RICCIA:
Systematic position:
CLASSIFICATION:

Division: *Bryophyta*: True roots, stems, leaves and vascular tissues absent; rhizoids and scales present.

Class: *Hepaticopsida (Hepaticeae)*: Plants are thalloidal, rhizoids unicellular; columella in capsule absent.

Order: *Marchantiales:* Rhizoids are of two types-Simple and tuberculated; air-pores, air-chambers are present.

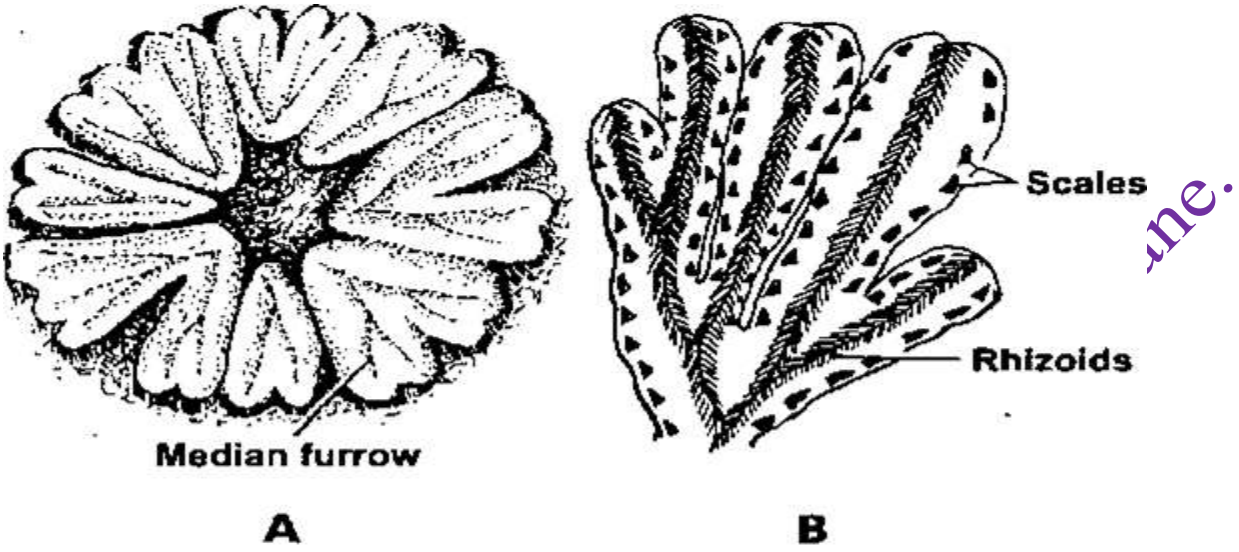
Family: *Ricciaceae*: Air pores are simple; sex-organs are present in middle dorsal groove; sporophyte consists of only capsule, foot and seta are absent.

Genus: *Riccia:* Vertical, photosynthetic filaments are unbranched; presence of scales at margins.

Habitat and Distribution:
It is the most widely distributed genus of the family Ricciceae.It comprises about 138 species .They are found practically over all parts of the earth.About 29 species have been reported from different parts of India. The important species are Riccia discolor, R.pathankotensis, Rfrostii, R.melanospora, *Riccia siliata, R. hitra, R. discolor, R. glauca, R. gangetica, R. melansspora, R. hirta, R.crystallina.and* submerged aquatics e. g. *R. fluitans*.
Riccia is common bryophytes. It occurs on damp or wet or moist rocks. There are two types of plants of Riccia i.e.gametophytic –haploid and sporophytic -diploid

External morphology
In Riccia, the gametophytic plant body is the dominant phase in the life cycle.

1. The plant body is small, green, flat, and rather fleshy. It grows prostrate on the ground and branches freely by dichotomy.
2. It grows prostrate on the ground and branch freely dichotomy and they are generally rosette form.
3. The dichotomous branches are also called as thallus lobes. They have central notch at apex called apical notch.
4. A growing point is present in each notch of the thallus.The thallus lobes are wedge shaped. They are thick in the middle and thin towards margin. The thick middle portion is called as Midrib.
5. Each lobe is thick in the middle and gradually this towards the margin.The thick middle portion constitutes the midrib region.
6. On the dorsal surface narrow groove of furrow is present along the midrib called Midrib groove.
7. The thallus lobes produce sex organs in the midrib region.
8. The thallus is attached to the substratum by slender, simple unicellur process called Rhizoids.
9. There are two kinds of rhizoids - Tuberculated and smooth walled. The Tuberculated rhizoid possesses Peg-like ingrowth of the inner wall which protect in to the cavity and they are narrow and lack of protoplasm at maturity. Where as smooth walled rhizoids the inner wall of the rhizoids is smooth.
10. The function of the rhizoids absorbs water and soil solutes.
11. In the lower portion arising two types of scales (Violet colour) and its function to protect a growing point.



