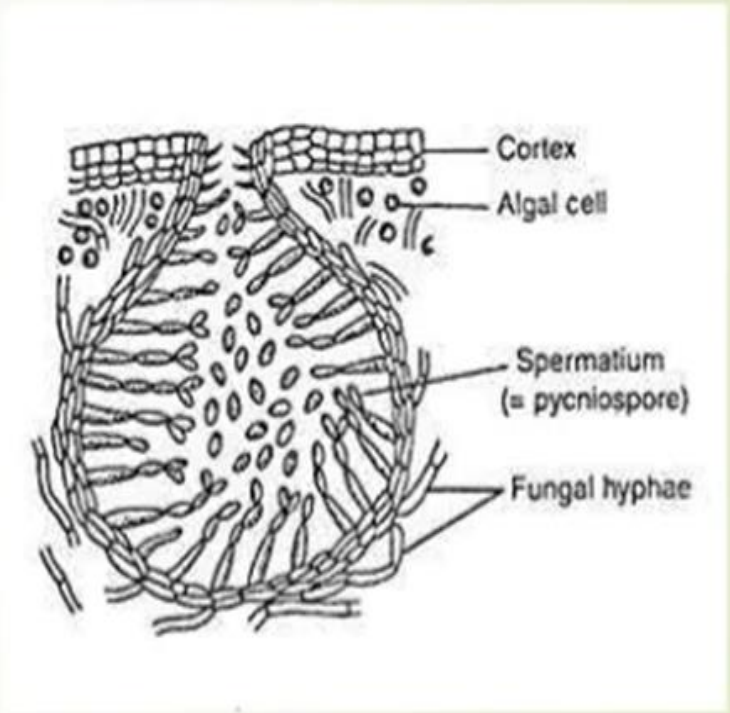


Fig. 13. Lichens : Carpogonium. Vertical section of thallus passing through Carpogonium

c) Sexual reproduction

Spermogonium :

- The male reproductive body is spermagonium (pycnium).
- It is flask-shaped cavity immersed in the thallus and opens to the exterior by small ostiole.
- The fertile hyphae lining the inner surface of the spermagonium produce large number of small non-motile gametes spermatia.
- The spermatia are functional male gametes.



Sexual Reproduction

- Fungal partner – long-lived fruiting bodies release spores
- After germination the spore must meet a suitable algal partner before it can develop further

Ascomycota

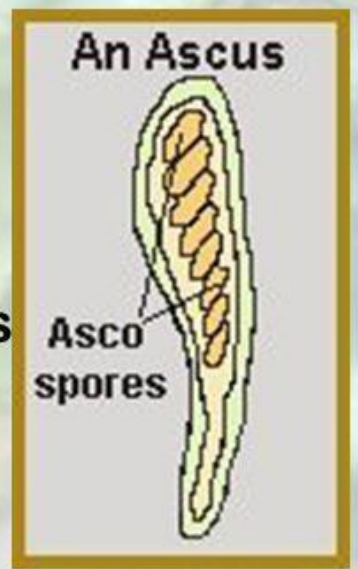
Ascocarps

- Most common

– spores in ascus

- usually 8 spores

– produced in perithecia & apothecia



Basidiomycota

Basidiocarps

- Spores on a basidium ->

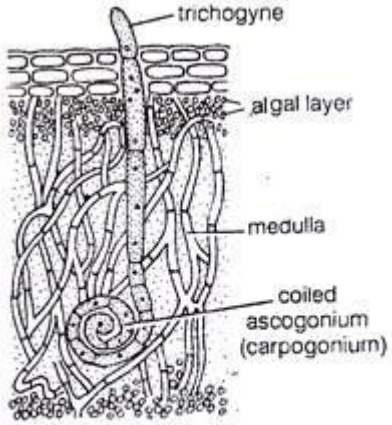


Fig. 13. Lichens : Carpogonium. Vertical section of thallus passing through Carpogonium

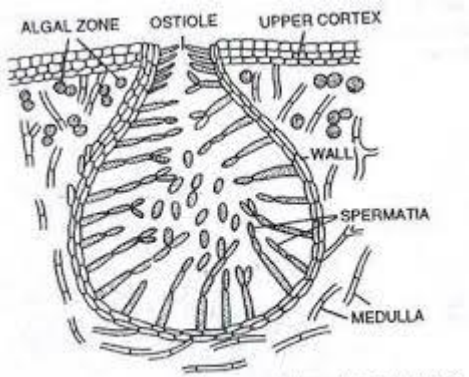


Fig. 18.13. Diagrammatic representation of spermagonium (pycnium) of *Physcia*.

