DEPARTMENT OF BOTANY
ALLIED SUBJECT FOR I B.Sc ZOOLOGY STUDENTS

I YEAR – I SEMESTER

COURSE CODE: 4BBOA1

ALLIED COURSE I – PLANT DIVERSITY, PLANT PATHOLOGY AND INTERNAL MORPHOLOGY

THALLOPHYTA

Unit I

Algae

General Characters, structure and life history of Cyanophyceae (*Oscillatori*a) and Rhodophyceae (*Polysiphonia*).

Fungi

General Characters, Structure and Life history of Basidiomycetes (*Puccinia*).

General Features, Structure and Life history of Lichens (*Usnea*).

Unit II

Bryophyta

General Characters, structure and life history of Moss(*Polytrichum*)- Development of Gametophyte, Sporophyte and sex organs need not be discussed.

Plant Pathology

Study of the Following Plant Diseases with reference to causes, symptoms, dissemination, Control and preventive measures.

1. Virus Diseases – Bunchy top of Banana.
2. Bacterial Disease – Citrus Canker.

Unit III

Pteriophyta

General Characters, structure and Life history of *Selaginella* (Development of gametophyte, sporophyte and sex organs need not be discussed).

Unit IV

Gymnosperms

General Characters , structure and Life history of *Pinus* (Development of Pinus need not be discussed)

Unit V

Internal Morphology

1. Tissues – Meristematic and permanent tissues.
2. Normal secondary thickening in dicot and monocot stem and root.

ALLIED BOTANY

SALIENT FEATURES OF ALGAE:

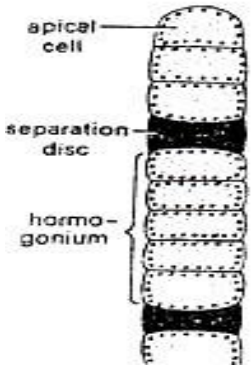
1. Algae live in aquatic or moist habitats
2. The plant body is unicellular or multicellular thallus
3. Chlorophyll and other photosynthetic pigments are present in the thallus.
4. They are autotrophic in nutrition.
5. They are prokaryotic or eukaryotic.
6. Algal cell wall is rich in cellulose.
7. Starch is the common reserve in algae.
8. They reproduce through only by vegetative, sexual and asexual method.
9. Asexual reproduction takes place by the formation of zoospores.
10. Sexual reproduction may be isogamous, ansiogamous and oogamous.

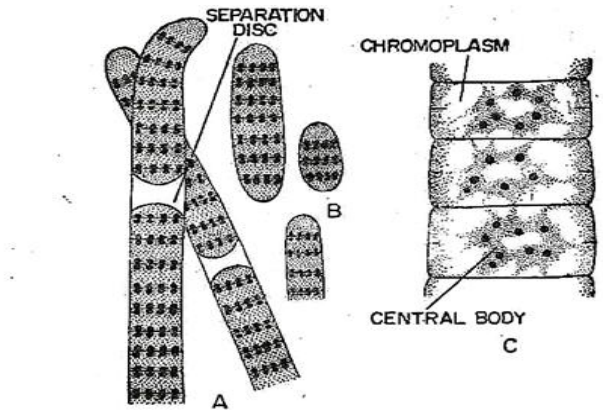
OSCILLATORIA

- ➔ It is a simple, unbranched, filamentous, blue green algae
- ➔ It comes under class myxophyceae or cyanophyceae
- ➔ The filament is called trichome
- ➔ The trichome is surrounded by mucilaginous sheath
- ➔ It is free floating algae
- ➔ Trichome consists of a row of cells arranged one above the other.
- ➔ The terminal cell has athickening called cap or calyptras at the tip.

STRUCTURE:

- ➔ Each cell consists of an outer cell wall and an inner protoplast.
- ➔ Cell wall is composed of hemicelluloses and pectin.
- ➔ The pigments like chlorophyll-a, carotenes, xanthophylls, phycocyanin.
- ➔ The protoplasm contains chrompplasm and centroplasm
- ➔ The reserve food is cyanophycean starch.





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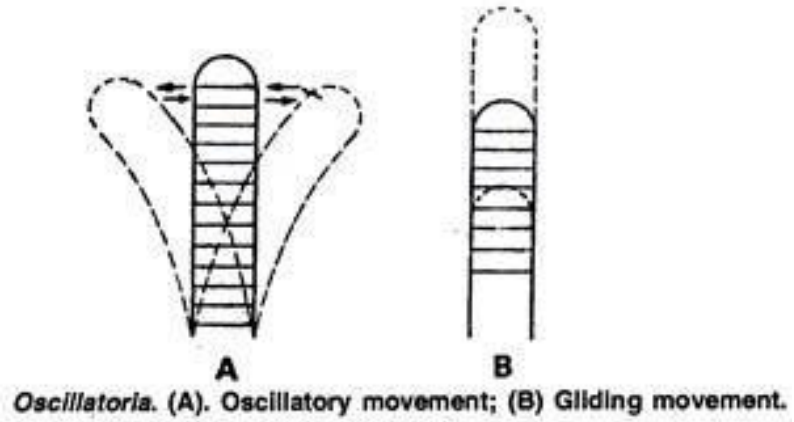
Oscillatoria shows three types of movement

→ Gliding movement
→ Oscillatory movement
→ Bending movement



Oscillatoria. (A). Oscillatory movement; (B) Gliding movement.

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REPRODUCTION:

It reproduces only by vegetative method
a) Fragmentation
b) Hormogone formation

Fragmentation:

The filament breaks into small pieces or fragments by mechanical forces. Each fragment later grows into a new filament.

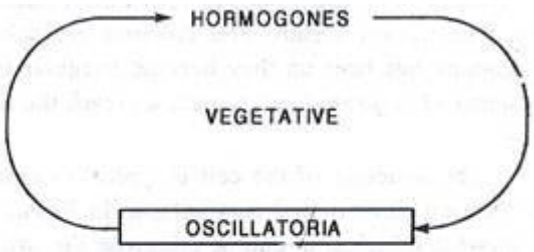

Fig. 2.43. Cyanobacteria. *Oscillatoria* sp. Graphic life-cycle.

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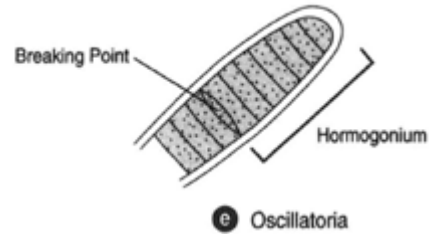
Hormogone formation

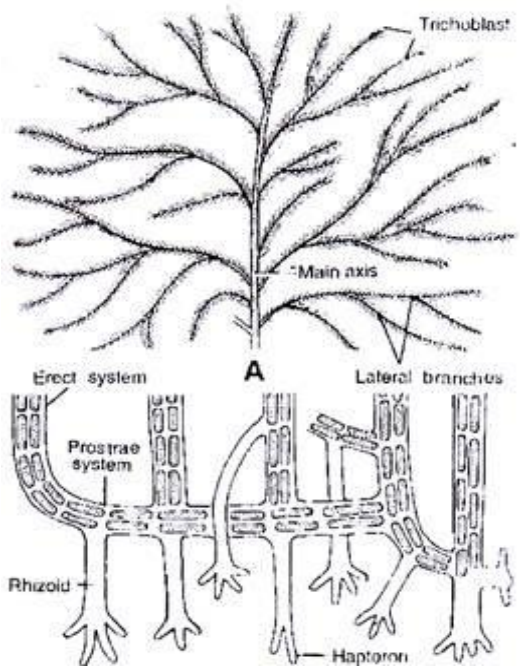
- ➔ Hormogones are produced in mature filaments.
- ➔ Some cells lose their protoplast and die.
- ➔ These cells become biconcave and filled with mucilage.
- ➔ The mucilage cells filled cells are called necridia.
- ➔ The cells present between two adjacent necredia is called hormongones
- ➔ These hormogones separate from the filament
- ➔ Now a new filament is formed.



http://www.biocyclopedia.com/index/introduction_to_botany/images_blue/12-1.gif

POLYSIPHONIA

- ➔ It is red algae
- ➔ The plant body consists of branched filaments and rhizoids.
- ➔ It has a creeping filament and erect filament.
- ➔ Creeping system grows over the substratum horizontally.
- ➔ It is attached to the substratum by rhizoids.
- ➔ The erect system is branched, multiaxial filament.
- ➔ It consists of central siphon surrounded by several pericentral siphons.
- ➔ The erect system has two of branches namely long and erect branches.



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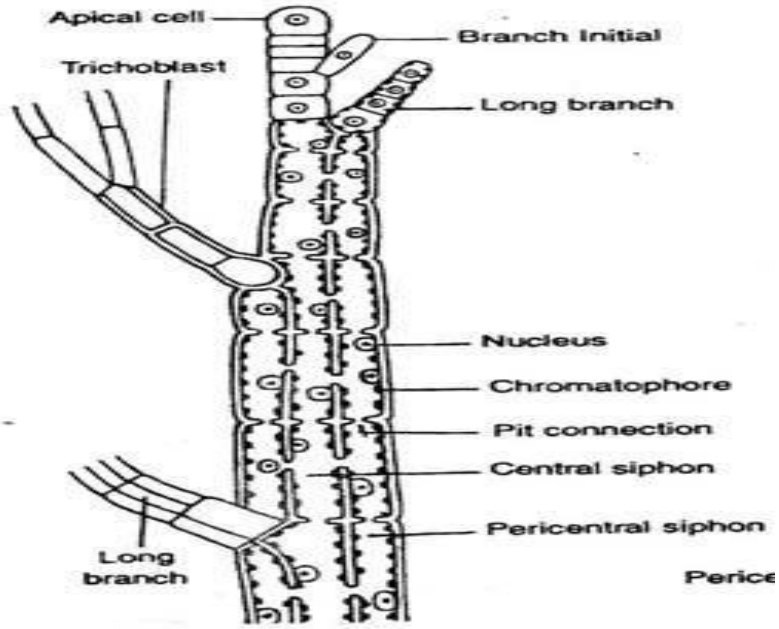
STRUCTURE:

- ➔ The cell is bound by a cell-wall.
- ➔ Inner to this is a plasma membrane which surrounds the protoplasm.
- ➔ The cells are interconnected by pit connections.
- ➔ The cytoplasm contains an nucleus, vacuole, chromatophores
- ➔ Floridean starch is the reserve food.



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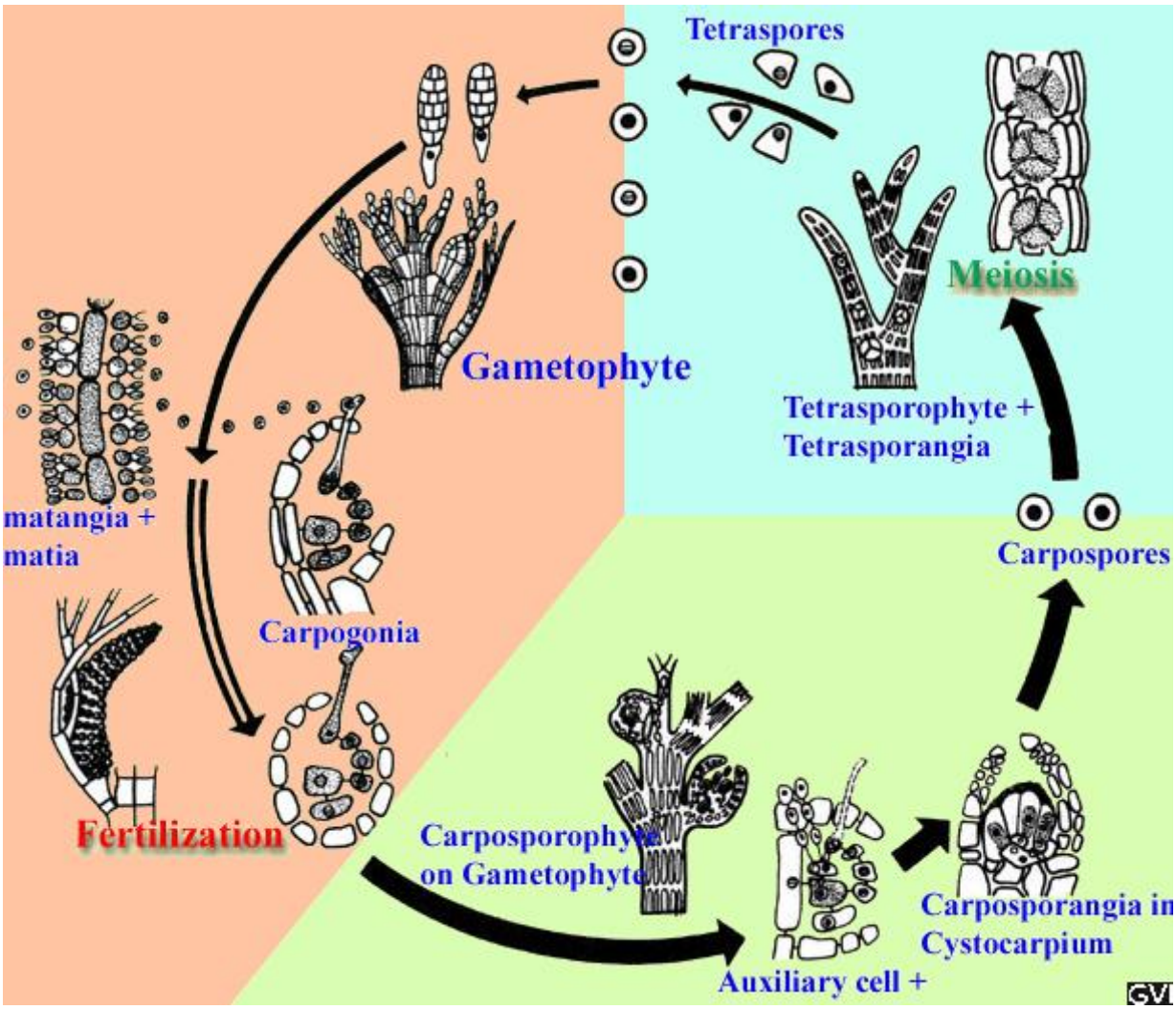
REPRODUCTION:

It reproduces both by sexual and asexual methods.
It has three types of individuals in life cycle

a) Gametophyte
b) Carposporophyte
c) Tetrasporophyte

Sexual reproduction:

- ➔ It is oogamous
- ➔ The male sex organ is called spermatangium and produced on male gametophyte.
- ➔ The female sex organ is called carpogonium and produced on female gametophyte.
- ➔ Each spermatangium develops develops into a single spermatium.
- ➔ The spermatium is round.
- ➔ Spermatia is released are carried to the carpogonium
- ➔ The male and female nucleus fuse and form zygote.



http://www.vcbio.science.ru.nl/images/lifecycles/IL042_685m_engPolysiphoniaLifeCycle.png

POST FERTILIZATION CHANGES:

Basal sterile cell of carpogonium filament
produces two cells called basal sterile.

