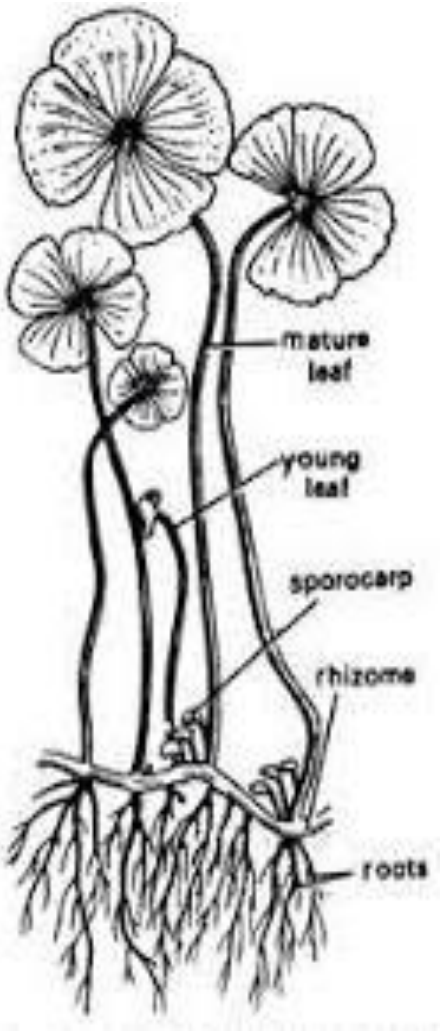
# MARSILEA

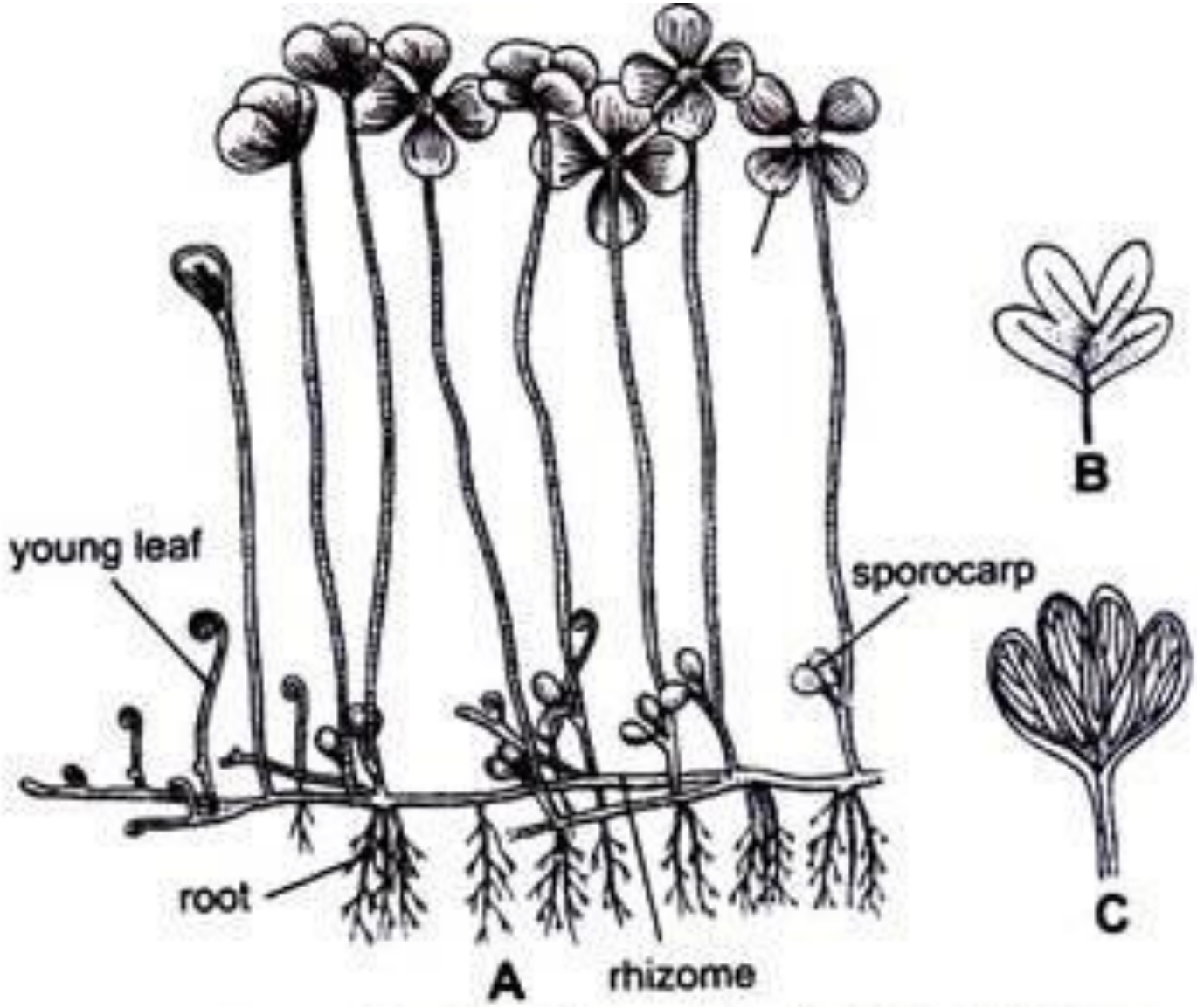
*Dr. Neeraja Tutakne*

# EXTERNAL MORPHOLOGY OF SPOROPHYTE

- Sporophyte is **creeping** in the mud & possess **root**, **rhizome** and **leaves**
- **Rhizome** is **horizontal** structure with fairly long **internodes**. From the rhizome, **leaves** and **roots** are given out from the **nodes**.
- The **roots** are **adventitious**, given out from the nodes from the underside of rhizome. They **absorb minerals**, **salt** and **water**, and anchor sporophyte in the mud.
- The **leaves** are alternately produced from **nodes** on rhizome and are arranged in **distichous manner**.