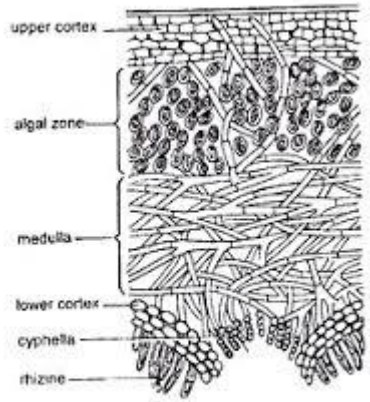
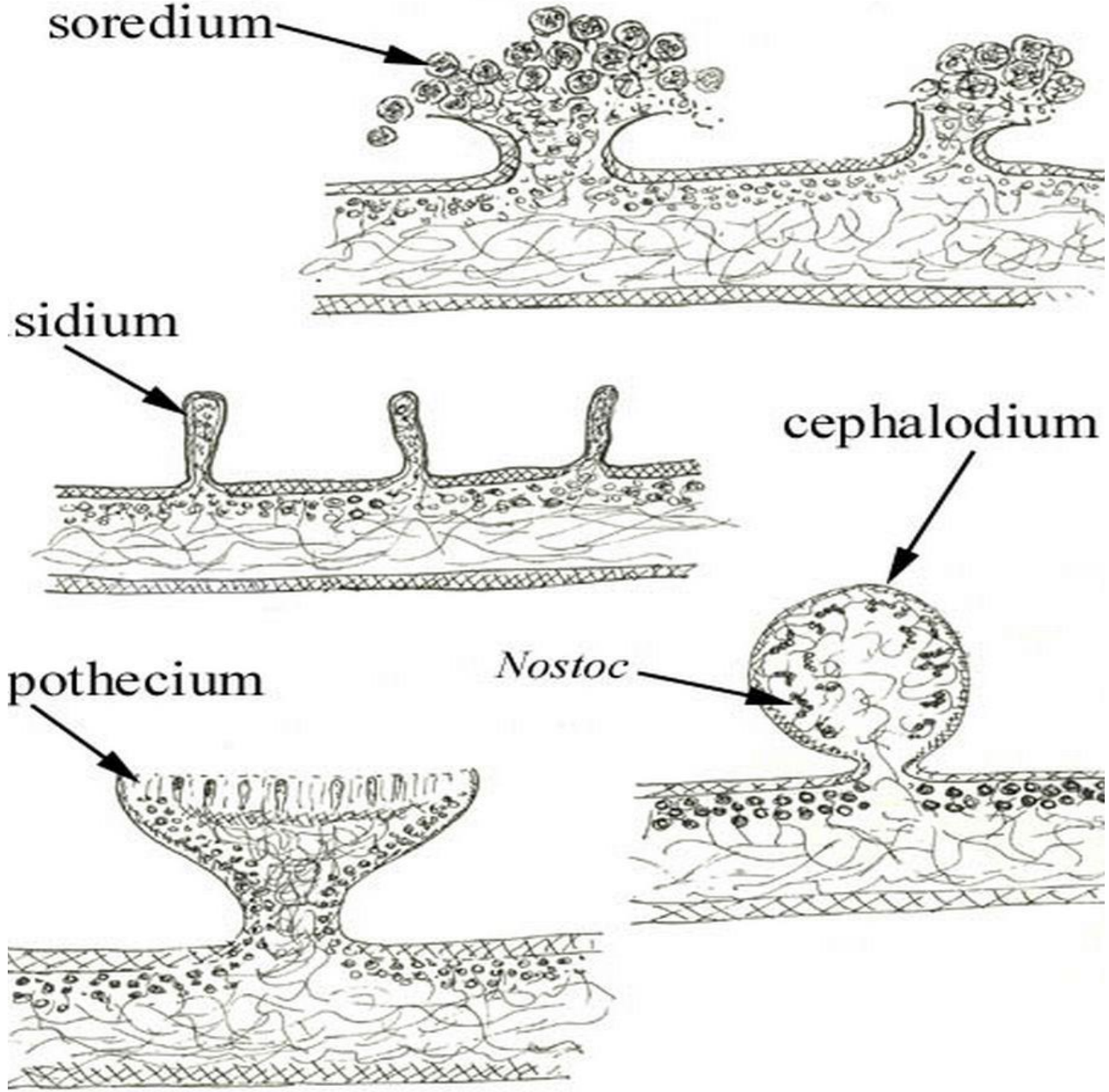


Fig. 8. Lichens : Cyphellae. Vertical section of thallus



- Mycorrhizae are highly evolved, mutualistic associations between soil fungi and plant roots. It is commonly known as root fungi.
- This asoociation are members of the fungus kingdom (Basidomycetes, Ascomycetes and Zygomycetes) and most vascular plants.
- Host plant receives mineral nutrients while the fungus photosynthetically derived carbon compounds from the plants.