↓

Supporting cell produces an auxillary cell

↓

A tubular connection develops between auxillary and carpogonium filament

↓

Diploid nucleus divides into two and enter through auxillary cell.

↓

Now auxillary, carpogonium filament and basal sterile cell fuse and form central cells.

↓

Now, diploid nucleus divides mitotic and form two nucleus.

↓

Now, goniomoblast initials develop from central cell.

↓

The terminal cell of the goniomoblast enlarges and form carposporangium

↓

Inside carposporangium, carpospores is formed.

↓

Then, sterile filaments grow around the goniomoblast and central cell.

↓

It covers and form pericarp.

↓

The entire body thus formed is known as cystocarp.

↓

The opening is called ostiole.

↓

The carpospores germinate into tetrasporophytes plant and form 4 tetraspores.

↓

Two sporophytes give rise to male gamtophytes and other two give female gametophytes.

CITRUS CANKER

- Citrus canker is a bacterial disease.
- It is caused by *Xanthomonas citrii.*
- It produces lesions and cankers.
- The disease was first reported in Japan (1904).

Symptoms:

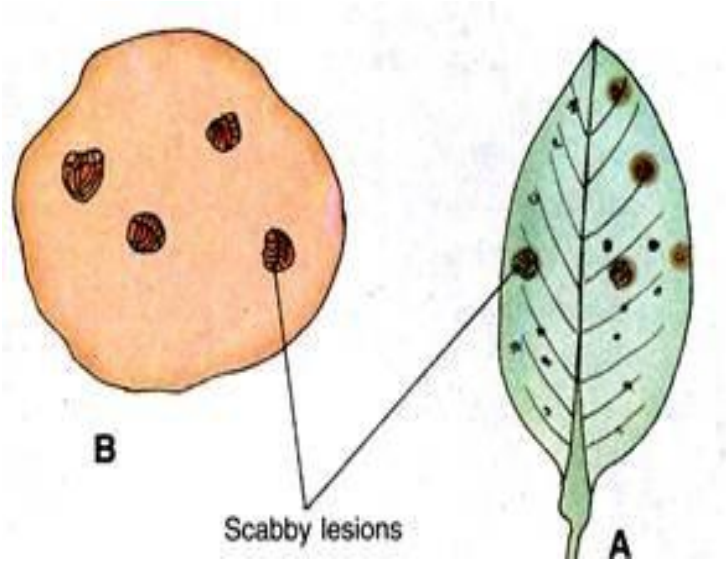
- A small yellow spots appears on young leaves.
- The yellow spots is known as lesions.
- The lesions turn into brown colour.
- The yellow spots appear on twigs also.
- The spots appear on fruits also.
- The lesions break in the centre and appear as cork.

Causal Organism :

- This disease is caused by *Xanthomonas citrii.*
- It is a Gram-negative, aerobic bacteria.
- The bacterium enters the host plant through stomata.
- Bacteria multiplies in the leave tissues.
- Then, canker develops.
- The bacteria is passed by wind, rain and insects.

Control measures:

- The infected trees must be removed and burnt
- Pruning of diseased twigs and leaves should be done.
- Disease resistant varieties should be cultivated.
- Spraying of neem cake can be done.
- Spraying the plant with 1% Bordeaux mixture should be done.
- Antibiotics can also be sprayed.



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BUNCHY TOP OF BANANA

- ➔ Bunchy top of banana is a viral disease.
- ➔ It is caused by virus Banana virus-I
- ➔ The plant becomes short
- ➔ At tip, cluster of leaves is formed.
- ➔ This is known as rosette.
- ➔ The disease was first reported in Fiji Island.

SYMPTOMS

- ➔ The leaves become bunched together at the top.
- ➔ This is known as rosette.
- ➔ Brown streaks in the veins appear.
- ➔ Brown streaks are also produced on leaf petiole.
- ➔ The leaves become smaller and narrow.
- ➔ Leaves are clustered at the top and form rosette.
- ➔ Plant becomes stunted growth.

Causal Organism:

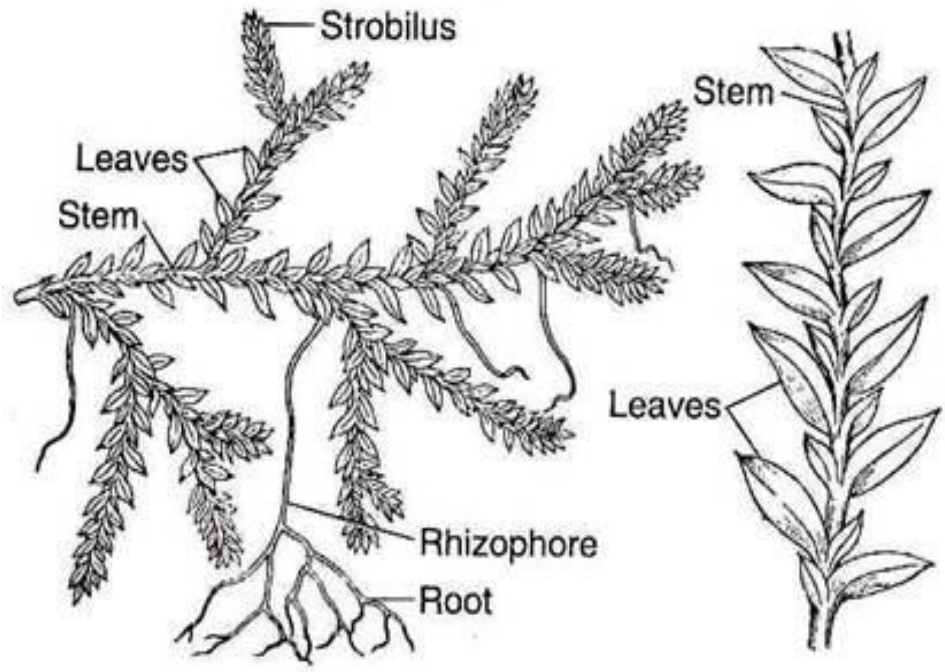
- ➔ This disease is caused by a virus, namely banana virus-I
- ➔ Virus is present in all the parts including the rhizomes and suckers.
- ➔ Virus first attacks the host plant around the basal portion of stem.

Control measures:

- ➔ the disease plants should be removed.
- ➔ It should be burned.
- ➔ The virus can be killed by spraying 2,4-D or MCPA.
- ➔ Virus free plants should be used.
- ➔ Strict control of banana plants from other states must be checked.
- ➔ The plants should be killed by pouring Kerosene over the plant.

SELAGINELLA

- Selaginella is a pteridophyta
- Some are xerophytic and epiphytic.
- It consists of about 700 species.
- It is also known as resurrection plants.
- It is diploid sporophyte.
- It consists of stem, leaves and roots.
- The stem is soft, branched or erect.
- The leaves are microphyllous with midrib.
- Leaves are dimorphic.
- The leaves are two kinds, small and large.
- Stems bear cylindrical downward structures known as rhizophores.
- Roots are adventitious and dichotomously branched.
- It produces microsporangia and megasporangia.
- A leaf which bears a sporangium on its upperside is called a sporophilla
- It is called as strobili or cones
- Each strobilus has a central cone axis on which the micro and mega sporophyll are arranged spirally



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INTERNAL STRUCTURE OF STEM

EPIDERMIS:

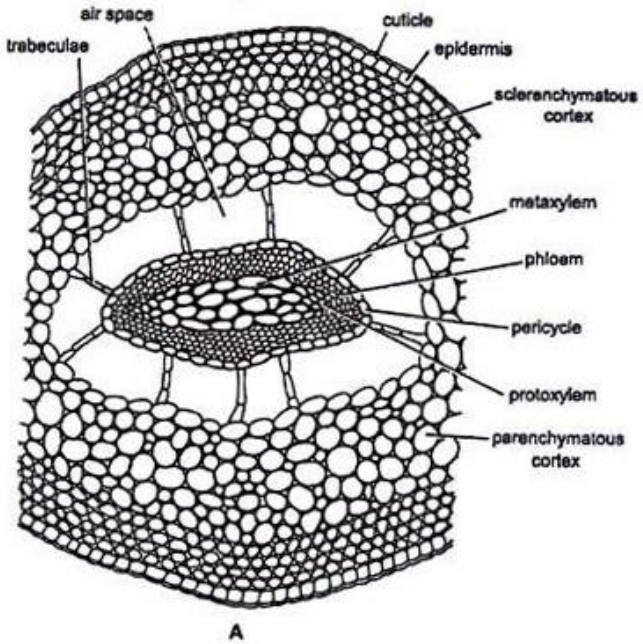
- Epidermis is the outer layer.
- It is made up of a single layer of thin walled cells

CORTEX

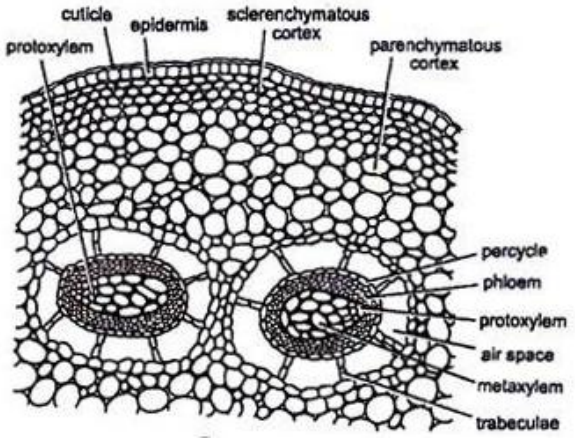
- Cortex lies below the epidermis.
- It is made up of an outer hypodermis and an inner endodermis and air space.
- The trabeculae are modified endodermal cells and possess casparian strips
- The trabecular endodermis is characteristic of selaginella
- The pericycle lies below the endodermis. It encloses the phloem and xylem.

STELE

- Stele is the vascular tissue.
- It consists of phloem and xylem.
- The stele is usually protostele (central core of xylem, surrounded by phloem) with
- xylem.
- The phloem completely encircles the central xylem.
- The centre of the stele is occupied by the xylem tissue.
- The xylem is exarch.


air space
trabeculae
cuticle
epidermis
sclerenchymatous cortex
metaxylem
phloem
pericycle
protoxylem
parenchymatous cortex

A


cuticle
epidermis
sclerenchymatous cortex
protoxylem
parenchymatous cortex
percycle
phloem
protoxylem
air space
metaxylem
trabeculae

INTERNAL STRUCTURE OF RHIZOPHORE

EPIDERMIS

- The epidermis forms an outer covering.
- It consists of a single row of thin walled cells.

CORTEX

- It consists of parenchyma cells.
- The endodermis is single layered.

PERICYCLE

- The pericycle consists of one to few layers of thin walled cells.

STELE

- The stele is made up of xylem and phloem.
- The stele is a protostele.
- The stele is exarch.
- The xylem is surrounded by phloem.

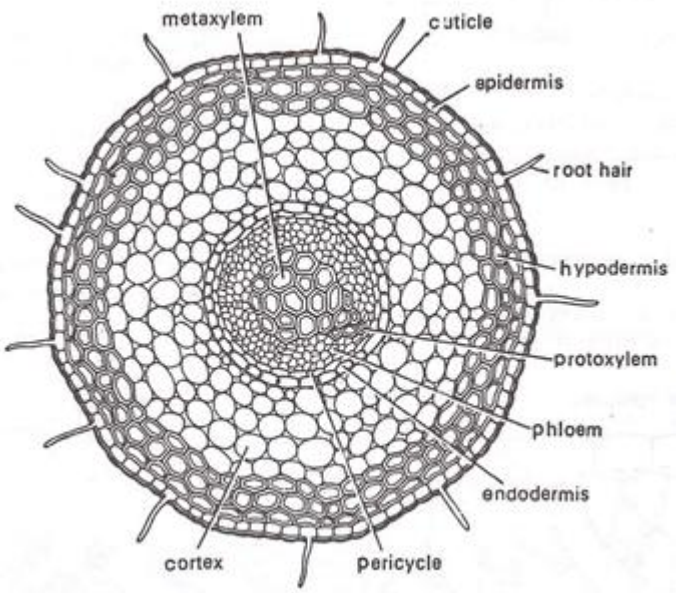


Fig. 214. Selaginella. T.S. root.