Internal structure of Riccia thallus:

The thallus lobe is boat shaped in vertical transverse section (V.T.S.).It is thick in the middle and thin towards the margins. It is differentiated in to the following structures.
1) Upper epidermis, 2) Photosynthetic region,3) Storage region (4) Lower epidermis

1. **Upper epidermis**: It is the upper most protective layer of the thallus lobe. It is composed of single layer of rounded or spherical cells. It has small pores between the rounded cells called air pores.

2. **Photosynthetic region**: It is present just below the upper epidermis. It is green in colour. It is composed of many small vertical rows of unbranched green filaments called the assimilatory filaments. The assimilatory filaments are made up of few to many small barrel shaped green cells. They are separated from each other by air chambers.

3. **Storage region**: It is colourless region present just below the photosynthetic region. It is composed of many layers of compactly arranged parenchymatous cells .The cells store large amount of water and food material in the form of starch.

4. **Lower epidermis:** It is the lowermost protective layer on the ventral surface of the thallus.It is present just below the storage region. It is made up of single layer of small barrel shaped cells. It bears two types of rhizoids and small violet scales along the margins on the ventral surface.

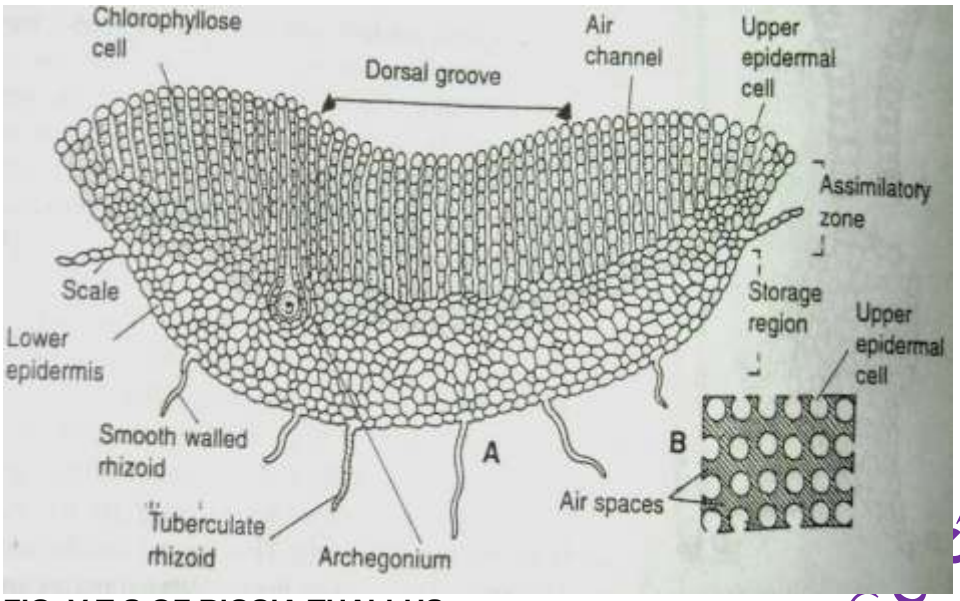


FIG. V.T.S.OF RICCIA THALLUS

Reproduction:

Riccia starts reproducing when it has reached a certain stage of maturity the gametophytic plant body reproduces vegetative and sexual methods after attaining a certain stage of maturity.

Vegetative reproduction:

The vegetative reproduction in Riccia takes place by the following methods:

1. **Fragmentation**: During the process of fragmentation the older portions die of old age and the younger portions with growing points in the notches become separated. Each separated young portion grows independently and give rise to new gametophyte of plant.