- Each mature leaf shows a **long petiole** with **four leaflets** at the tip. The leaflets are actually one pair is placed a little higher than the other in **opposite decussate manner**.
- Each **leaflet** shows very **minute** petiole (sub-sessile). The leaflet is **obovate** in **shape** with entire or **serrate margin**, **rounded apex** and **dichotomously venation**.



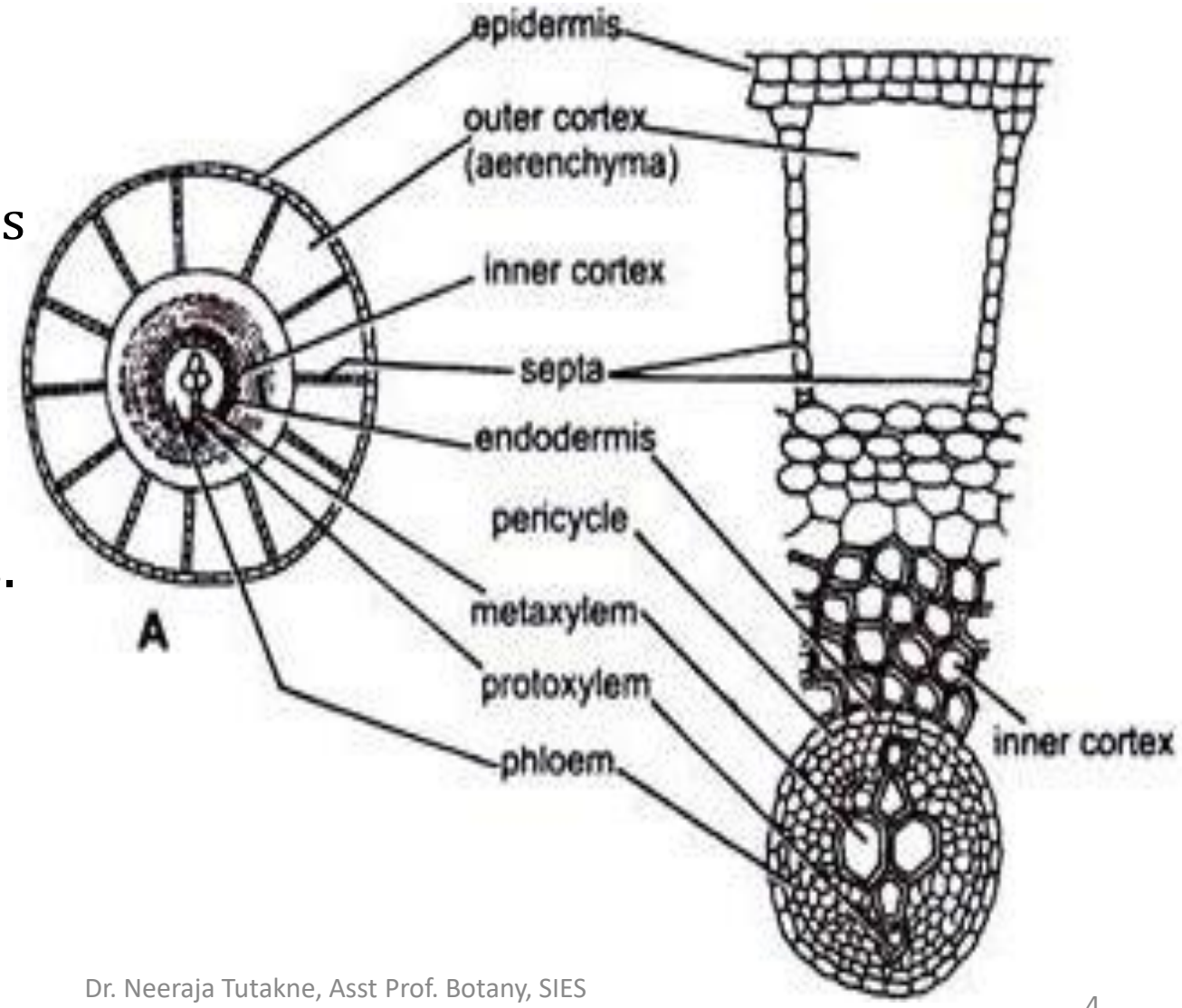
# EXTERNAL MORPHOLOGY OF SPOROPHYTE



# INTERNAL MORPHOLOGY OF SPOROPHYTE

## T.S. OF ROOT:

- **Epidermis**
- **Cortex:** Outer aeparenchymatous cortex, middle parenchymatous cortex & inner cortex sclerenchymatous.
- **Stele:** Endodermis, pericycle, radial vascular bundles with diarch & exarch xylem.