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REPRODUCTION

In selaginella, reproduction takes place by three methods.

1. Vegetative reproduction
2. Asexual reproduction
3. Sexual reproduction

VEGETATIVE PROPOGATION

FRAGMENTATION:

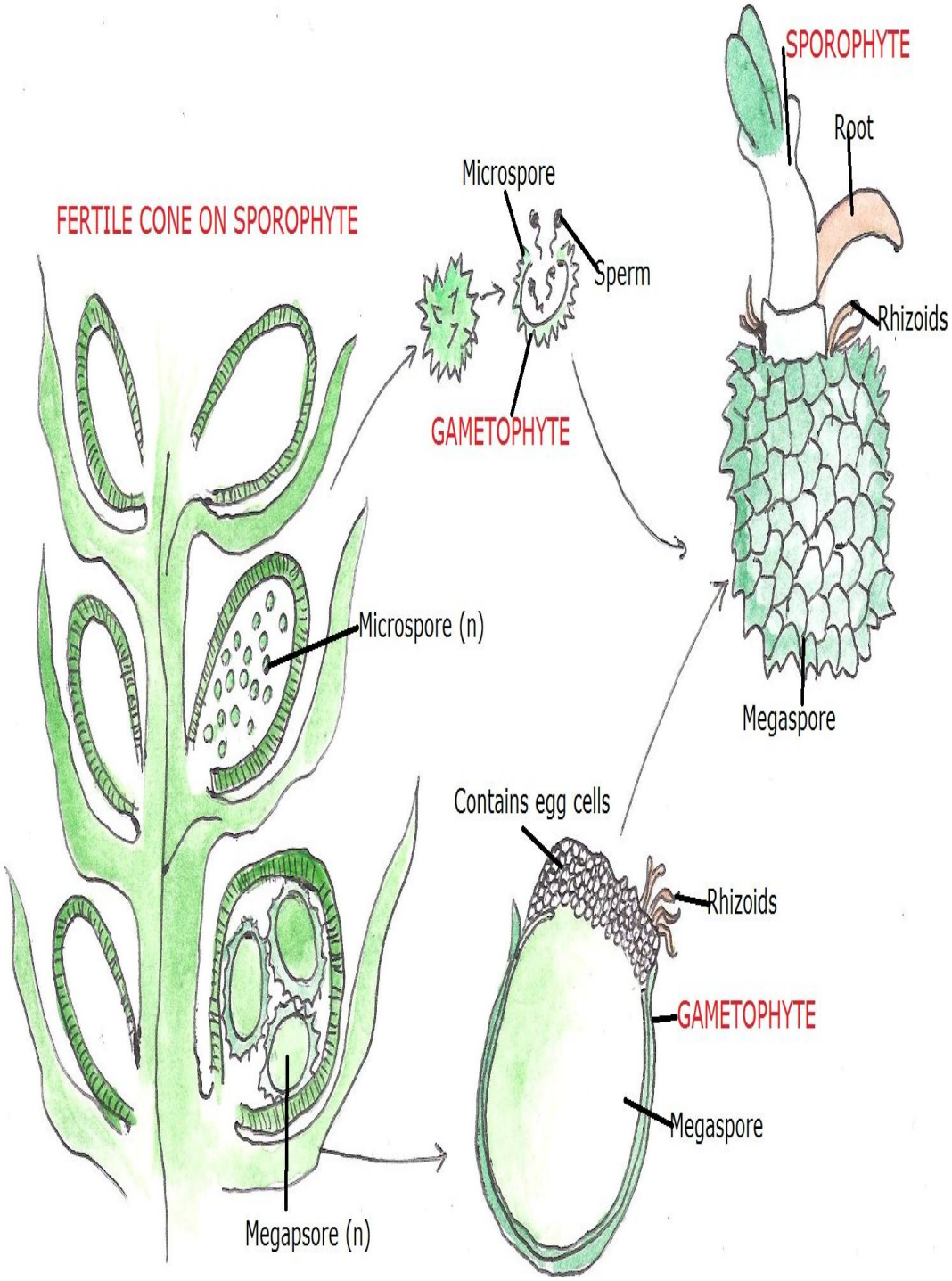
→ Branches of the stem develop adventitious branches.
→ Later they detach from the parent plant and grow into separate.

TUBERS

- The tubers are formed underground
- During unfavourable condition, the aerial plant parts die.
- Tuber germinate into new selaginella plants

ASEXUAL REPRODUCTION

➔ It is diploid.
➔ It reproduces asexually by spores.
➔ It produces two kinds of spores namely microspores and megaspores.
➔ Cones are the asexual reproductive structure.
➔ The cones are produced at the tip of the branches.
➔ Each cone consists of a cone axis and a number of sporophylls.
➔ There are two types of sporophylls,
    1) microsporophylls bearing microsporangia
    2) megaporophylls bearing megasporangia.
➔ Microsporangium is small in size and produces about 600 micospores.
➔ Megesporangium is larger in size and produces 4 spores.
➔ Thus, two types of spores in selaginella is found.
➔ This is known as **Heterospory.**


SPOROPHYTE
Root
Microspore
FERTILE CONE ON SPOROPHYTE
Sperm
Rhizoids
GAMETOPHYTE
Microspore (n)
Megaspore
Contains egg cells
Rhizoids
GAMETOPHYTE
Megaspore
Megapsore (n)

GAMETOPHYTE:

- ➔ After formation, microspore and megaspore comes out.
- ➔ They develop into gametophytes.

MALE GAMETOPHYTE:

- ➔ Each microspore, has a single nucleus and dense cytoplasm.
- ➔ The wall is composed of exine and intine.
- ➔ Further, microspore undergoes many division and form male gametophyte.
- ➔ A single antheridium is formed.
- ➔ Each male gametophyte is called Androcyte.

FEMALE GAMETOPHYTE:

- ➔ The megaspore develops into a female gametophyte.
- ➔ It is larger in size.
- ➔ It is divided into two regions.
- ➔ The apical region consists of smaller cells.
- ➔ The larger cells are present in lower region of megaspore.
- ➔ Archegonia are developed in the upper region.
- ➔ It consists of venter canal and neck canal cells.
- ➔ At maturity, sperms fuses with the egg forming zygote.

HETEROSPORY:

- → Selaginella produces two kinds of spores namely, microspores and megespores.
- → This is called as Heterspory.
- → Heterospory results in two gametophytes.
- → Development of gametophytes begins even before spores are shed.

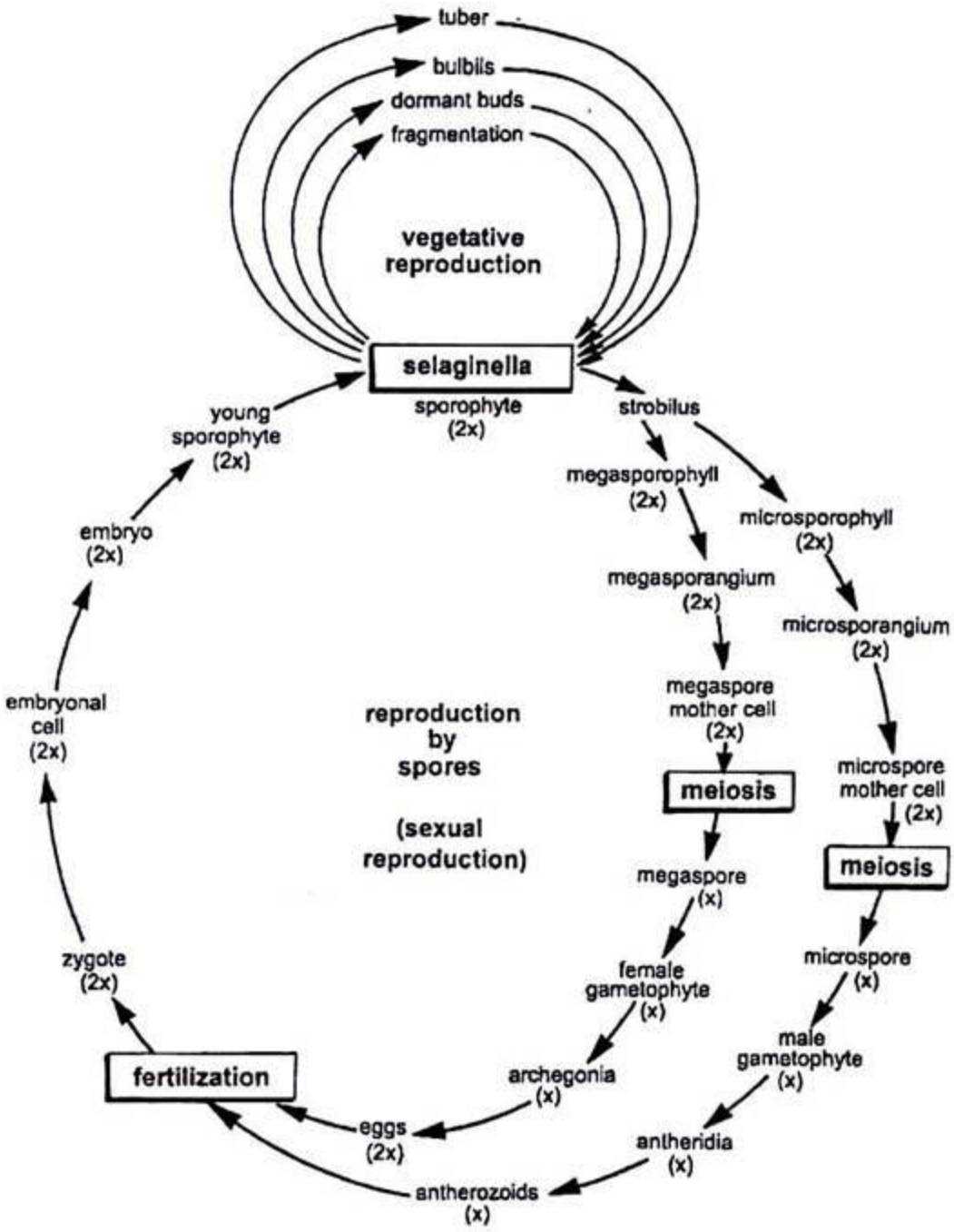


Fig. 20. *Selaginella* : schematic life cycle

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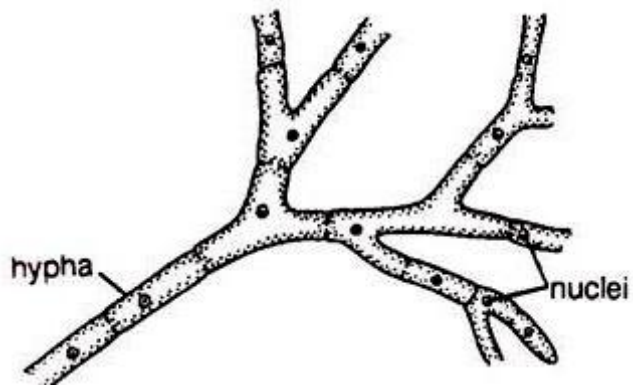
PUCCINIA

- Puccinia is a fungus. It is included in the class basidiomycetes.
- It causes rust disease in crops like wheat, barley etc.,
- It causes black rust disease of wheat.
- It is an Internal obligate parasite.

Structure:

- The plant body is called mycelium.
- The mycelia contain tubular filaments called hyhphae.
- The hyphae are intercellular, septate and branched.
- The Cell wall consists of cell wall, plasma membrane and protoplasm.
- The cell wall is made up of chitin.



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REPRODUCTION:

- It completes its life cycle in two hosts, namely wheat and barberry plant.
- The life cycle of Puccinia graminis is macrocyclic because it produces several types of spores.
- Different types of spores are produced

Uredospores
Teleutospores
Basidiospores
} Wheat plant

Pycnidiospores
Aecidiospores
} Barberry Plant

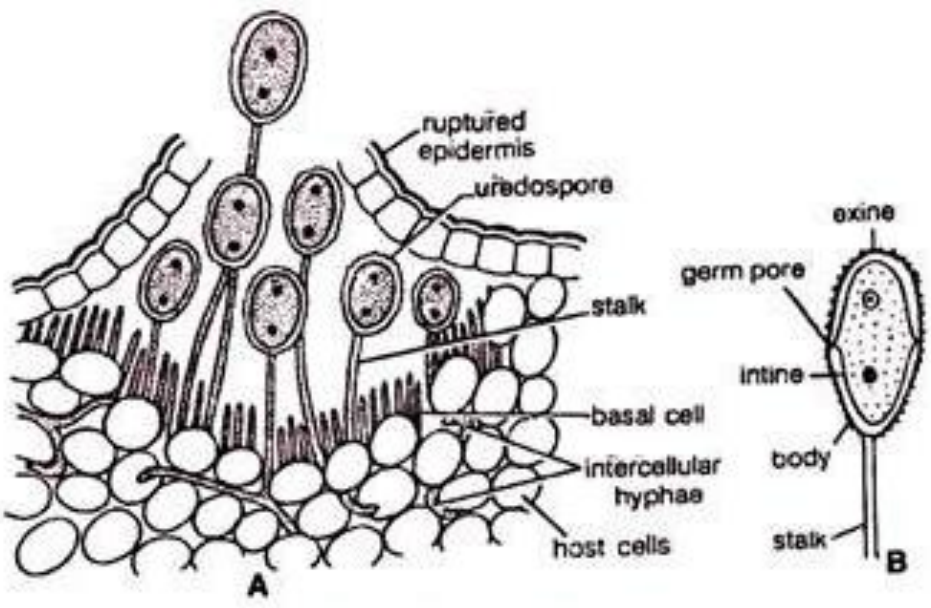
STAGES OF PUCCINIA GRAMINIS:

→ Wheat Plant is the primary host.
→ The dikaryotic mycelium found in the plant is branched.
→ The dikaryotic hyphae are formed by the germination of aecidiospores.
→ The life cycle of Puccinia graminis is divided into five stages.