2. **Adventitious branches**: In some species *Riccia fluitans* special adventitious branches, arise from the ventral surface of the thallus in the midrib region. They become detached to the parent thallus similar to parent thallus by the decay of connecting tissue and form new plants. These branches get detached and develop into new thalli.

3. **Tubers**: In some species (*R. discolor, R. perennis, R.vescata)* the apices of the thallus lobes become thickened to form tubers at the end of the growing seasons with the advent of unfavorable conditions the plant perishes. The tubers remain dormant and resume growth under suitable conditions and develop thallus.
4. **Persistent apices**: In many species of Riccia which grow in region with prolonged dry season as in the Punjab, the whole plant except the growing apices of the thallus lobes killed. The surviving persistent apices resume growth in the succeeding rainy season. During next season growing the apices resume growth and form new thallai.

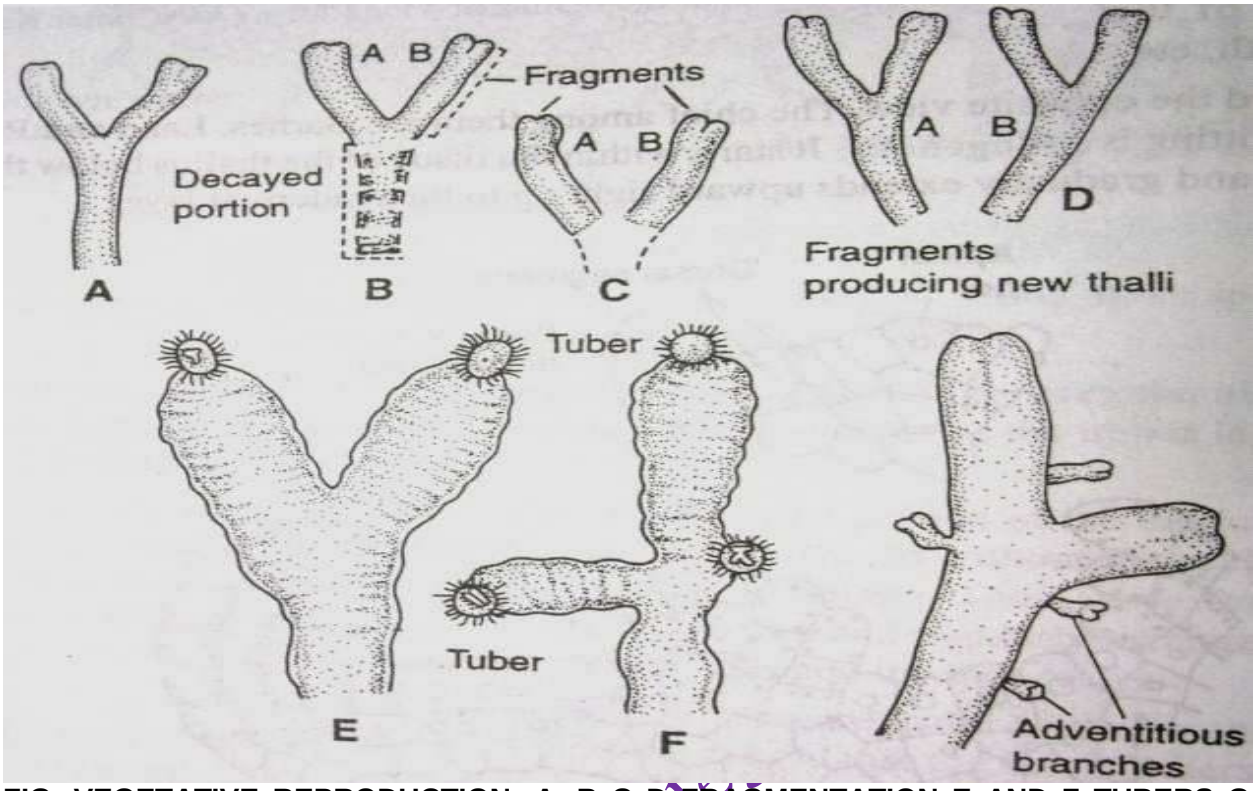


FIG. VEGETATIVE REPRODUCTION: A, B C D FRAGMENTATION E AND F TUBERS G ADVENTITIOUS BRANCHES

Sexual reproduction:

The sex organs are developed on the thallus lobes. They are developed in the lines extending back from the growing points. Generally they lie in the dorsal furrow or groove each in the separate cavity. They are developed in an acropetal order. The younger ones just near the tip and older are away from it.