Introduction :

- *Mycorrhizae* are mutualistic symbiotic associations formed between the roots of higher plants and fungi.
- It is an Greek word, mykes: mushroom or fungi; rhiza: root.
- Fungal roots were discovered by the German botanist A B Frank in the last century (1855) in forest trees such as pine.
- In nature approximately 90% of plants are infected with mycorrhizae. 83% Dicots,79% Monocots and 100% Gymnosperms.
- Convert insoluble form of phosphorous in soil into soluble form.

Types of mycorrhizae :

- On the basis of morphological and anatomical features, mycorrhizae are divided into the three types.

1. Endomycorrhizae
2. Ectomycorrhizae
3. Ectendomycorrhizae

- Endomycorrhizae further classified in to five types.

1. VAM fungi (vesicular arbuscular mycorrhizae)
2. Orchidoid mycorrhizae
3. Monotropoid mycorrhizae
4. Ericoid Mycorrhizae
5. Arbutoid mycorrhizae

Mycorrhiza

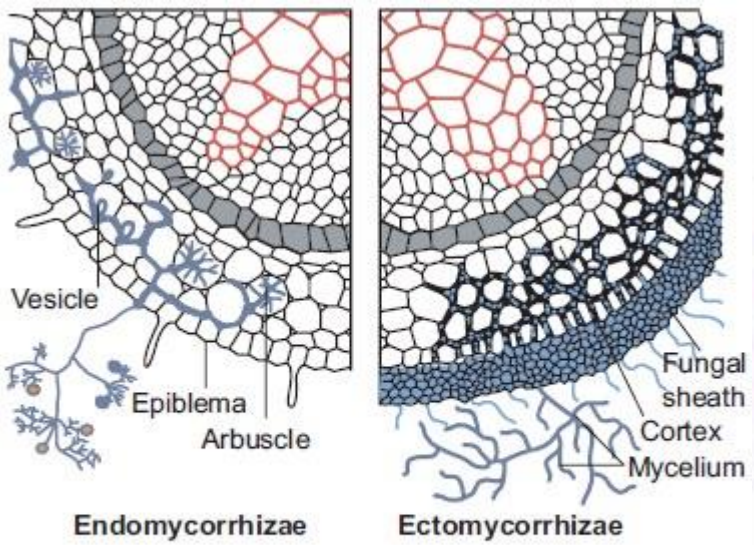
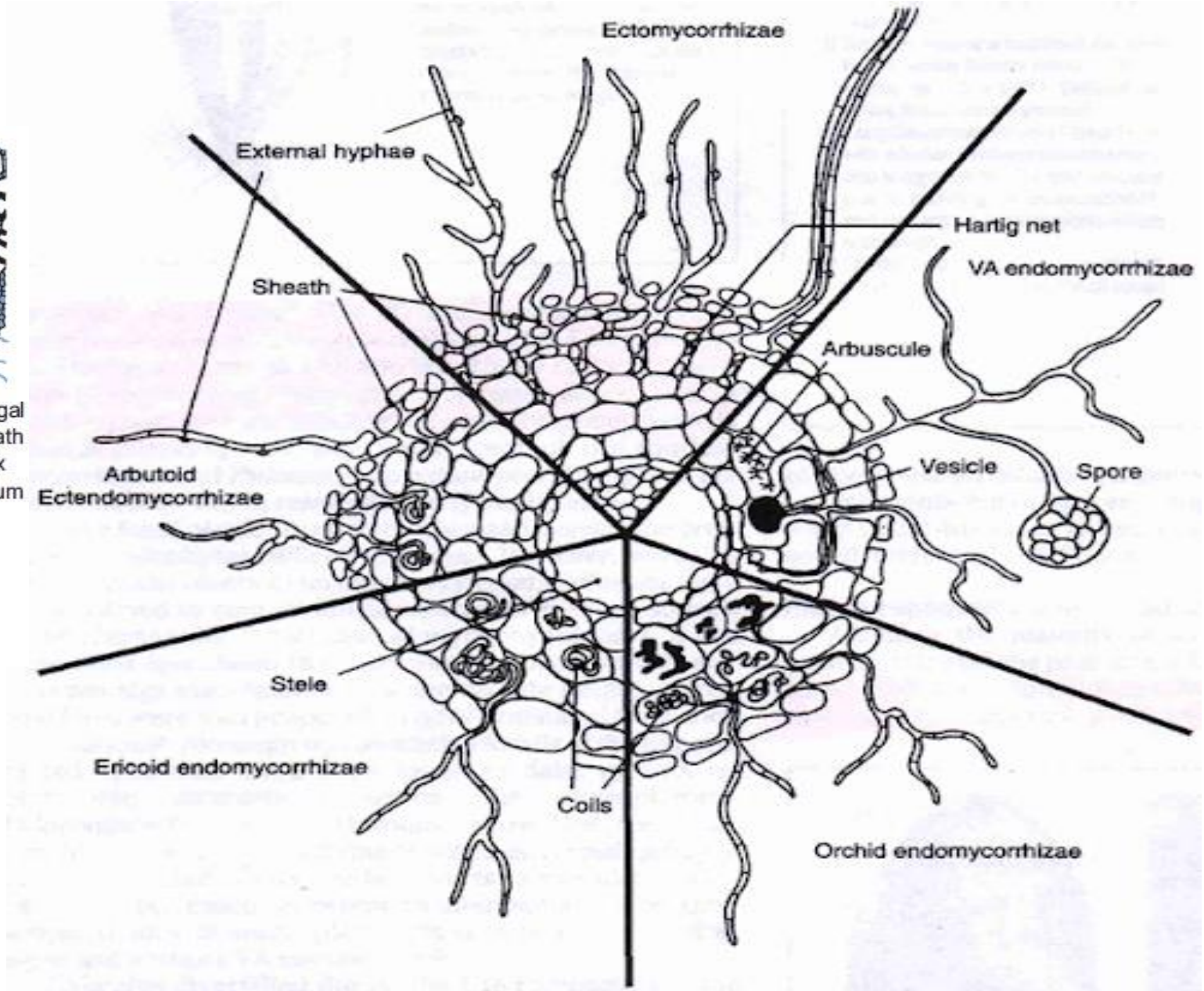