- **Uredospores stage**
- **Teleutospores stage**
- **Basidiospores stage**
- **Pycnidiospores stage**
- **Aecidiospores stage**

1. UREDOSPORES STAGE:

→ During early summer, aecidiospores infect wheat plant and produce a number of reddish brown mycelium.
→ Pustules are formed on surface of the leaves.
→ This pustules is known as Uredospores.
→ The uredospores are stalked, unicellular, ovoid, binucleate spores.
→ The uredospore enters through the stoma and produce within 6-10 days.



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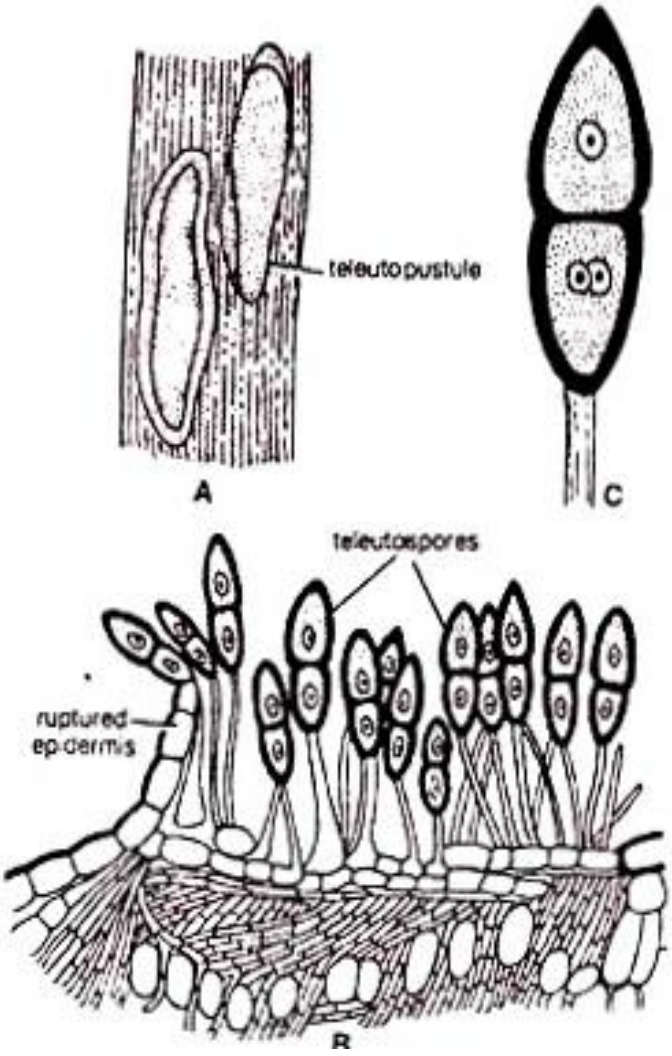
2. TELEUTOSPORE STAGE:

→ This stage is found on wheat plant.
→ uredospores now give rise to new spores called teleutospores.
→ They produce black streaks in leaf sheaths and stems.
→ It is bicelled, stalked and binucleate.
→ The teleutospores are liberated out by the breaking the epidermis.
→ They remain dormant in the soil.



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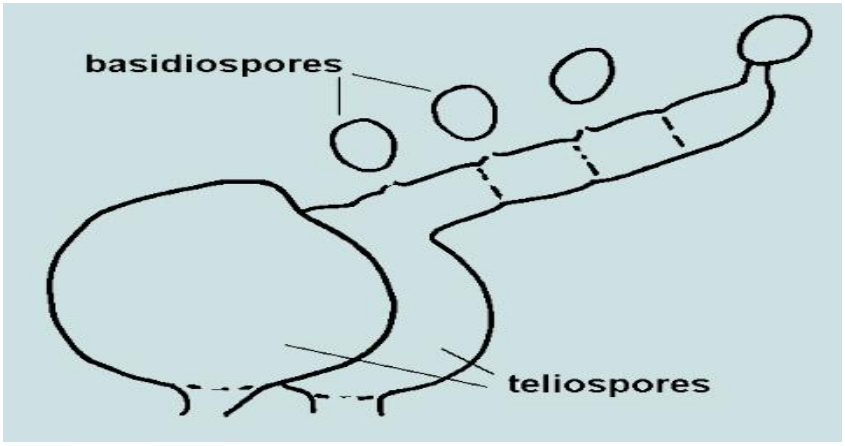
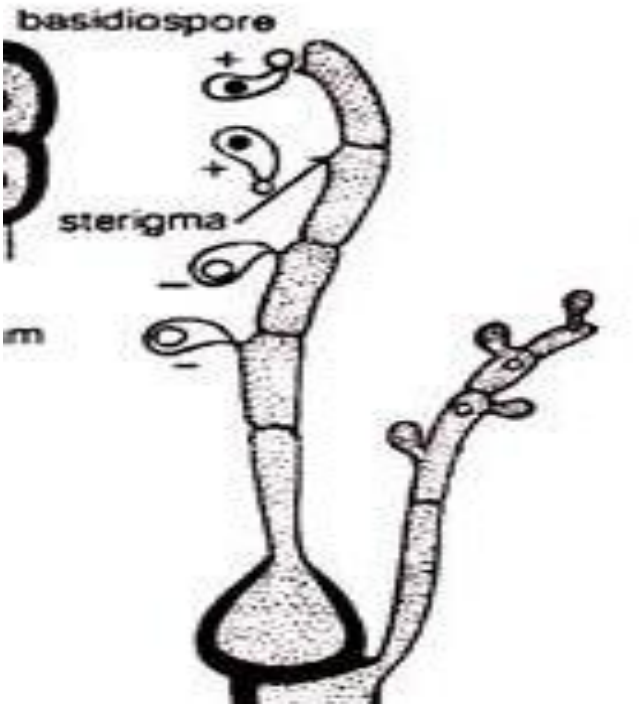
3. BASIDIOSPORE STAGE:

→ The teleutospore produces one germ tube from each cell.
→ From each cell, promycelium arises a sterigma.
→ At the tip of the sterigma, a basidiospore is formed.
→ each cell produces four types of basidiospores.
→ Two are positive strain and other two are of negative strain.
→ The basidiospores are haploid.
→ It can germinate only on the leaves of alternate host, Barberry plant.





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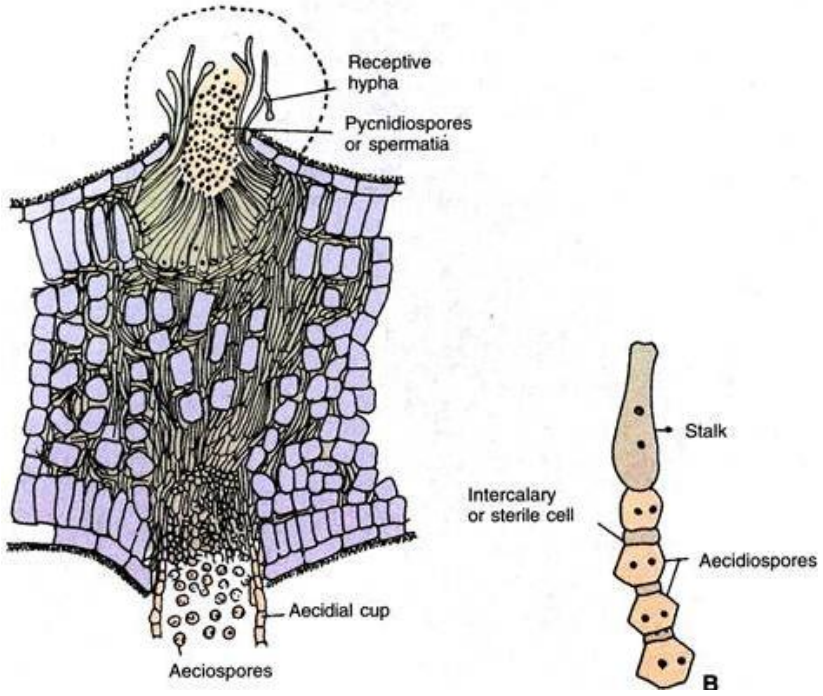
4. PYCNIDIOSPORE STAGE:

→ This stage is found on the barberry plant.
→ The spore germinates on the leaves of berberry plant.
→ They produce flask shaped structures called the pycnidium or spermagonium.
→ The opening is seed in the pycnidium is called ostiole.
→ In ostiole, there are sterile hairs which is called periphyses.
→ At the lower portion, there are long filaments which is called as spermatiophores.
→ From this spermatiophores, pycnidiospores are produced.
→ The pycinidiospores (+) received in the receptive hyphae fuse with the other strain (-).
→ This is known as spermatization.



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5. AECIDIOSPORE STAGE:

→ This stage is formed on the berberry plant.
→ The mycelium accumulates and produces aecidiospores on lower surface of the leaf.
→ There is sterile covering called Peridium.

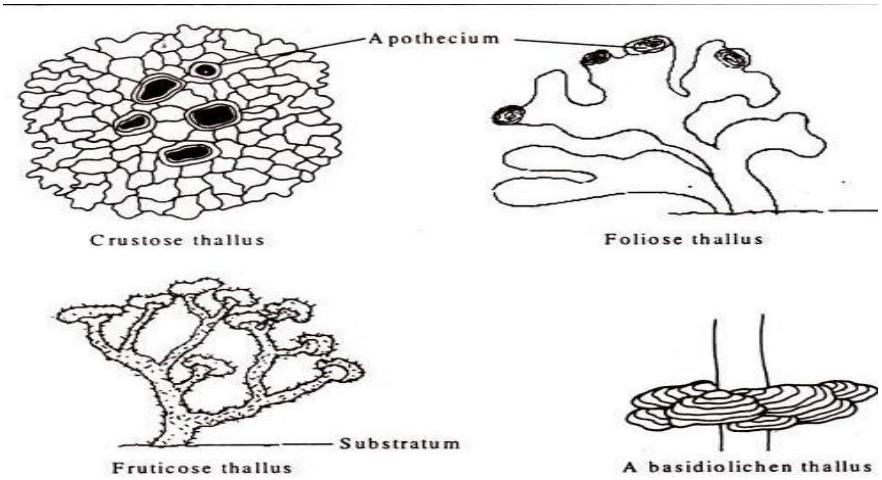
→ The peridium produces sterile hyphae called sporophores.
→ Each sporophores produce a number of aecidiospores.
→ The aecidiospores are liberated out and germinate on wheat plant.
→ Then, after 10-15 days, uredospores are produced.

LICHENS

- ➔ Lichens are dual organisms formed by the symbiotic association of a fungus and alga.
- ➔ Each lichen consists of a fungus and alga.
- ➔ The fungal component is known as mycobiont.
- ➔ The algal component is known as phycobiont.
- ➔ They live together in association and form a lichen.
- ➔ This association is called as Symbiotic association.
- ➔ lichens grow in tropical and temperate regions.
- ➔ They grow on leaves, tree trunks and rocks.
- ➔ They require moisture and sunlight.

STRUCTURE :

- ➔ The plant body is known as thallus.
- ➔ It has no root, stem and leaves.
- ➔ They are usually greyish in colour.
- ➔ There are three types of lichens
    1. **Crustose lichens**
    2. **foliose lichens**
    3. **fruticose lichens**
- ➔ Crustose lichens are thin, flattened and leathery in texture.
- ➔ Crustose lichens looks like small small crust.
- ➔ Foliose lichens are flat, leaf like and it is attached to substratum by attaching disc.
- ➔ Fruticose lichens are erect, slender and freely branched. It contains apothecium on the tip of the branches.