# INTERNAL MORPHOLOGY OF SPOROPHYTE

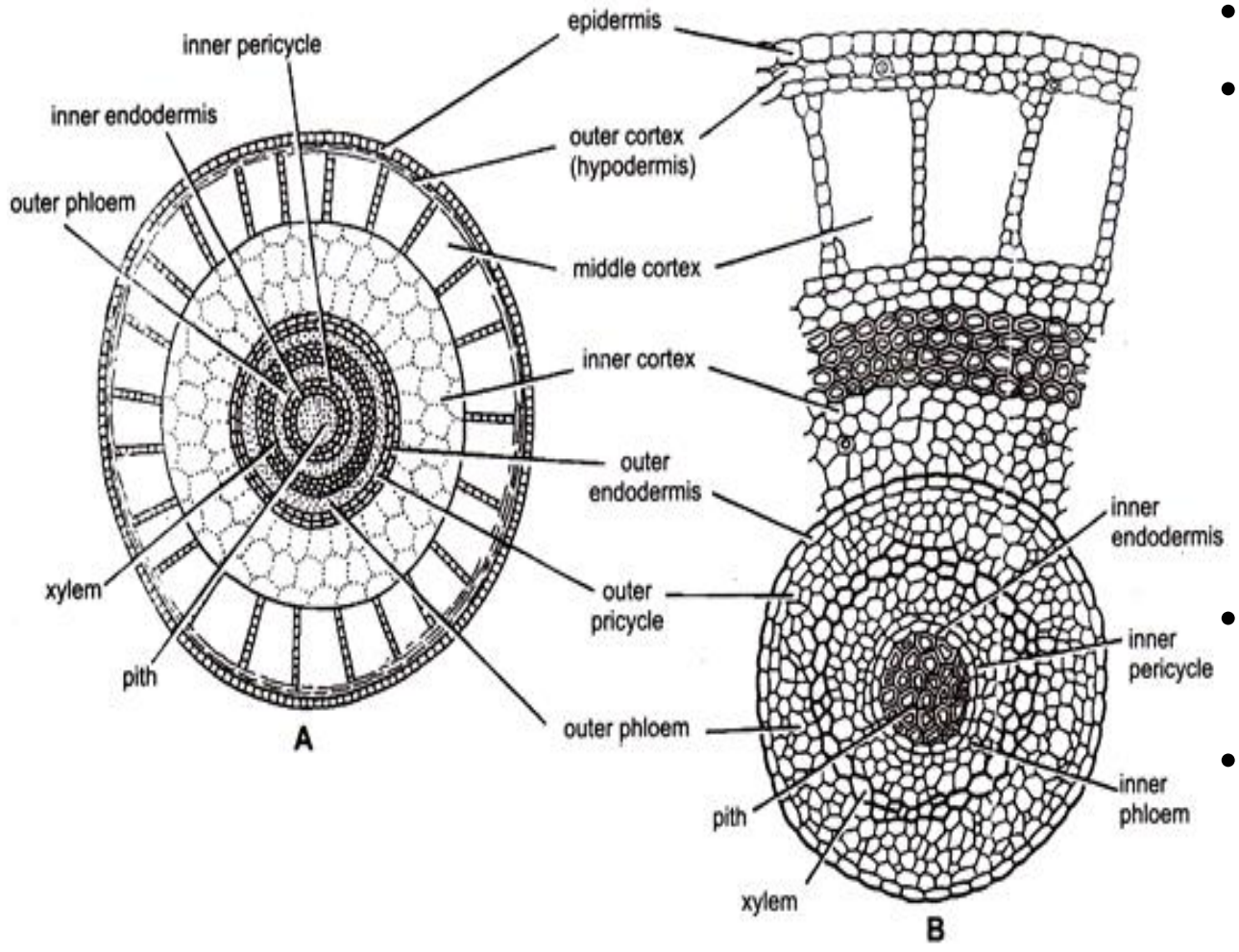
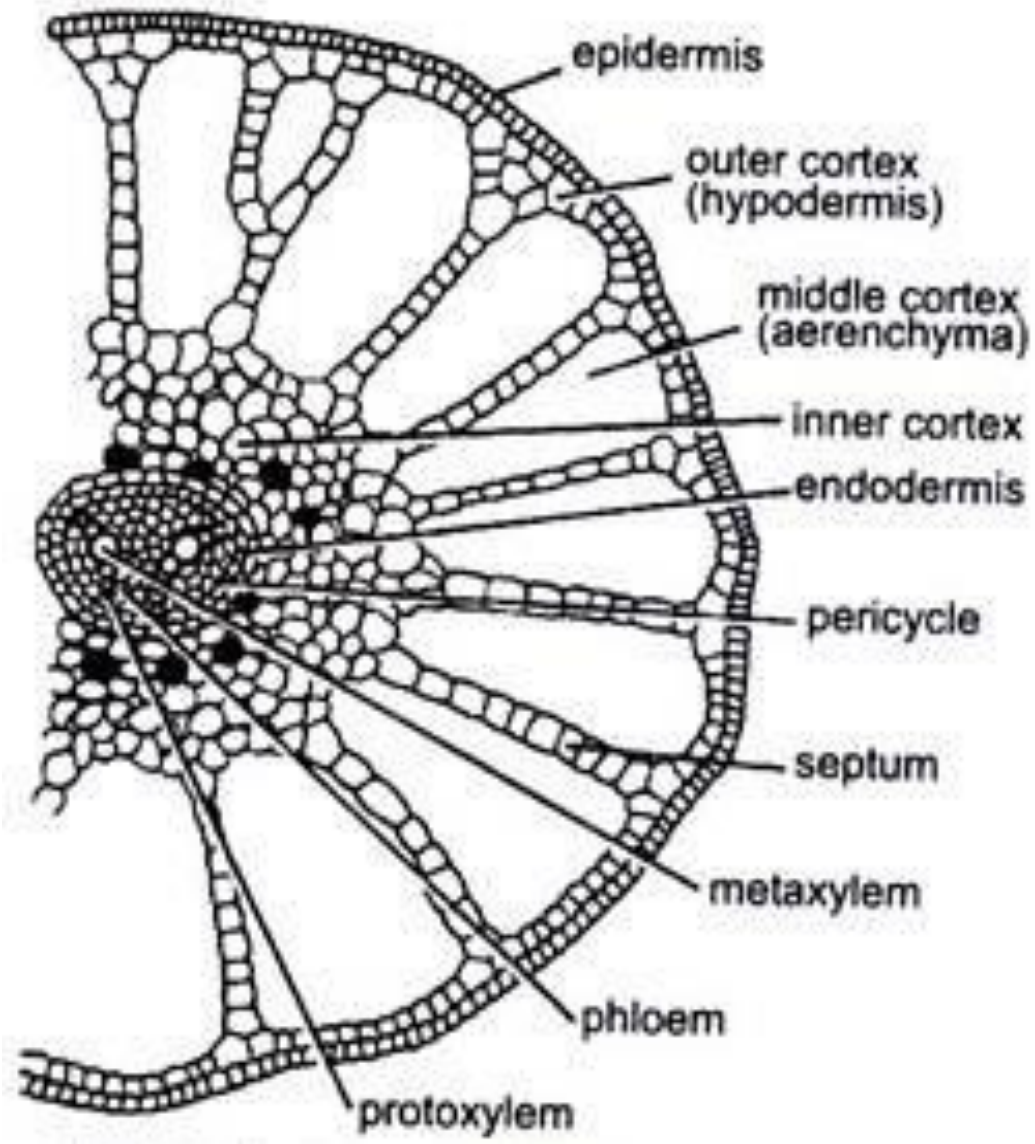