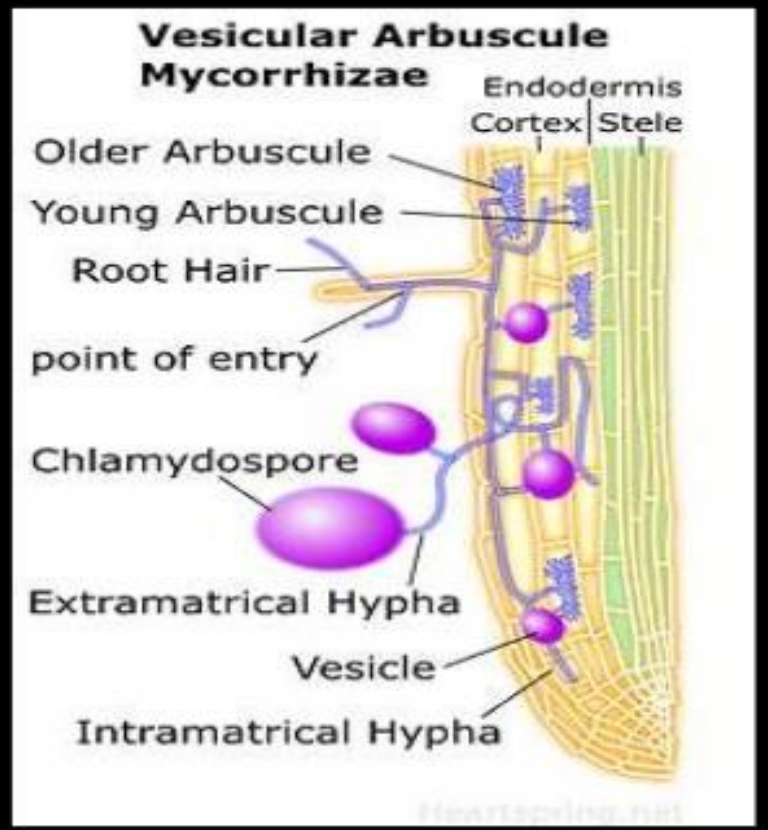
Figure 1.31: T.S. of root showing mycorrhizae