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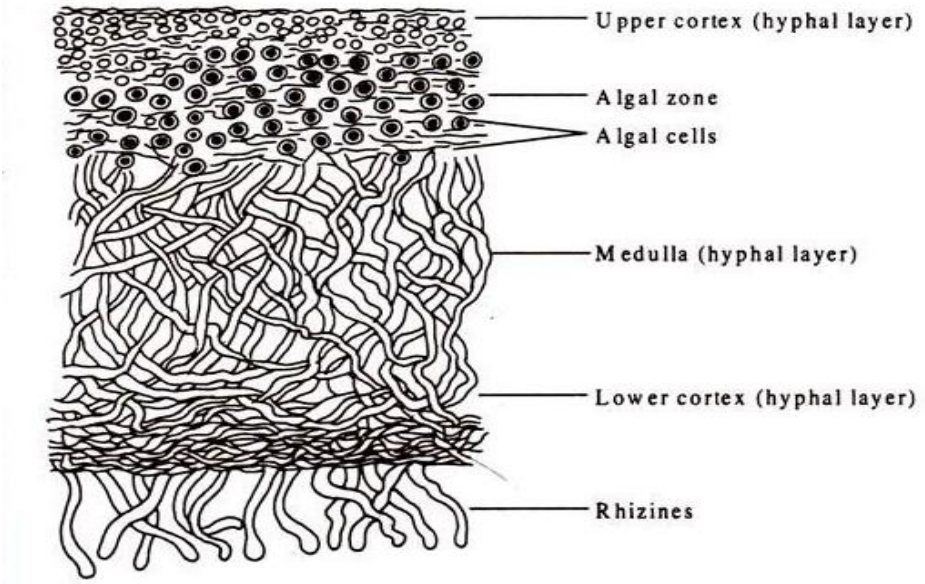
USNEA

- ➔ It is a fruticose lichen.
- ➔ It grows on tree branches and rock branches.
- ➔ The plant body is called thallus.
- ➔ The thallus is cylindrical and branched.
- ➔ The thallus is attached to the substratum by a mucilaginous disc.
- ➔ In mature thallus, tip of the branches bears fruit bodies called apothecia.

STRUCTURE OF USNEA LICHENS:



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- ➔ Thallus structure shows cortex, algal zone and medulla.
- ➔ The cortex is the outer covering for the thallus.
- ➔ It is composed of fungal hyphae.
- ➔ The cortex forms the protective zone.
- ➔ The algal zone consist of network of hyphae in which algal cells are found in groups.
- ➔ medulla is the central part of the thallus with spaces in between them.
- ➔ The fungal partner absorbs water from the substratum.
- ➔ The algal partnet prepares starch by photosynthesis.
- ➔ This type of association is known as symbiosis.

REPRODUCTION:

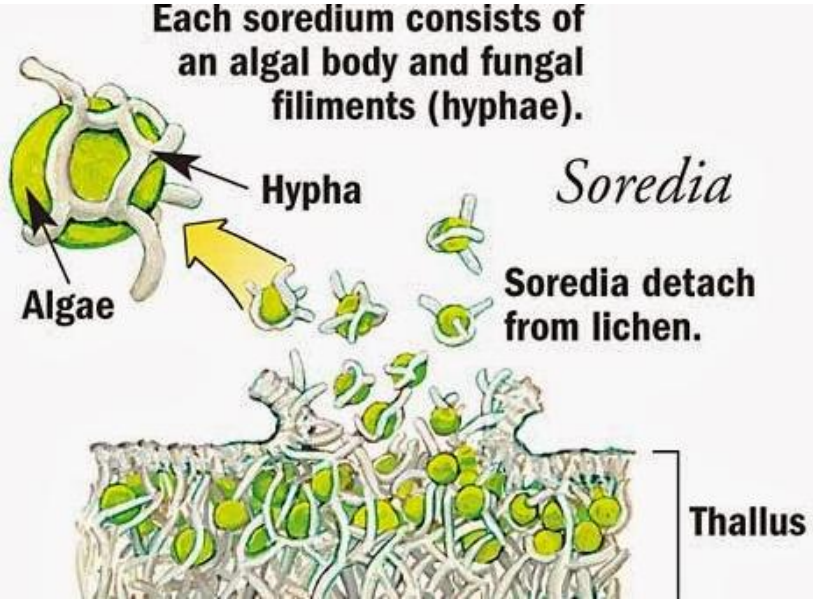
VEGETATIVE REPORDUCTION:

- Fragmentation.
- Isidia.
- Soredia.
- Binary Fission.

1) FRAGMENTATION:

   The thallus breaks into small pieces by wind or by death. each fragment develops into new thallus, provided it contains both algal and fungal components.

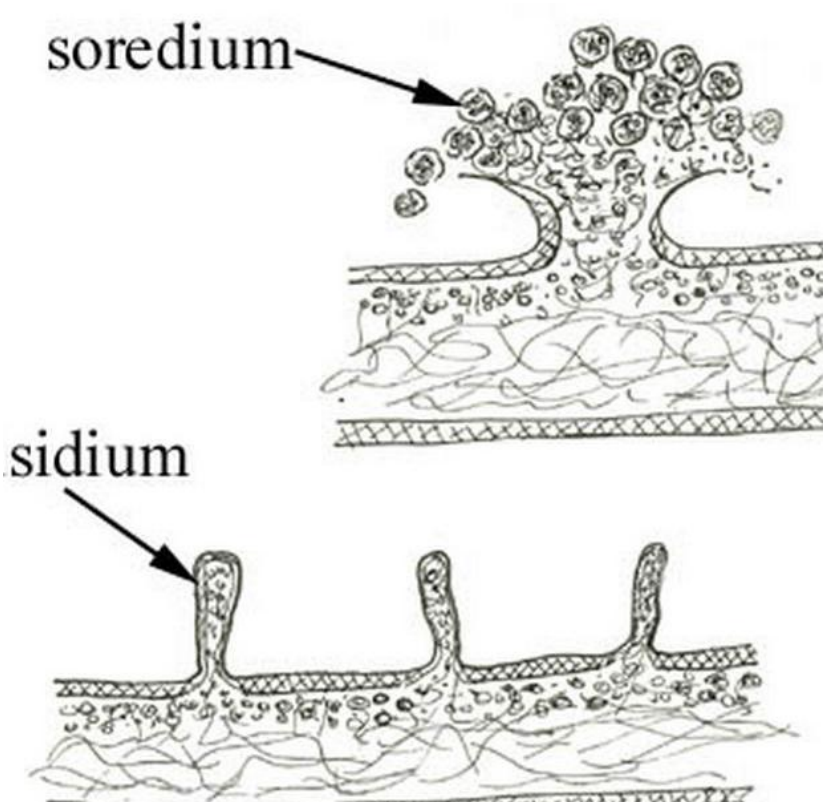
2) SOREDIA:



http://4.bp.blogspot.com/-2nJnSSSybws/Unl4NnjsK5I/AAAAAAAAAHs/ITnpm5vFIV8/s1600/soredia.jpg

Soredia are small rounded asexual bodies produced on the surface of the lichen thallus. They are grayish white in colour. It contains few algal cella and fungal hyphae. They are detached from the thallus and develop into new lichen thalli.

3) ISIDIA:



They are small, stalked, grayish-black, outgrowths of lichens which develop on thallus. They contain algal and fungal cells. The Isidia break from the thallus develop into new lichen thalli.

SEXUAL REPRODUCTION:

- ➔ It take place by process known as spermatisation.
- ➔ The female sex organ is called carpogonium.
- ➔ The carpogonium consists of basal coiled filament, ascogonium and elongated trichogyne.
- ➔ The male sex organ is the spermagonium.
- ➔ spermagonium is a flask shaped structure which opens outside by a narrow opening called ostiole.
- ➔ It produces large number of male gametes called spermatia.
- ➔ The spermatia are liberated and carried to the trichogyne by wind.

- ➔ The spermatium attaches in the trichogyne.
- ➔ The male nucleus pairs enters and reaches the egg.
- ➔ Now, it fertilizes with the egg.
- ➔ After fertilization, ascogenous hyphae are formed.
- ➔ In each ascogenous hyphae, ascus are fromed.
- ➔ In each ascus, 8 ascospores are produced.

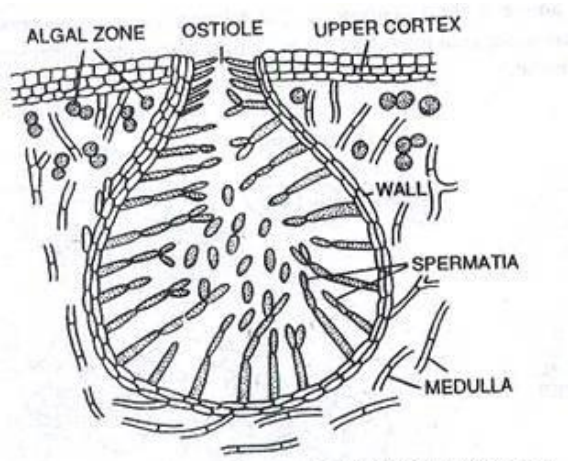


Fig. 18.13. Diagrammatic representation of spermagonium (pycnium) of *Physcia*.

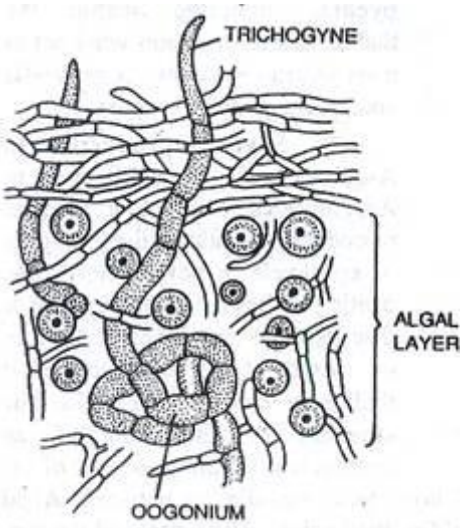


Fig. 18.15. V.S. thallus (*Physcia*).

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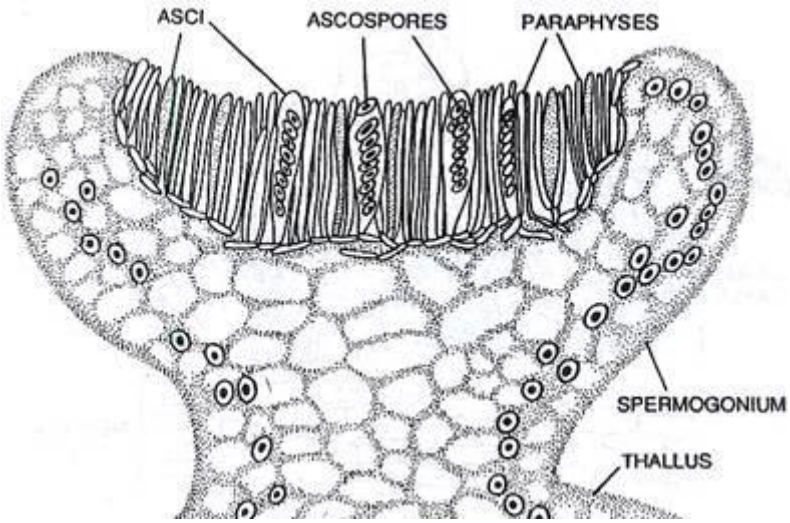
APOTHECIUM:



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- ➔ Apothecia are fruit bodies which are produced after sexual reproduction or spermatization.
- ➔ They are cup shaped or disc shaped.
- ➔ Inside the apothecium, there is peridum, algal zone and hymenium.
- ➔ perdium is the couter covering of the apothecium
- ➔ In the algal zone, algal cells and fungal hyphae are present.
- ➔ On the upper surface of the apothecium, hymenium is present.
- ➔ It contains ascus and paraphysis.
- ➔ The ascus has eight ascospores.
- ➔ The ascospores are liberated out and reaches the substratum.
- ➔ Then, a new lichen thalli is formed.

GYMNOSPERMS

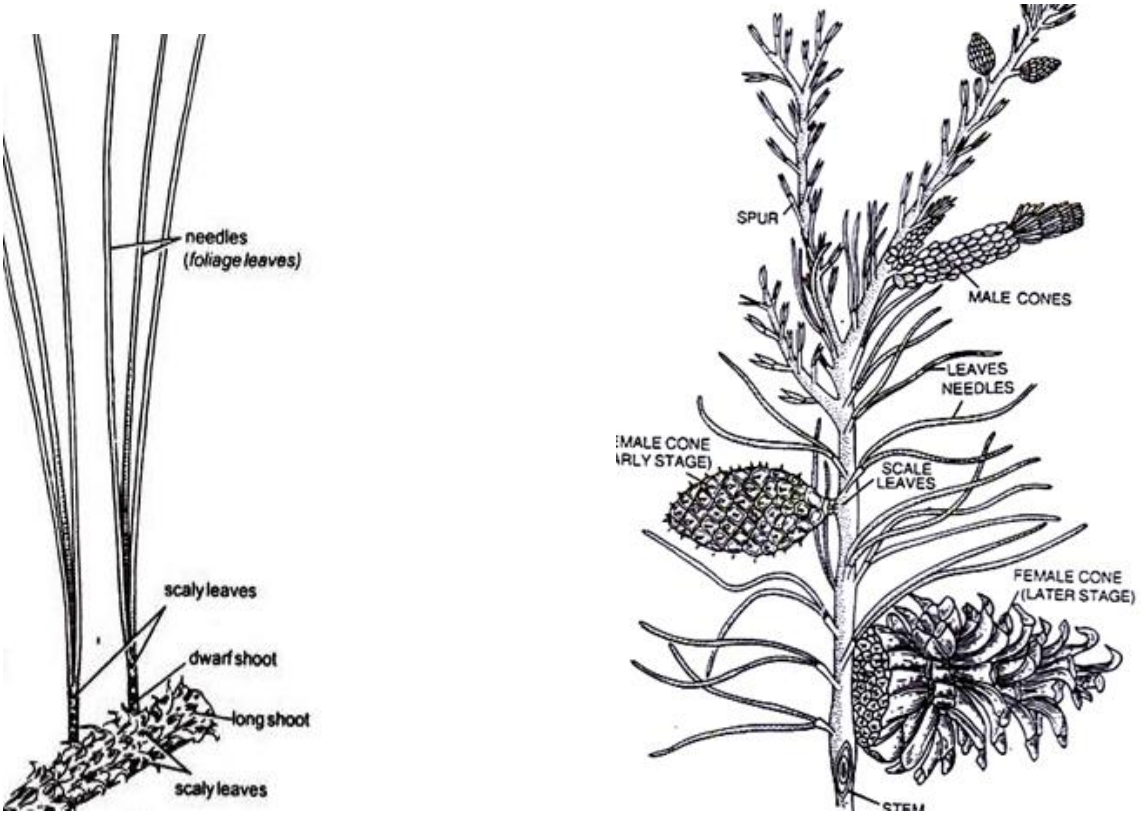
- Gymnosperms are naked seeded plants (Gymno = naked; sperma = seed).
- It consists of 70 genera and 725 species.
- They are evergreen slow growing plants.
- They are tall, woody, evergreen, perennial trees or shrubs.
- They show xerophytic characters.
- Leaves may be dimorphic (foliage and scale leaves).
- The reproductive parts are arranged in the form of cones or strobili.
- In male cones, many microsporophylls are arranged on the central axis.
- The microsporophylls contain microsporphylls with microspores
- In female cones, many megasporophylls are arranged on the central axis.
- The megasporophylls contain megasporphylls with megapores
- The ovules is orthotropous.
- The ovules are naked.
- The megaspore give rise to archegonia.
- Polyembryony is present.
- Pinus, Cedrus, Cycas are some examples of gymnosperms.