Fig. 2. A, B. *Marsilea.* Internal structure of rhizome. A. Diagrammatic, B. A part cellular.

## T.S. OF RHIZOME:

- **Epidermis**
- **Cortex:** Outer parenchymatous cortex with a ring of air chambers (aerenchymatous), inner parenchymatous cortex with sclerenchymatous patch.
- **Stele:** Amphiphloic siphonostele.
- **Pith**: Present in the centre and can be parenchymatous (in submerged plants) or sclerenchymatous (terrestrial plants)

# INTERNAL MORPHOLOGY OF SPOROPHYTE



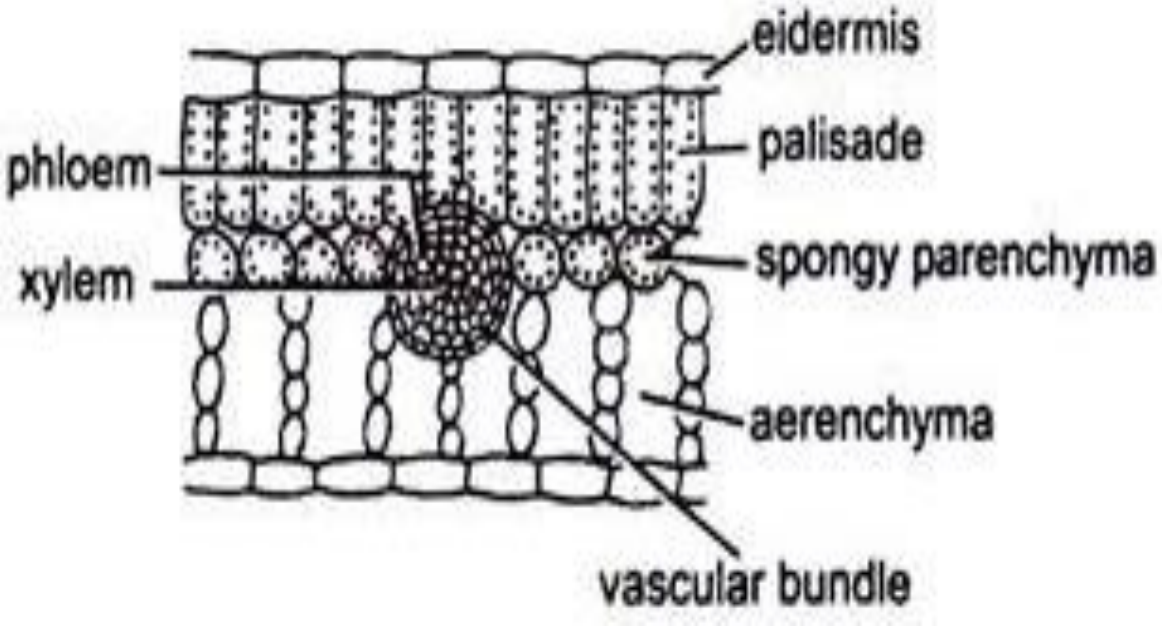

## T.S. OF PETIOLE:

- **Epidermis**
- **Cortex:** Outer cortex parenchymatous, Middle cortex aerenchymatous (septate), inner cortex parenchymatous.
- **Stele:** Protostele (plectostelic). Xylem consists of two plates with metaxylem in the centre & protoxylem towards the periphery.