VAM fungi (Vesicular Arbuscule mycorrhizae) :

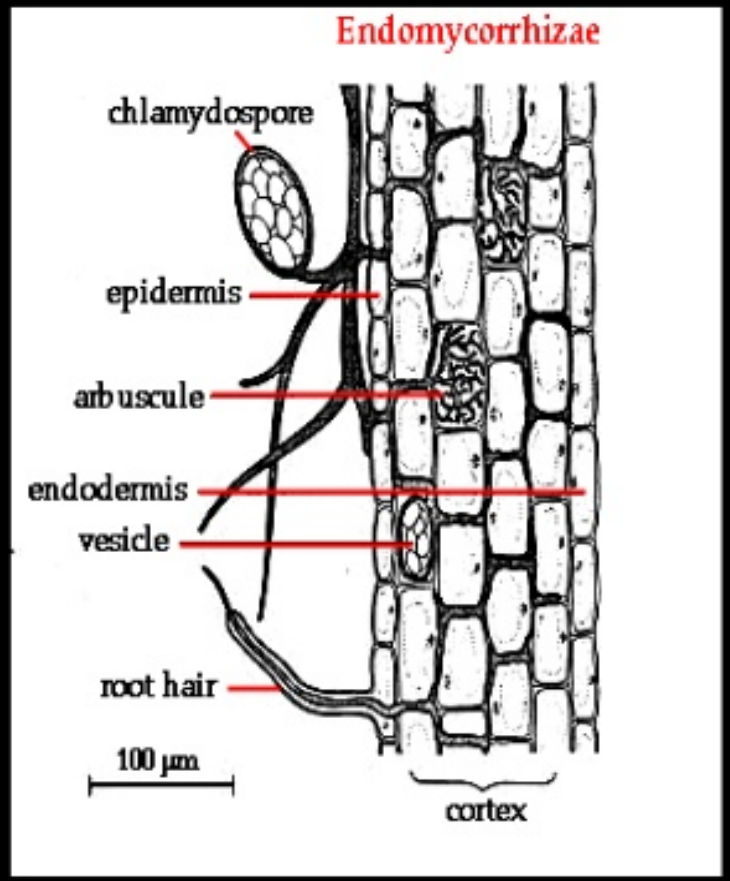
- Fungi formed VAM association with plants may belongs to ascomycetes , basidiomycetes and zygomycetes.

- All VAM fungi are obligate biotrophic, as they are completely dependent on plants for their survival.



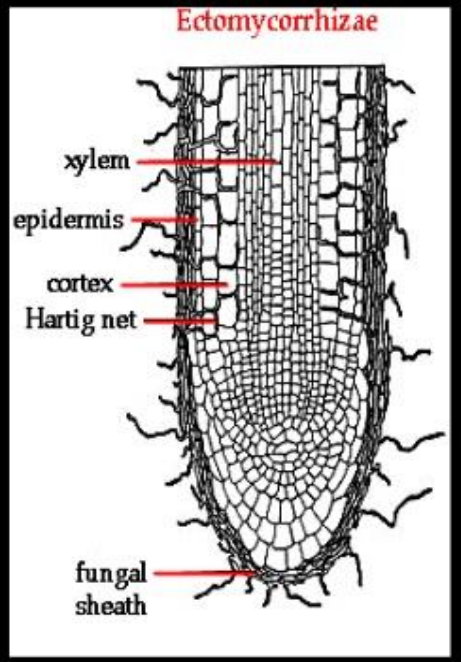
Endomycorrhizae :

- It is a mycorrhizal association in which the fungal hyphae are present on root surface as individual threads that may penetrate directly into root hairs, other epidermal cells & into cortical cells.



Ectomycorrhizae :

- Ectomycorrhizae (ECM) are association, where fungi form a mantle around roots. There is no hyphal penetration of cells. Fungal hypha is generally separate. A distinct Hartig's net is present between the cells.