PINUS

- It is a gymnosperm plant.
- It is distributed in temperate regions and hill stations.
- It consists of 105 species.
- It is diploid sporophyte.
- Pinus reproduces by two methods, asexual and sexual.

STRUCTURE:

- It is tall evergreen, perennial xerophytic plants.
- The stem is erect, woody and branched.
- The branches are two types namely long and dwarf shoots.
- The long shoots bears only scale leaves.
- From the tip of the scale leaves, dwarf shoots are formed.
- Dwarf shoots contain scale leaves and foliage leaves.
- Leaves are also dimorphic.
- There are two types of leaves namely scale leaves and foliage leaves.
- Foliage leaves are acicular (needle like) and green.
- They are known as needle.
- A dwarf shoots with a cluster of needles is called spur shoots.



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INTERNAL STRUCTURE OF PINUS NEEDLE:

a) EPIDERMIS:
- It consists of single layer of thick walled cells.
- The outer walls are covered by thick cuticle.
- Stomata opens internally into an air cavity.
- It is made up of two layers of sclerenchymatic cells.

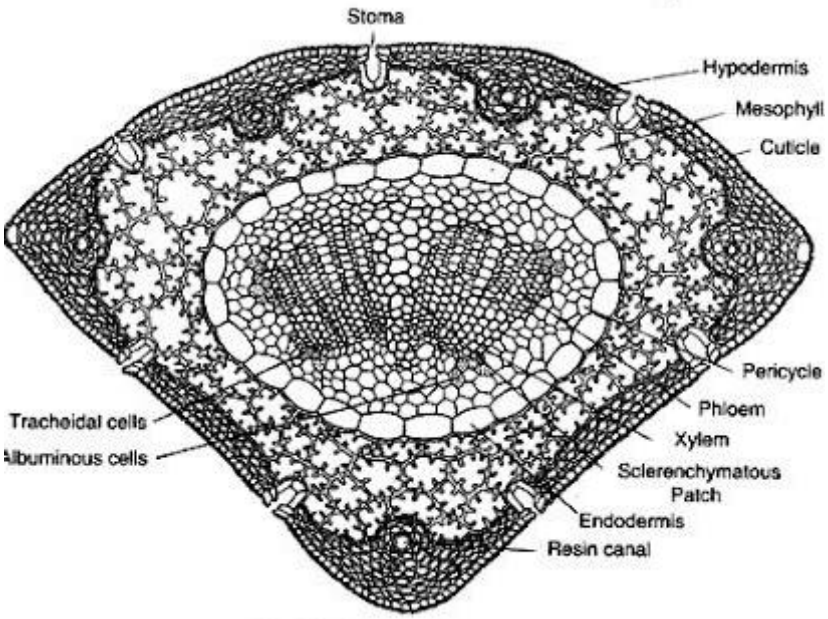
b) MESOPHYLL:
- It is found below the hypodermis.
- It consists of parenchymatous cells
- They are loosely arranged.
- Two resin canals are present.
- Each resin canal cells are surrounded by epithelial layer.

c) ENDODERMIS:
- It consists of single layer of barrel shaped cells.
- Pericycle is many layered and parenchymatous.
- The trachedial cells conduct water and mineral salts.

- The albuminous cells conduct food from the mesophyll cells.

d) VASCULAR BUNDLES:

- There are two vascular bundles.
- These two vascular bundles are present inside the pericycle.
- Each vascular bundle is collateral and open.
- Protoxylem is pointing outwards.
- Metaxylem is pointing innerwards.



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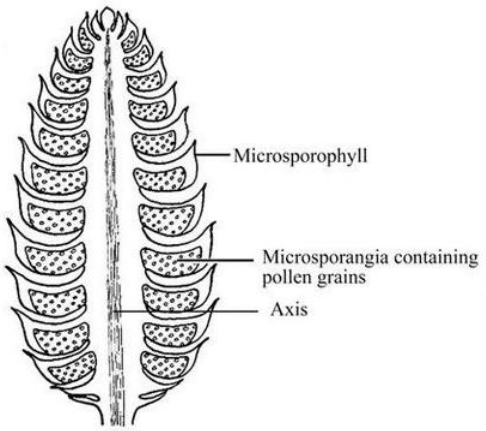
REPRODUCTION:

- It reproduces asexually by spores.
- Cones are the reproductive structures

MALE CONE

- It is the male reproductive organ.
- The male cones develop in the clusters in the axil of scale leaves.
- It is ovoid in shape.
- It consists of central axis and numerous microsporophylls.
- Each microsporophyll is small leaf like structure.

- Each microsporophyll bears on its either side microsporangium.
- Each microsporangium consists of mass of archesporial cells.
- Each microsporangium contains numerous microspores.
- Each microspores develop into male gametophytes



Male pine cone

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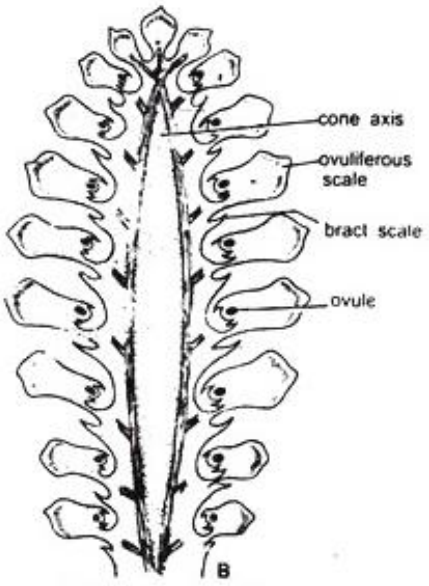
FEMALE CONE:

- It is the female reproductive organ.
- Each female cone consists of a central axis and many megasporophylls
- They are spirally arranged on either side.
- The megasporphylls consists of two scales namely Bract scale and Ovuliferous scale.
- Each ovuliferous scale bears on its upper side two naked ovules.
- The ovuliferous scale is wedge shaped.



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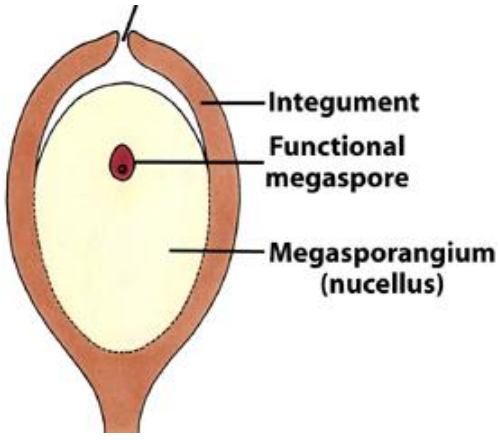
OVULE:

- A young ovule consists of a single integument enclosing nucellus.
- The integument is three layered.
- There is a opening at the top called called micropyle.
- Inside the ovule there will be only functional megaspore.
- The megaspores are haploid.
- The megespores develops into female gametophyte.



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SEXUAL REPRODUCTION:

MALE GAMETOPHYTES

- Microspore germinates into a male gametophyte.
- The microspore is unicellular and uninucleate.
- It has two coats, namely exine and intine.
- The outer layer exine has wings on the sides.
- The wings helps for dispersal for microspore.

FEMALE GAMETOPHYTE

- The female gametophyte develops from the megaspore.
- It is haploid
- The female gametophyte is completely dependent upon the sporophyte.
- The female gametophyte bears 3 to 5 archegonia at the micropylar end.
- The mature archegonium is flask shaped.
- Each archegonium is surrounded by sterile jacket layer.
- It consists of swollen venter and short neck canal cells.
- Venter consists of egg.
- The egg is haploid.

FERTILIZATION:

- Fertilization occurs about a year after pollination.
- The pollen grain consists of two male gametes.
- One male gamete fuses with the egg formatting zygote.
- The zygote is diploid.

PLANT ANATOMY

The study of the internal structure of a plant is called plant anatomy.

TISSUES:

A tissue is defined as a group of cells which are similar in structure and similar in function.

TYPES OF TISSUES;

There are 2 types of tissues in plants

- ➔ Meristematic tissue
- ➔ Permanent tissue

MERISTEMATIC TISSUE:

Meristematic tissue is defined as a group of young and undifferentiated cells having the power of division. It has the following characters.

- ☞ Cells are small and isodiameteric
- ☞ Celss are thin walled.
- ☞ Cells have large nucleus and dense cytoplasm.
- ☞ Intercellular space is absent.

CLASSIFICATION OF MERISTEM.

Based on position, meristems are classified into three types,

- ➔ Apical meristem
- ➔ Intercalary meristem
- ➔ Lateral meristem

Apical Meristem

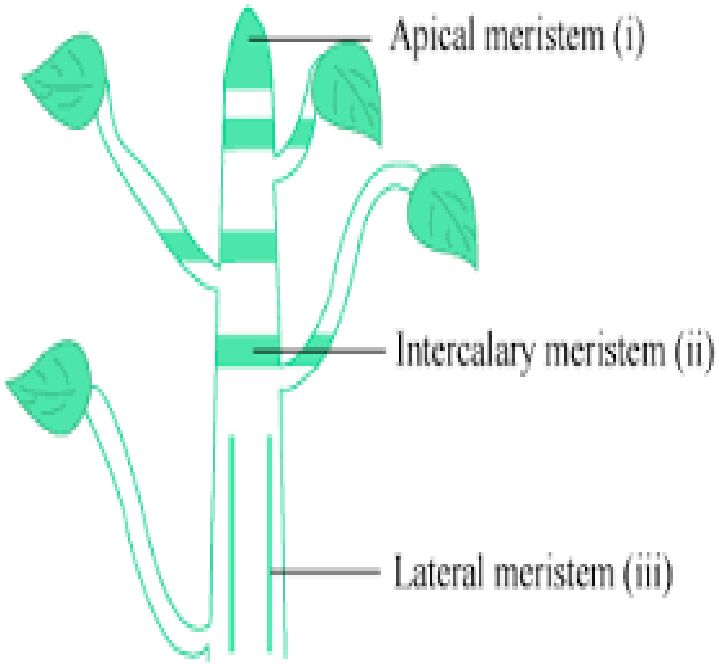
It is found at the stem, branches and root.

Inter callery meristem:

It is found along the internodes of a stem.

Lateral meristem

It is found along the lateral sides of a stem.



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Based on origin, it is classified into 2 types.

Primary meristem

The primary meristems are produced from the embryonic cells eg. Apical meristems and lateral meristems

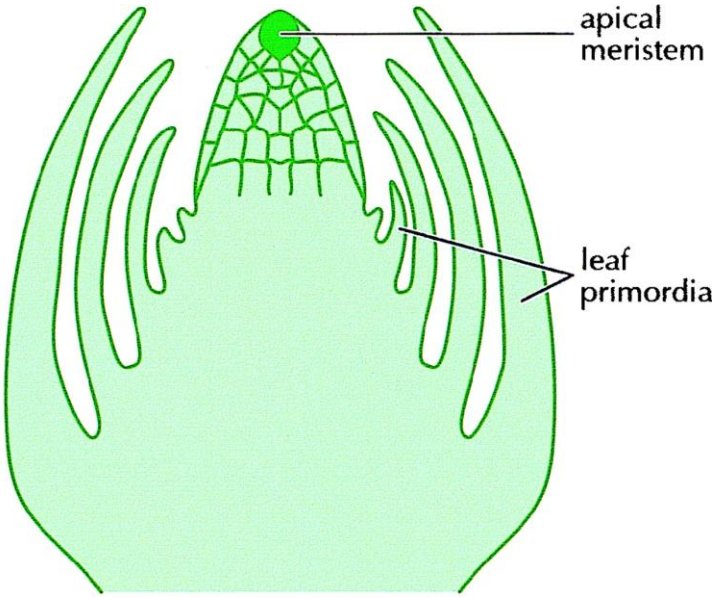
Secondary meristems;

This meristem is formed from permanent tissue like parenchyma cells eg. Cortex

Theories on apical meristems:

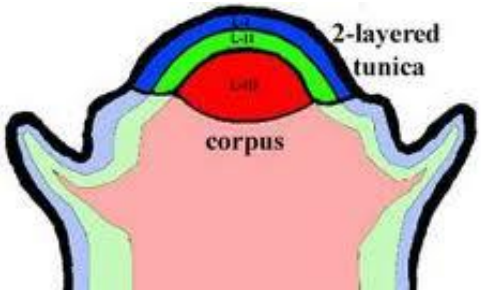
Apical cell theory:

- ✓ It was proposed by Nageli in 1858.
- ✓ According to this theory, there is only one meristematic cell at the tip of the stem, branches and roots.
- ✓ This single produces the entire plant.
- ✓ This theory is not applicable to all plants.
- ✓ It is found applicable to algae and bryophytes.