# INTERNAL MORPHOLOGY OF SPOROPHYTE

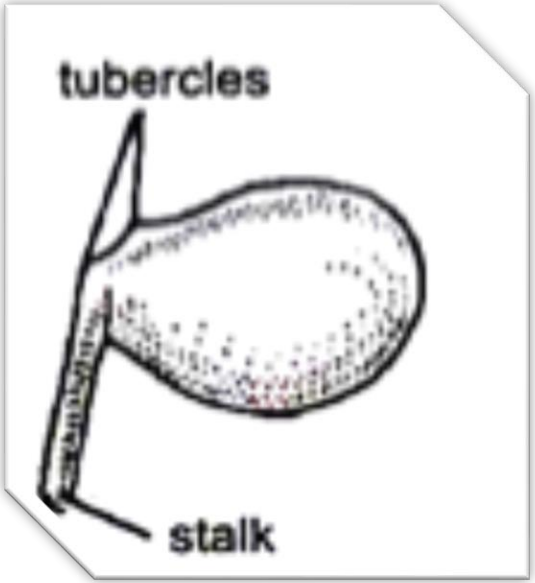
## T.S. OF LEAFLET:

- **Upper epidermis**
- **Mesophyll:** Isobilateral (in the submerged species), dorsiventral with aerenchyama (in terrestrial species)
- **Vascular bundles:** Concentric vascular bundles arranged in parallel series.
- **Lower epidermis**



# REPRODUCTION

- **Vegetative:** Tubers
- **Asexual:** Heterosporous (Microspores, megaspores), microsporangia & megasporangia in sporocarps




# SPOROCARP

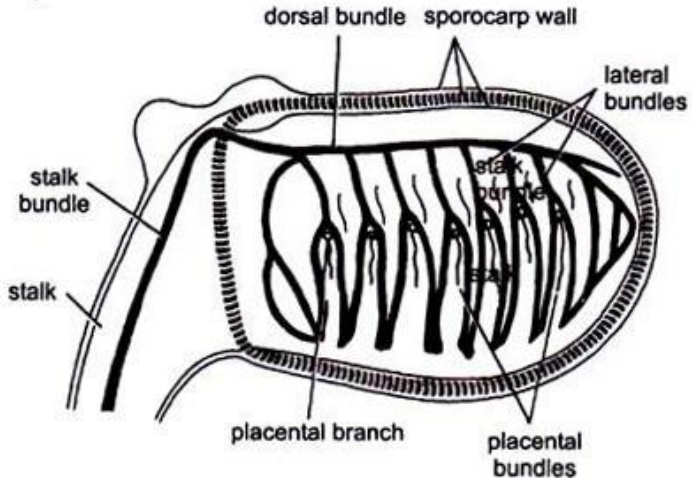
**External morphology of sporocarp**

- Young sporocarps – Soft and green
- Mature sporocarps – Dark brown and hard (Withstand desiccation 20 to 25 years).
- Sporocarp = Pedicel or stalk + Body, Pt. of attachment = **Raphe**.
- Distal end of raphe – 1 or 2 teeth-like projections known as **horns**.
- Sporocarp wall – Hard, thick, resistant. Differentiated into 3 layers – Outer (epidermis with sunken stomata), middle (thick walled palisade) and inner (thin walled palisade).

# SPOROCARP

**Vascular supply of sporocarp**

- V.L.S. – Single vascular strand enters the sporocarp near the lower horn and continues forward along the upper side forming a midrib (**dorsal bundle**).
- From midrib, the lateral branches (**lateral bundles**) arise & pass to both sides.
- **Placental bundle** develops from the point of forking of lateral bundle which enters into the receptacle bearing sporangia and dichotomises.
- **Sporocarp** - **Bivalved structure** with **closed network** of **vascular system**.
- **Fertile sporophyll** with **marginal sori.** Developed from 2 folded pinnae.
- **Sori** – **Gradate** type, **megasporangia** in **upper** rows, **microsporangia** in **lower** rows and **leptosporangiate** type of sporangial development.

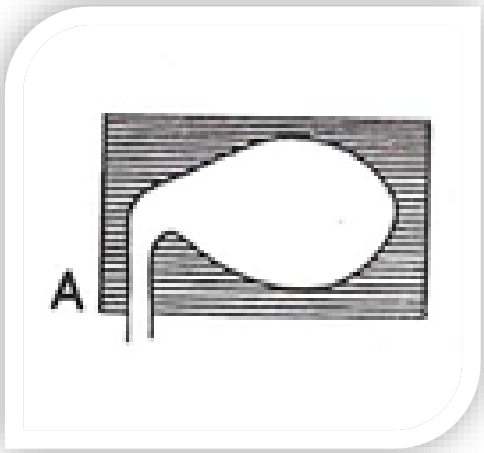


# SPOROCARP - Internal structure

## V.L.S.

### (Vertical Longitudinal Section)

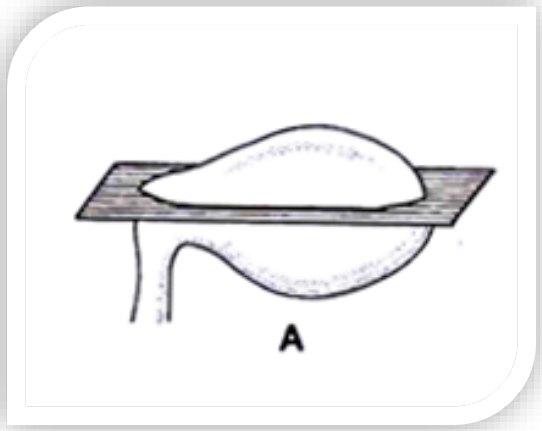
- Section is cut vertically but the sporocarp is cut longitudinally.