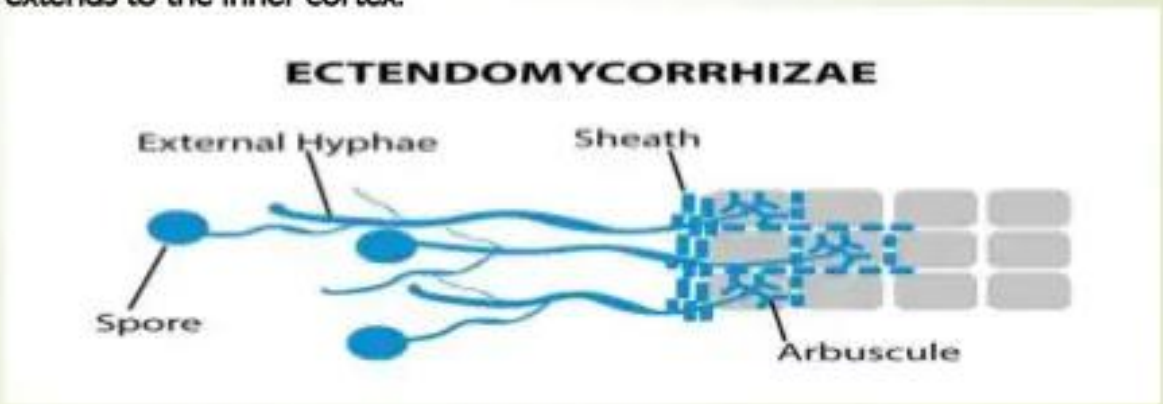


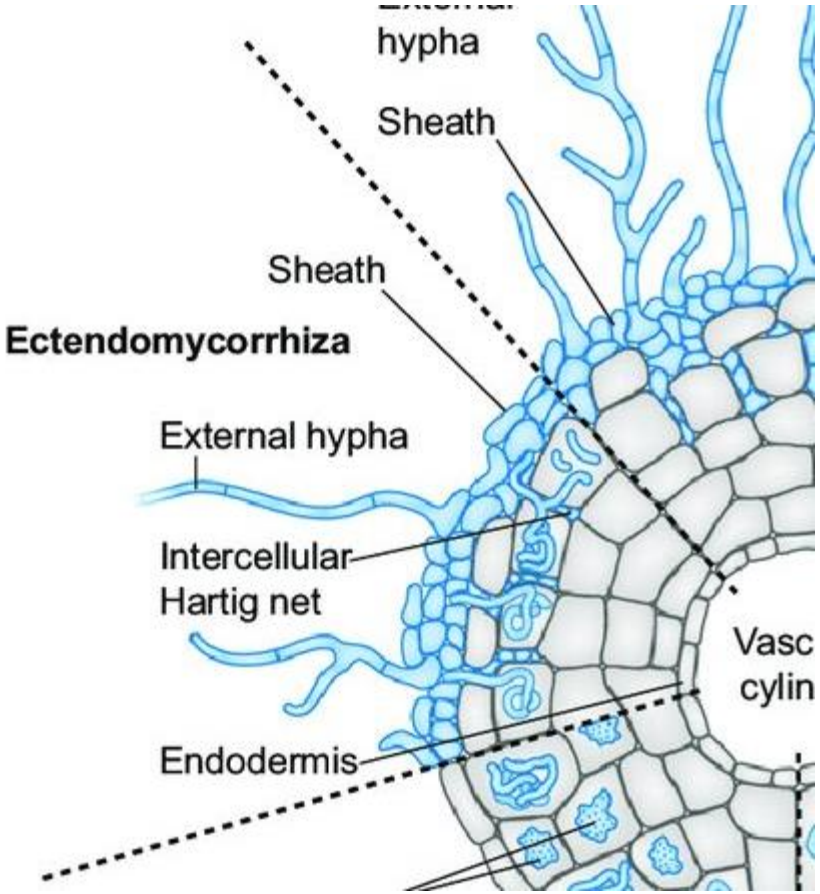
Ectomycorrhizae (EM)

- The fungal mycelia extend inward, between root cortical cells, to form a network (Hartig net) and outward into the surrounding soil. Usually the fungal hyphae also form a mantle on the surface of the root.
- Hyphae do not penetrate into cells but contact with roots is very close and metabolites are transferred in both direcions.
- Some ectomycorrhizae produce large above ground sporocarps or mushrooms which facilitate dispersal of spores along with underground fruiting bodies.
- Found on many woody plants ranging from shrubs to forest trees. Host plants belong to the families Pinaceae, Fagaceae, Betulaceae and Myrtaceae and a few others but no grasses.

3- Ectendomycorrhizae

- The fungi belong to Basidiomycotina, which covers both gymnosperms and Angiosperms plants.
- Ectendomycorrhizae show many of the same characteristics' of Endomycorrhizae but also show extensive intercellular penetration.
- The formation of Ectendomycorrhizae begins with formation of a hartig's net, which grows behind the apical meristem of the growing root.
- The hartig net penetrates between the epidermal and outer cortical cells and later extends to the inner cortex.