Tunica Carpus theory;

- ✓ This theory was proposed by schimidt in 1924.
- ✓ According to schimidt theory, the apex of a stem and roots consists of two zones.
- ✓ They are called tunica and Carpus.
- ✓ The tunica is single layer. It forms epidermis.
- ✓ The carpus has a group of meristematic cell. It forms vascular cells and cortex.



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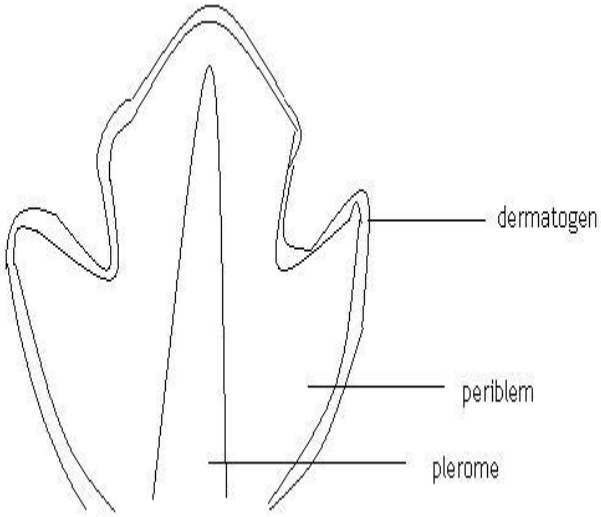
Histogen theory:

This theory was proposed by hanstein in 1870.

It has three regions

- Dermatogen
- Periblem
- Pleurone

- ❖ Dermatogens is outer layer and forms epidermis.
- ❖ Periblem is the middle region and forms cortex.
- ❖ The pleurome is the central region produces the vascular tissues.



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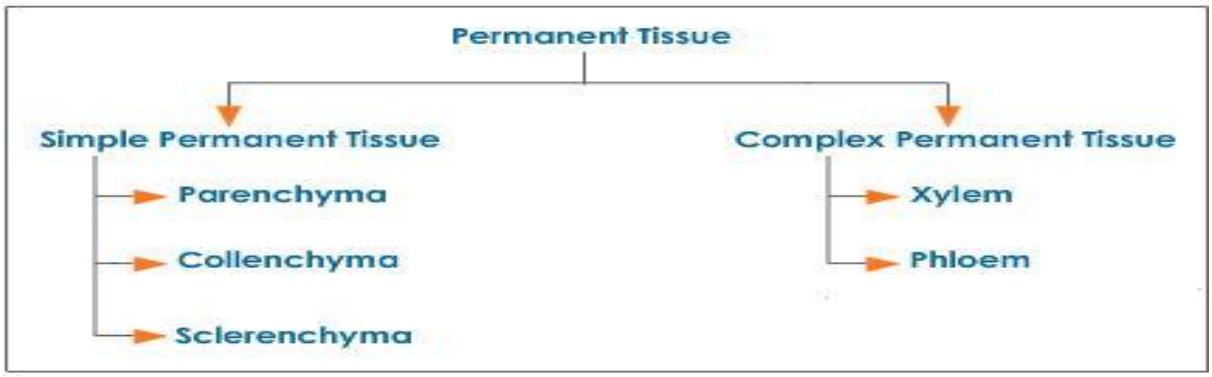
PERMANENT TISSUES

Permanent tissues are those tissues which have undergone complete differentiation.

It is of two types

- ➔ Simple permanent tissues
- ➔ Complex permanent tissues



Simple tissues:

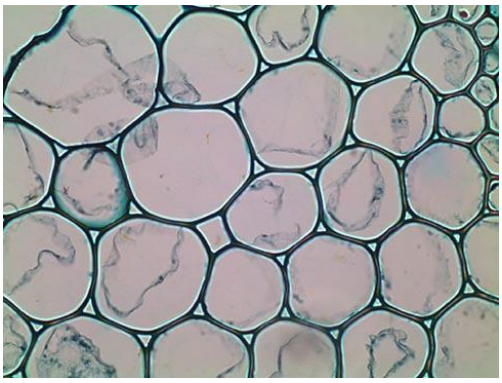
The simple permanent tissue is one which is made up of only one type of cells. It is classified into three types

- ❖ Parenchyma
- ❖ Collenchymas
- ❖ Sclerenchyma

Parenchyma tissue

It has the following characters

- o It is living
- o It is thin walled.
- o Intercellular space is present.
- o Nucleus is large
- o Cytoplasm is dense



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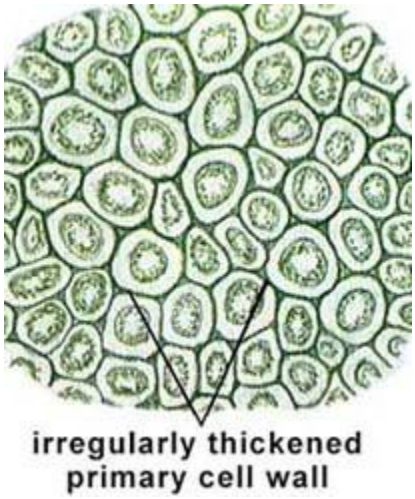
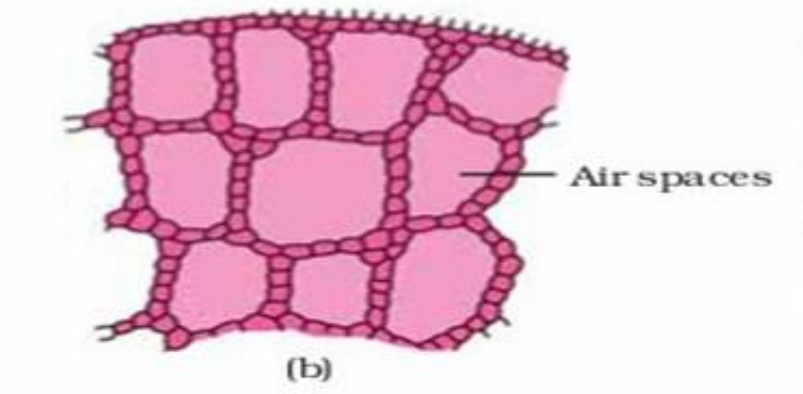
Types;

- ❖ Chlorenchyma cells – with chloroplast.



- ❖ Aerenchyma cells – with air space.



Functions;

- ➔ It forms the ground tissue such as epidermis, cortex etc.,
- ➔ It performs photosynthesis
- ➔ They help store materials
- ➔ They store water in some plants.
- ➔ It helps in gas exchange.
- ➔ It produces cambium during secondary growth.

Parenchyma

COLLENCHYMA:

- It is living
- cell wall is thick at the corners.
- Intercellular spaces is absent.
- They give strength to the plants.

There are 3 types

1. Angular Collenchymas.
   Here, the cell wall is thickened in the corners.

2. Lamella Collenchyma.
   Here, the tangential wall is thickened.

3. Lacunar Collenchyma.
   Here, the cell wall is thickened along the corners but intercellular is present.

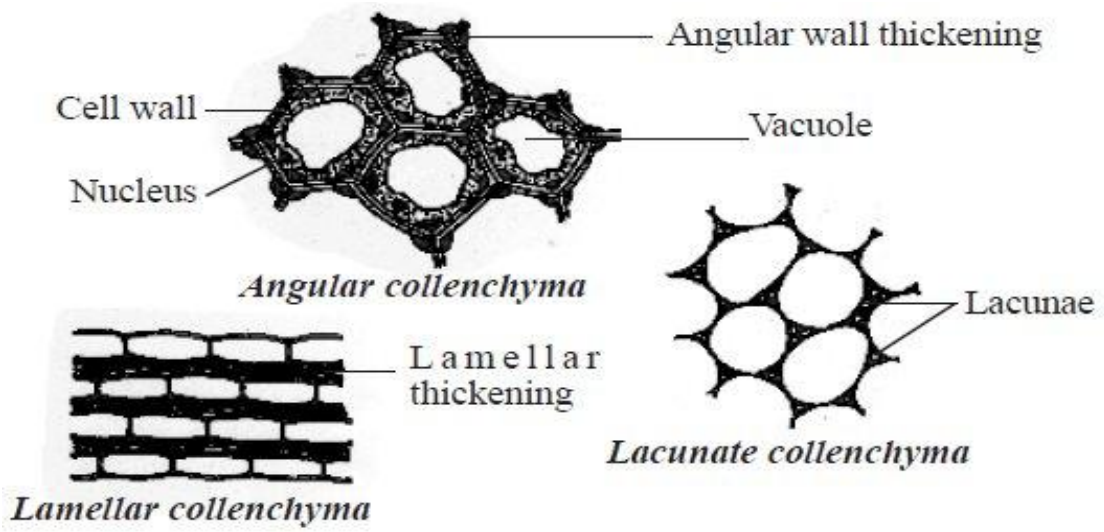


Fig. 2.3. Types of collenchyma

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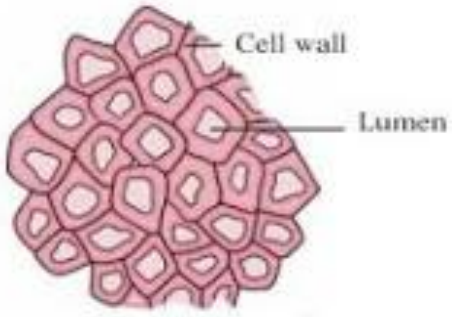
SCLERENCHYMA

This is a simple permanent tissue.
It has the following characters

1. Cells are without protoplasm.
2. The cell wall is highly thickened.
3. It has primary layer and secondary layer and tertiary layer.
4. Inter cellular space is absent



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It is of two types;

Fibre are elongated cells. It looks like a long needle.

Sclerieds :

It is also called stone cells.

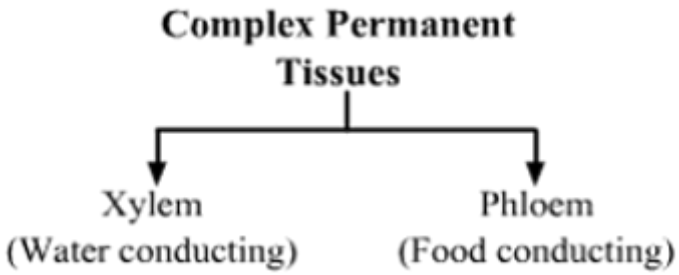
It is provided with very thick cell wall but they are normally isometric in shape.

It is of various types

Functions:

1. It helps in mechanical functions.
2. It helps xylem and phloem

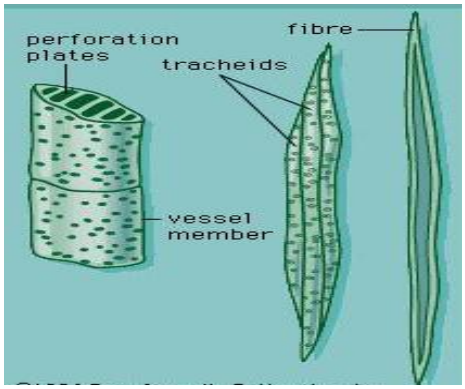
COMPLEX TISSUE:



XYLEM

It is a complex permanent tissue which is made up of 4 types of cells

1. Tracheids
2. Vessels
3. Xylem parenchyma
4. Xylem sclerenchyma



https://media1.britannica.com/eb-media/02/5602-004-2C2C2DD3.jpg

Tracheids:

- ➔ It is elongated and tube like cells.
- ➔ The ends may be tapering, round or oval.
- ➔ It has thick cell wall and large lumen.

Annular tracheids

The wall materials are deposited in the form of rings.

Spiral tracheids

Wall material is deposited spirally.

Scalariform trachieds

The wall material are deposited in the form of a ladder

Reticulate Tracheids;

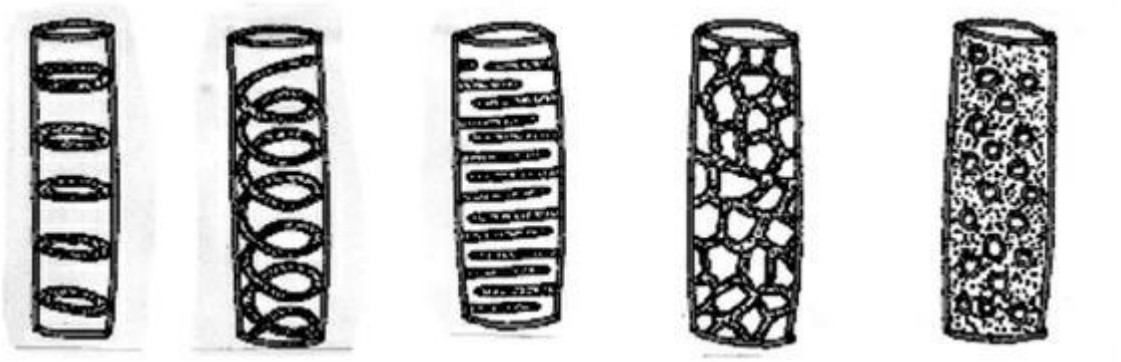
The wall materials are deposited in the form of network.