## H.L.S.

### (Horizontal Longitudinal Section)

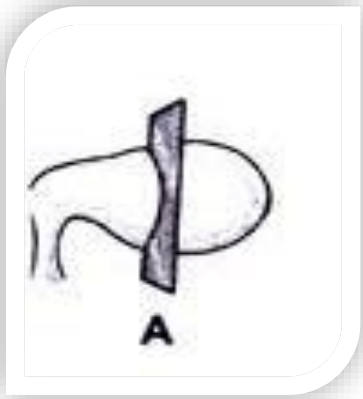
- Section is cut horizontally but the sporocarp is cut longitudinally.




## V.T.S.

### (Vertical Transverse Section)

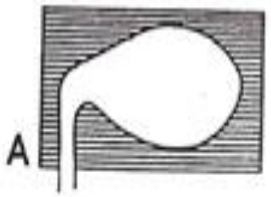
- Section is cut vertically but the sporocarp is cut transversely.

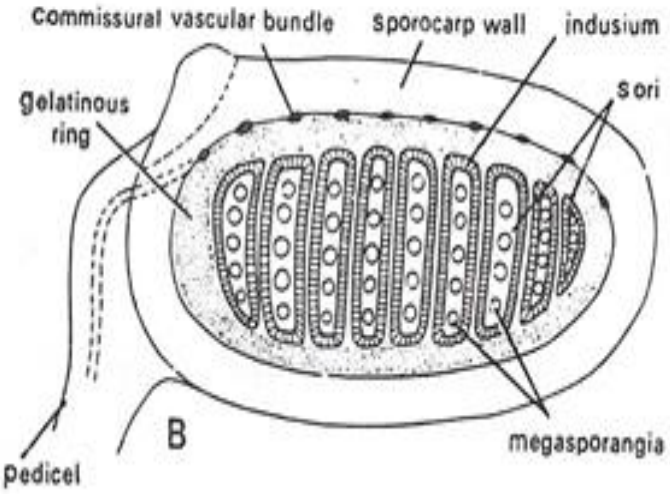


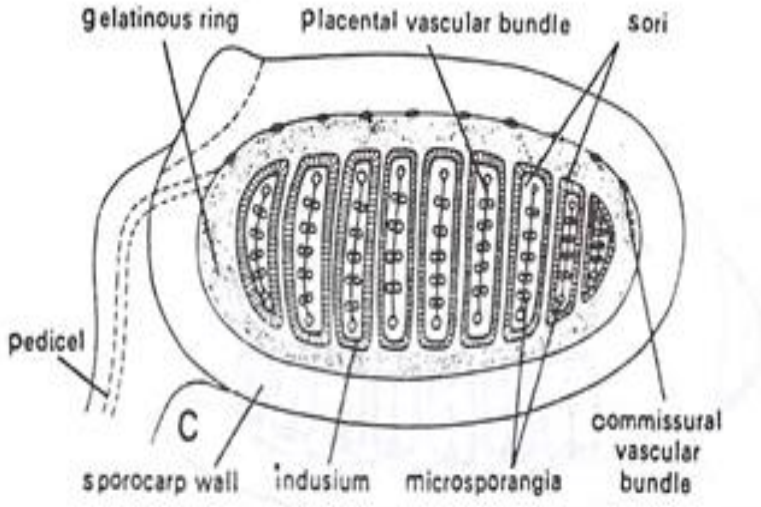
# SPOROCARP - Internal structure

## Vertical longitudinal section (V.L.S.)

- Many sori arranged in vertical rows.
- Either megasporangia or microsporangia are visible.
- Each sorus is surrounded by an indusium.
- The development of sori is of gradate type.
- The gelatinous mucilage ring is more prominent in dorsal side.