Orchidoid Mycorrhizae :

- Fungi belongs to basidiomycotina and colonize only member of family orchidaceae. This association is probably pseudomycorrhizal but play an important role in establishment of orchid seedlings.

Ericoid Mycorrhizae :

- Fungal members are usually basidiomycetous and Ascomycotina. This is found in roots of plants belonging to order ericales. Rootlets are covered by a loosely woven mesh of dark brown septate hyphae from which branches penetrate the cortical cells.

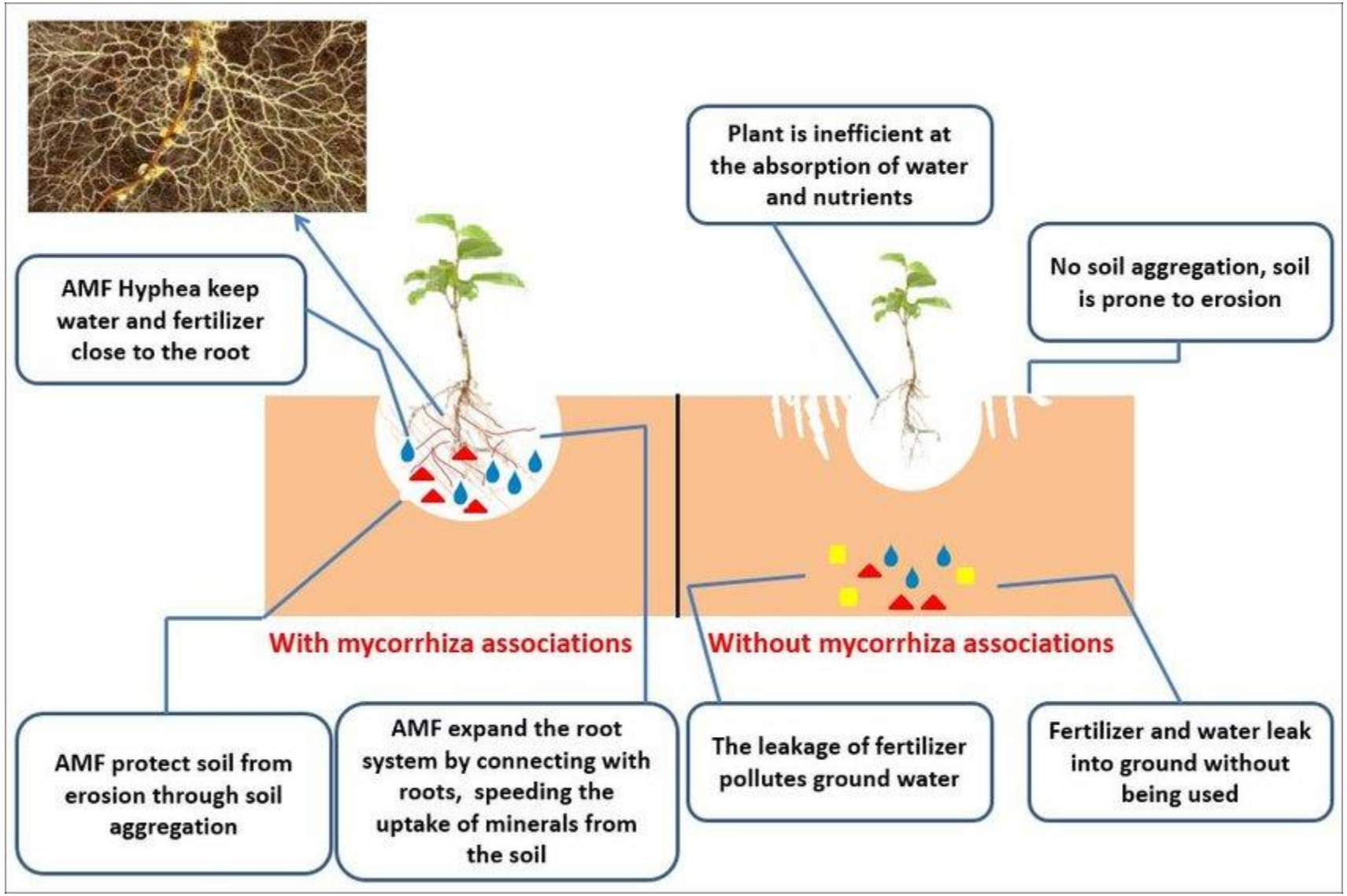
Monotropoid Mycorrhizae :

- The fungi belong to basidiomycotina, colonizing achlorophyllous members of angiosperms belonging to family monotropaceae. Fungal sheath present.