Pitted tracheids

The wall material are deposited in the form of small pits.

Functions:

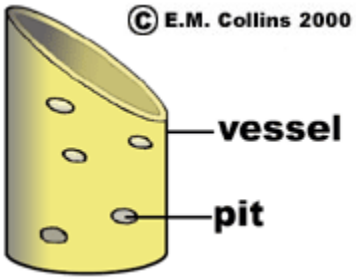
It helps in conduction of water.
It is absent in algae.
It is present in pteridophytes.



https://image.slidesharecdn.com/tracheidandvesselelements-150512230433-lva1-app6892/95/tracheid-and-vessel-elements-6-638.jpg?cb=1431471931

2) Vessels;

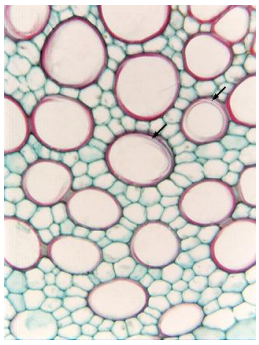
1. It is a component of xylem.
2. It is elongate and large lumen.
3. End walls have openings.
4. Cell wall is thick.



http://waynesword.palomar.edu/images/vessel3.gif

3) Xylem Parenchyma:

1. It has parenchyma cells.
2. It is connected with storage of food materials.



http://www.kbg.fpv.ukf.sk/studium_materialy/morfologia_rastlin/webchap11stem/web11.5-9.jpg

PHLOEM

➔ It is permanent complex tissue.

Sieve tube:

b. It is elongate cells.
c. It is thin cell wall.
d. Sieve tube has a round plate at its upper end and lower end.
e. It has several pores.
f. These plate look like a sieve.
g. It placed one above the other to form a long tube like structure.
h. It helps in conduction of food materials.

Companion cells;

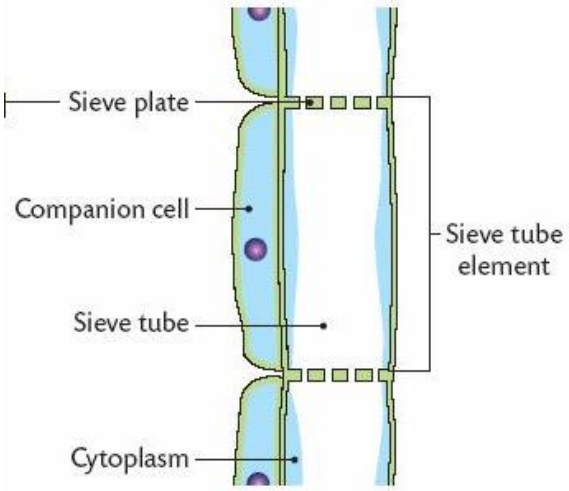
- It is a normal parenchyma cells found always in association with sieve tube.
- It has large nucleus and dense cytoplasm.
- Companion cells are absent in gymnosperm.
- It controls the function of sieve tubes.

Phloem Sclerenchyma:

It is also called bast fibres. It gives strength.

Phloem parenchyma:

It is a common parenchyma cells helps in storage cells.



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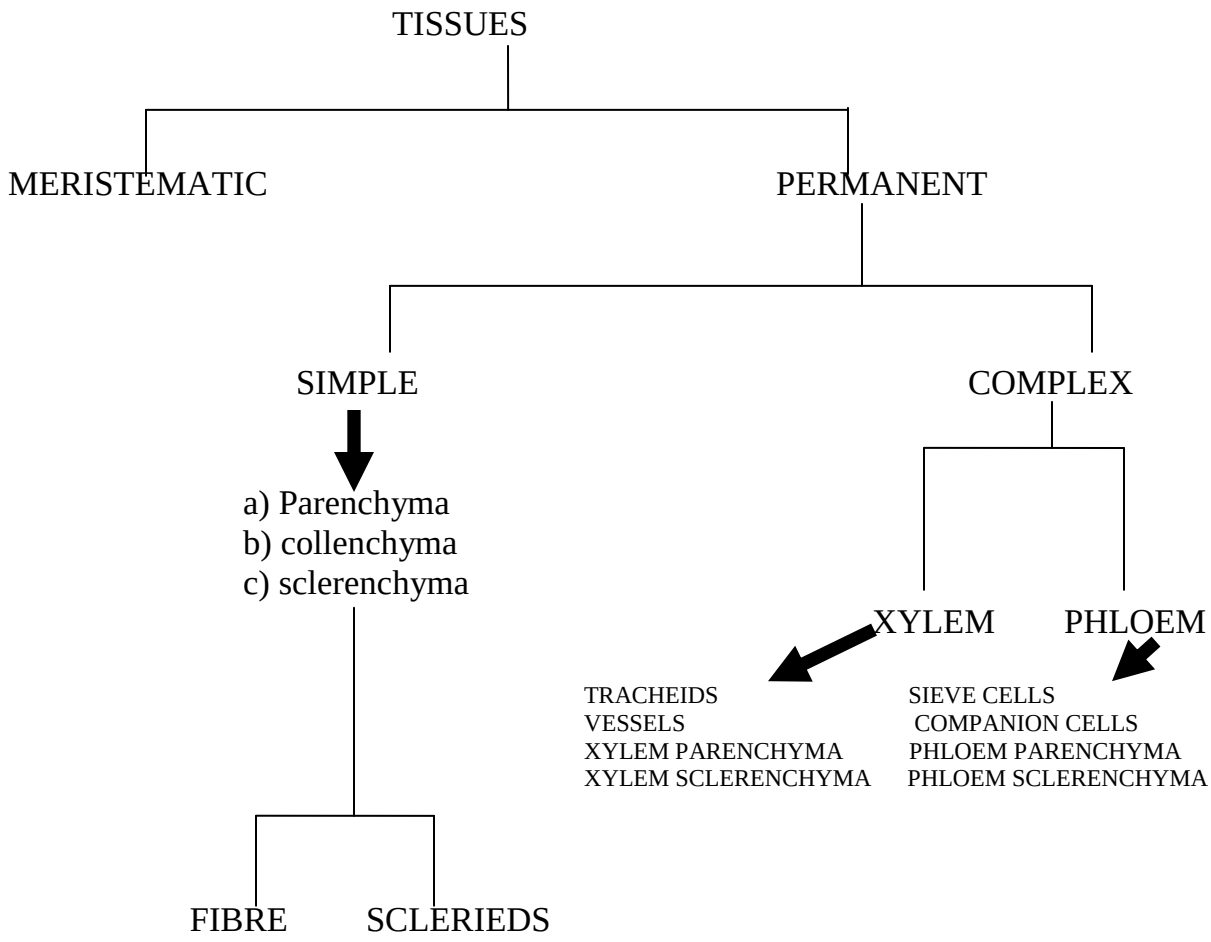
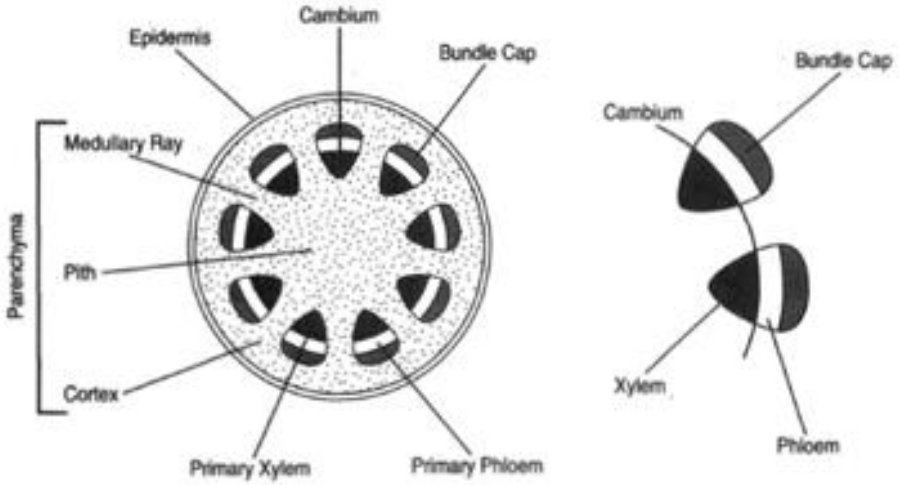

TISSUES
MERISTEMATIC
PERMANENT
SIMPLE
COMPLEX
a) Parenchyma
b) collenchyma
c) sclerenchyma
XYLEM
PHLOEM
TRACHEIDS
VESSELS
XYLEM PARENCHYMA
XYLEM SCLERENCHYMA
SIEVE CELLS
COMPANION CELLS
PHLOEM PARENCHYMA
PHLOEM SCLERENCHYMA
FIBRE
SCLERIEDS

SECONDARY GROWTH IN DICOT STEM



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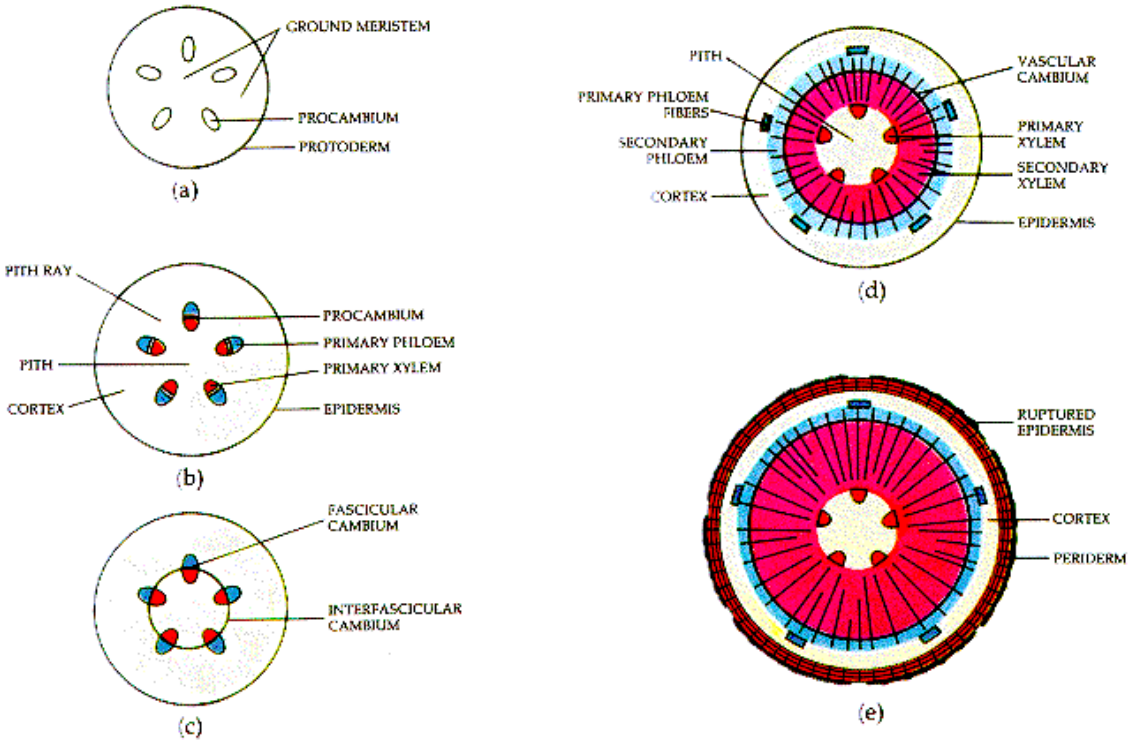

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In dicot stem, secondary growth takes place through the following steps:

a) **Formation Of Cambium Ring**:

- Formation of the cambium ring is the first step of secondary growth.
- The cambium of vascular bundles becomes meristematic.
- It form a strip of interfasciular cambium together with intrafasciular cambium form a complete circular ring, which is called cambium ring.

b) **Formation Of Secondary Vascular Tissues:**

- The cambium ring cuts off new cells, both on outer and inner sides.
- The new cells formed on the outerside forms secondary phloem.
- The cells formed on the inner side forms secondary xylem.

c) The vascular cambium cell divides produces secondary phloem to outside of the dicot stem and secondary xylem inside.

- This leads to the growth of bark.
- Bark consists of all the tissue layers outside the vascular cambium. Like secondary phloem, cork, cork cambium.
- During secondary growth, as the secondary phloem increases in its thickness, the primary phloem decreases in its thickness. An outer layer of it is nothing but cork cambium, an another type of cambium apart from vascular cambium which plays role in secondary growth.
- Cork cambium gives rise to cork cells and the epidermis is gradually replaced by periderm.

d) **Annual rings:**

- The cambium stops dividing in winter.
- In the spring season or early summer, the cambium becomes more active and produces a large number of vessels.
- These are called **spring wood** or **early wood.**
- During the autumn the cambium becomes less active and produces vessels with narrow lumens.
- These woods are called **autumn wood** or **late wood.**

e) Sapwood and Heartwood:

- In older stems, the woody trunk is differentiated into two regions.
- The outer light coloured region is called **sap wood.**
- Central dark colored region is called **heart wood.**
- The heartwood is stronger and more durable than sapwood.

SECONDARY GROWTH IN DICOT ROOT