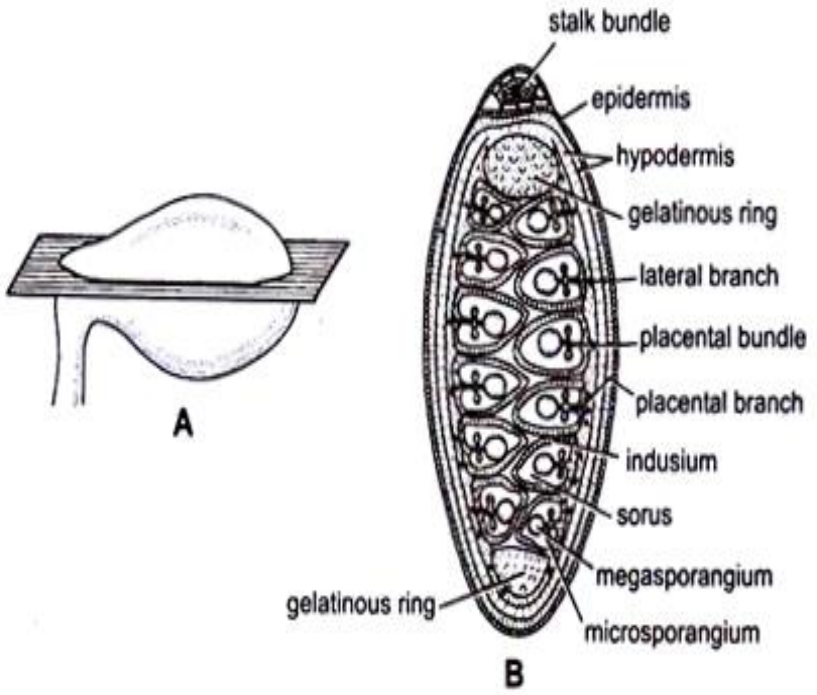



# SPOROCARP - Internal structure

## Horizontal Longitudinal Section (H.L.S.)

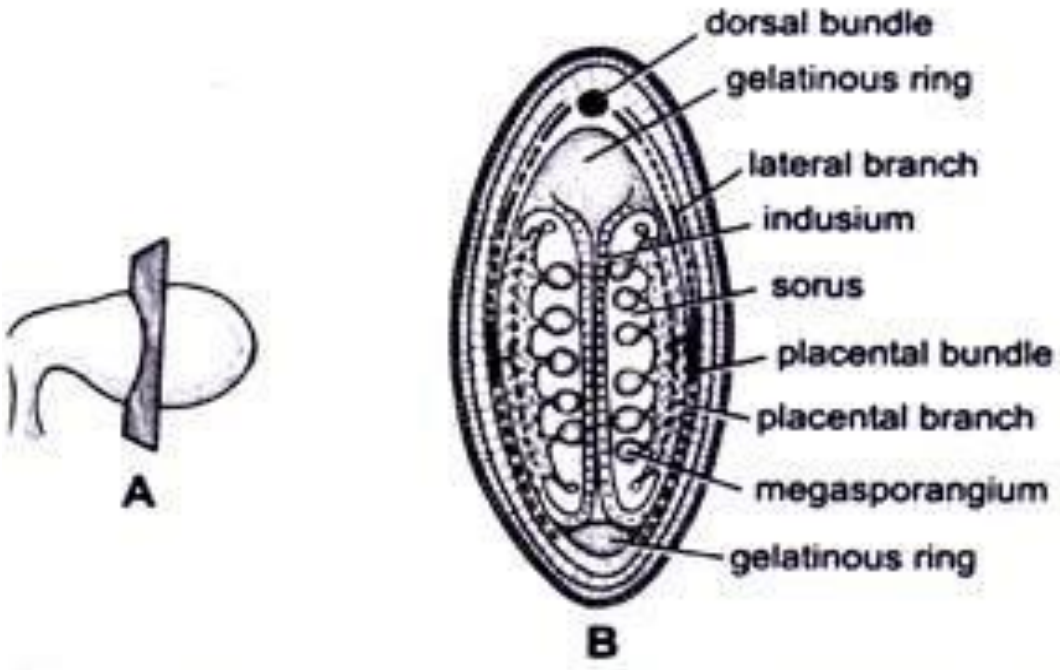
- Each sorus is cut transversely
- Sorus is an elongated structure, covered by a delicate indusium.
- Sori are of gradate type, in basipetal pattern.
- Sorus consists of a row of megasporangia at top and two rows of microsporangia on either sides.
- Mucilage ring is present in two masses on dorsal and ventral sides.



# SPOROCARP - Internal structure

## Vertical transverse section (V.T.S.)

- Two sori opposite to each other.
- Each sorus shows many megasporangia in the middle while 1-2 microsporangia at the ends.
- The mucilage ring is present only on the dorsal side.



# SPORANGIUM – Structure & Dehiscence

## Structure

- Each micro or megasporngium, consists of a single layered jacket enclosing spore mother cells.
- At maturity, the spore mother cells undergo meiosis followed by few mitosis to produce 32-64 spores.
- In microsporangium, all spores survive while in megasporangium, only one spore survives and becomes a very large megaspore.