Arbutoid Mycorrhizae :

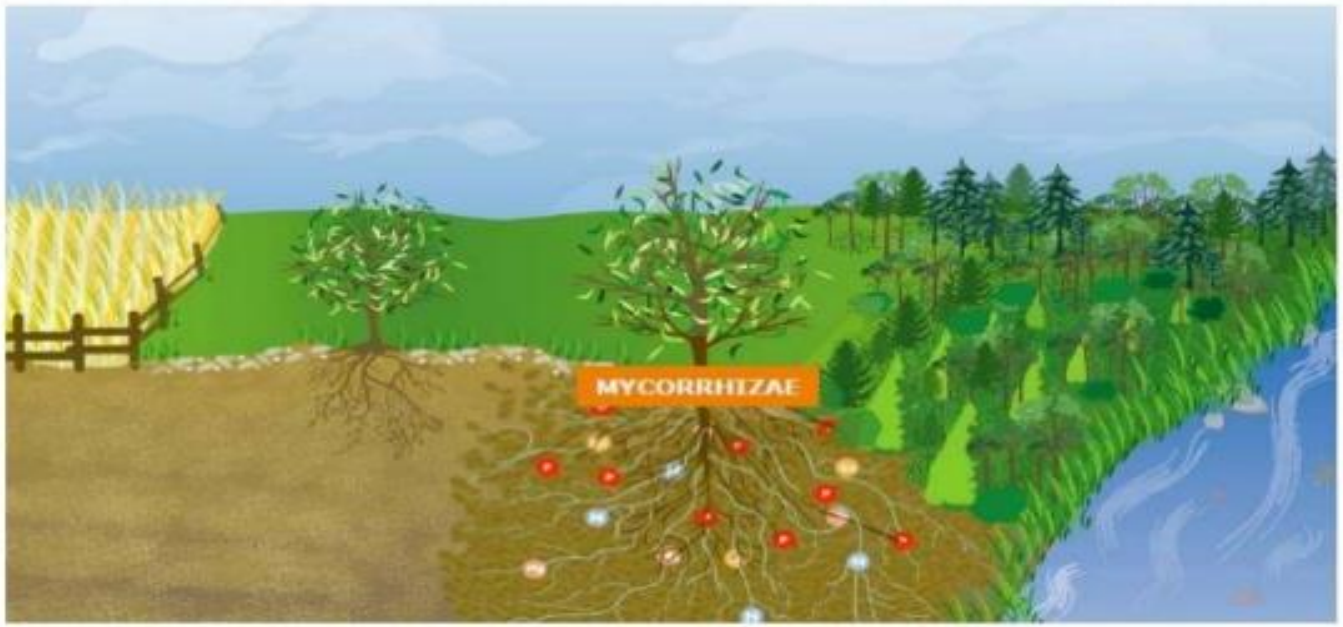
- Arbutoid mycorrhizal associations are variants of ectomycorrhizae found in certain plants in the ericaceae characterized by hyphae coils in epidermal cells.

- A major difference between the arbutoid and ectomycorrhizal association is that the hyphae of the former actually penetrate the outer cortical cells and fill them with coils.


AMF Hyphea keep water and fertilizer close to the root
Plant is inefficient at the absorption of water and nutrients
No soil aggregation, soil is prone to erosion
With mycorrhiza associations
Without mycorrhiza associations
AMF protect soil from erosion through soil aggregation
AMF expand the root system by connecting with roots, speeding the uptake of minerals from the soil
The leakage of fertilizer pollutes ground water
Fertilizer and water leak into ground without being used

Ecological Importance

- Improvement of soil structure • Stimulation of beneficial microbial activity
- Water infiltration improvement • Reduction of erosion and nutrient leaching



Applications of Mycorrhizae :

- Increase nutrient uptake of plant from soil.
  - P nutrition and other elements: N, K, Ca, Mg, Zn, Cu, S, B, Mo, Fe, Mn, Cl
- Increase diversity of plant.
- Produce uniform seedling.
- Significant role in nutrient recycling.
- More tolerant to adverse soil chemical constraints which limit crop production.
- Increase plant resistance to diseases and drought.
- Stimulate the growth of beneficial microorganisms.
- Improve soil structure.
  - Stable soil aggregate – hyphal polysaccharides bind and aggregate soil particles.