## Dehiscence

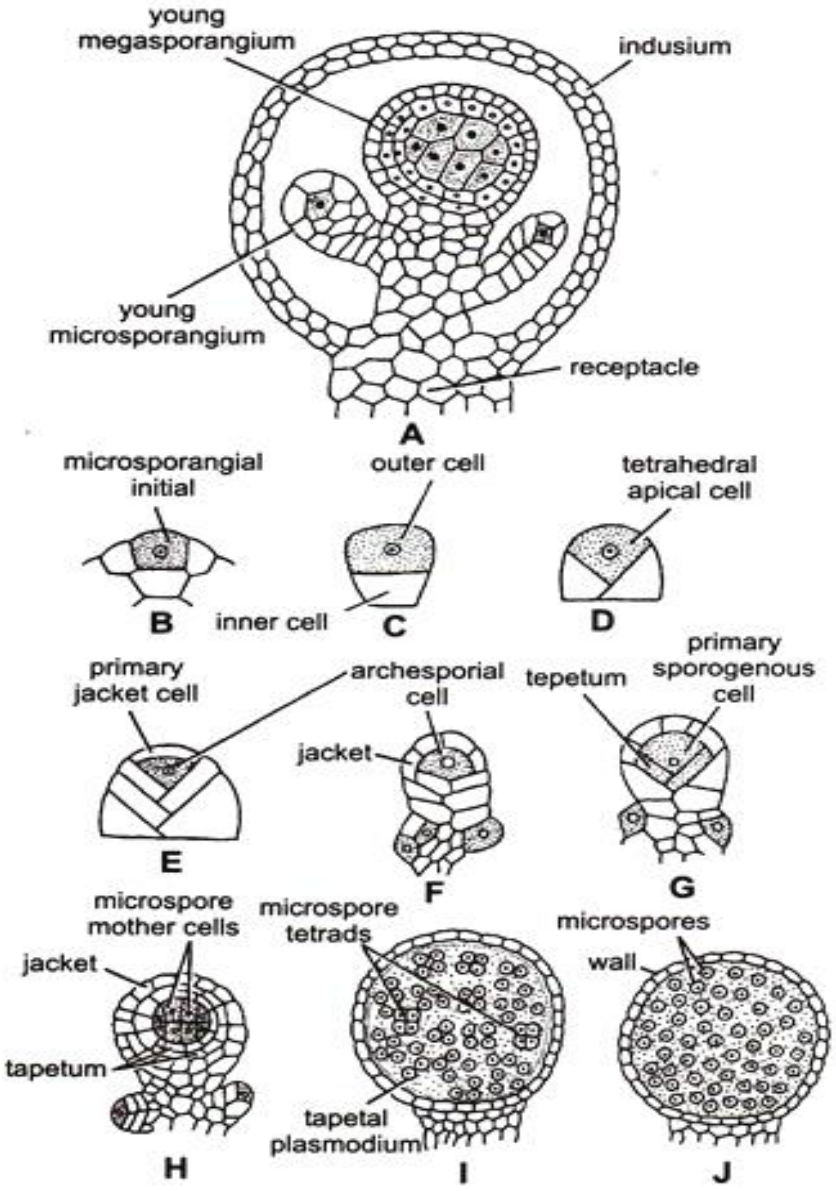
- During dehiscence, sporocarp imbibes water and the gelatinous ring swells, expands and pushes out of the split sporocarp.
- It also pulls the sori and the sori come out in a row.
- Indusium gelatinise and liberate the sporangia.
- Later the sporangial walls also gelatinise and the spores are liberated in the surrounding water.

# GAMETOPHYTE – Male

## Microspore and male gametophyte

- Microspore – Yellowish, spherical haploid with a triradiate ridge & consists of uninucleate cytoplasm is surrounded by spore wall.
- Spore wall – 2 layered – endosporium & exosporium.
- Spore absorbs water and increase considerably in size.
- Nucleus divides to form a small prothalial cell & large apical cell.
- Apical cell divides to form two antheridial initials.
- Antheridial initial – few jacket cells externally & one spermatogenous cell internally.
- Spermatogenous cell forms 16 androcytes which represent one antheridium.
- At this stage, prothalial cell and jacket disintegrate and two groups of androcytes remain free but within the microspore.
- Each androcyte now develops into multiciliated, coiled spermatozoid with vesicle at one end.
- Thus, development of male gametophyte is endosporic.

# GAMETOPHYTE – Male



# GAMETOPHYTE – Female

## Megaspore and female gametophyte

- Mature megaspore is elliptical with a short papilla at one end.
- Spore wall – 2 layered – endosporium & exosporium.
- Papilla is surrounded only by endosporium.
- Nucleus is located in the apical papilla and is surrounded by a dense cytoplasm.
- The rest of the spore is filled with watery cytoplasm & food.
- Megaspore germinates to give rise to female gametophyte. The development is endosporic.
- Apical nucleus is divided into unequal nuclei. One nucleus remains in the dense cytoplasm while the larger one migrates to watery cytoplasm.
- Transverse wall is formed at the base of the papilla separating the upper small cell and lower larger cell called prothalial cell.
- Prothalial cell do not divide further and acts as nutritive cell.
- Upper cell soon develops an archegonium with a short neck and venter. The neck has single neck canal cell surrounded by jacket made up of two tiers of four cells each.
- Venter contains a venter canal cell. At maturity, megaspore absorbs water, the tip of the megaspore splits in **tri-radiate fissure** and the archegonium is exposed.
- Female gametophyte is surrounded by a gelatinous mass & a funnel shaped opening at the top.

## GAMETOPHYTE – Fertilization

- During fertilization, spermatozoids or male gametes are liberated from ruptured male gametophyte and are attracted by the chemical substances present in the gelatinous mass.
- Movement of spermatozoids under the influence of chemical substances is called chemotaxis.
- Spermatozoids swarm around and enter the gelatinous matrix of the female gametophyte. Only one spermatozoid enters the open neck and fertilizes the egg to form diploid zygote.

## SPOROPHYTE – Development

- Zygote develops into embryo. Embryo shows cotyledons and roots developed from upper half of the embryo while stem and foot developed from lower half of embryo.
- The cotyledon comes out from calyptra. The rhizoids are developed at first on the root. Very soon the embryo settles in the mud and develops into new sporophyte.