Sexual reproduction in Riccia is oogamous type i.e. union between a motile flagellate male gamete flagellate female gamete takes place. The gamete bearing organs i.e. sex organs in Riccia are multicellular and are called **Antheridium** (male) and **archegonium**

Both the types of sex organs may develop on the same thallus such species known as Monoecious.In other sex organs may develop on different thalli are referred as Dioecious.
The thallai of Riccia as it bears the sex organs is known as gametophyte plant .The sperm and the eggs are last structure developed during the gametophytic phase.

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Antheridium:

1. It is the male sex organ. It is developed from middle dorsal groove
2. A mature antheridium of Riccia is a pear shaped body with in an antheridial chamber which is formed by the overarching tissues. The antheridial chamber communicates with the dorsal surface by a pore.
3. The antheridium is attached to the base of the antheridial chamber by means of a few-celled stalk.
4. The pear-shaped antheridial body has got a flat broad base and a conical apex.

5. The antheridial body is surrounded by a single- layered wall or jacket made of thin-walled cell.
6. Each antheridial chamber opens at the upper surface of the thallus by narrow pore called ostiole.
7. A central mass of cuboidal cells enclosed by the jacket layer are the androgonial cells or androcyte mother cells
8. Each androcyte mother cell, on maturity, divides diagonally to produce two triangular androcytes or spermatia.
9. Each androcytes ultimately metamorphoses into a single biflagellate antherozoid or spermatozoid.
10. During metamorphosis cell walls of the androgonial get disorganized to form a semifluid mucilaginous content in which the mature antherozoids float freely.
11. Next gelatinization of jacket cells towards the apex marks it more breakable.
12. When water enters into the antheridial chamber the gelatinized jacket cells absorb it and swell and finally break open.
13. Then the semifluid mucilaginous content of the antheridium containing the antherozoids oozes out of the antheridial chamber to the dorsal surface of the thallus.
14. Each sperm is minute, curved structure .It is furnished with a pair of whiplash (Smooth) flagella at its anterior end.

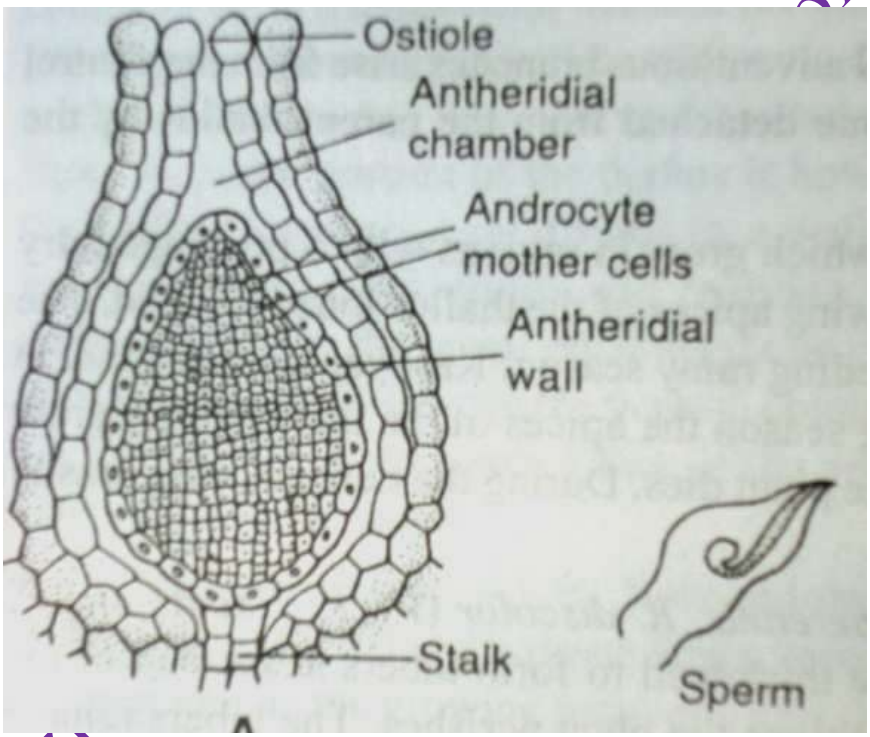

FIG. ANTHERIDIUM

Archegonium:

1. It is the female sex organ. It is developed in the middorsal groove in a cavity called archegonial cavity or chamber.
2. A mature archegonium is a **flask-shaped body embedded** within a chamber called archegonial chamber, which communicates with the dorsal surface by a pore.
3. The archegonium is attached to the base of the archegonial chamber by means of a short few celled stalk.
4. The flask-shaped archegonium is differentiated into a basal swollen part the Venter, and an elongated protruding tubular portion, **the neck.**
5. The venter consists of a single layered wall having more than six cells in perimeter and encloses a lower large **egg** or female gamete with an upper small ventral canal cell.
6. The wall of upper tubular neck consists of 6 arranged in 6 vertical rows which encloses a narrow central canal consisting of 4-**6 neck canal cells** in a single row.
7. The tip of the neck is covered by four specialized cells called cover cells.
8. When the archegonium is matured, the canal cells (neck and ventral canal cells) degenerate, leaving a mucilaginous mass. The mucilaginous substances absorb water and swells due to the cover cells separate from each other and narrow passage created between them.
9. The egg cell in the venter metamorphosis in to non motile, haploid egg or ovum or female gamete.

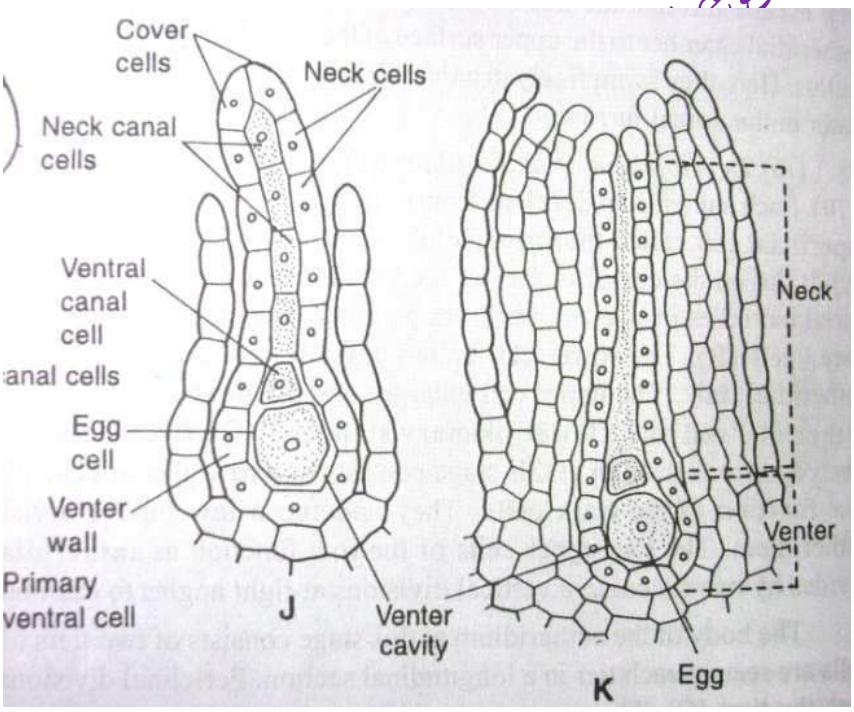

FIG. ARCHEGONIUM

Fertilization:

1. The fertilization takes place only in the presence of water. During the process of fertilization the sperm in the dorsal groove swim around the archegonium, many of them enter in to the venter through the neck canal one of them sperm fuses with the egg.
2. The antherozoids (Sperm) when liberated from the mature Antheridium swim actively in water present in the form of thin film in the dorsal side.
3. Even the dew or the heavy fog is sufficient to provide necessary water on the thallus surface. Water also acts as a medium for transportation of antherozoid towards the egg.
4. When the sperm reach near the archegonium they are attached towards the neck by some chemical substances present in the mucilaginous secretion of the archegonium.
5. One of the sperms fuses with the egg. The wall of contact between the fusing gametes dissolves and **Plasmogamy** takes place. The plasmogamy is followed by **Karyogamy.**The Karyogamy results in to the formation of a diploid nucleus
6. Several sperm may swim down neck and reach the venter, but only one of them fertilizes the egg. Finally a single antherozoid (n) fuses with the egg (n) and forms a diploid (2n) zygote.
7. The zygote is the first cell of the sporophytic generation.
8. The zygote thus formed diploid and first cell is of the sporophyte.
9. Soon after formation the diploid zygote becomes enlarged and undergoes mitotic divisions and results into the formation of a mass of diploid cells called the embryo. At the same time the neck of the archegonium separated from venter.The venter wall becomes double layered and enveloped over the embryo. The calyptra protects the developing embryo.
10. The embryo is composed of 20 to 40 undifferentiated diploid colourless cells. The outer cells of the embryo divide and redivide and form two layers around embryo. The outer layer is called as **Amphithecium** and inner as **endothecium .**The amphithecium is composed of a single layer of cells. The endothecium is composed of many similar diploid cells forming a tissue called archesporium or sporogenouos tissue.
11. When the sporophyte matures the diploid cells of the archesporium divide and redivide mitotically and form a mass of many diploid cells. The diploid cells are also called the sporogenous cells or spore mother cells of sporocytes.
12. The sporogenous cells of the mature sporophytic phase undergo reduction division and result into the formation of tetrads of haploid cells. Each cell of the tetrads metamorphosis in to single haploid spore called the **meiospore.**
13. When the meiospore mature they liberated outside by the decay of the sporophyte. The liberated spores in the soil undergo rest during the period of unfavorable conditions or they may be dispersed by the wind also. They remain alive for some time .They germinate after the return of favorable conditions and give rise to the new haploid gametophyte of Riccia.

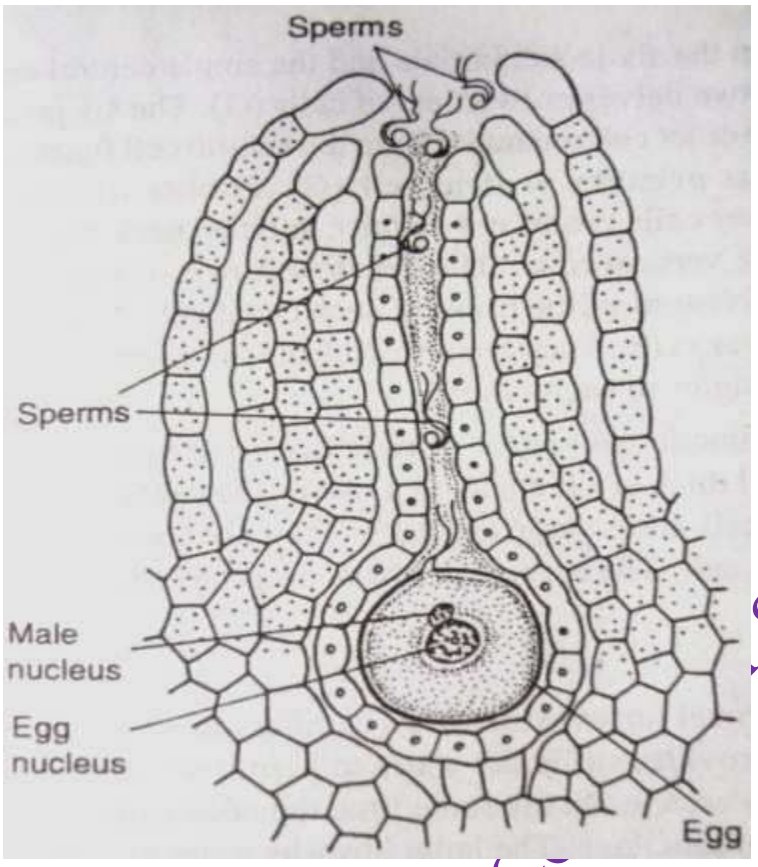

FIG. FERTILIZATION

Structure of the sporophyte:

1. It is very simple structure. It is only spore producing structure hence also called the spore sac or capsule. It is spherical in outline. It is differentiated in to the following structures.
2. The mature sporophyte of Riccia is a globular **capsule**, embedded within the gametophytic plant tissue and is without foot and seta.
3. After fertilization, the zygote secretes a wall and increases in volume until it nearly fills the cavity of the venter.
4. Simultaneously, the cells of the venter divide to form a two layered venter enclosing the developing sporophyte, a structure called **calyptra.**

a. Calyptra,(b)Jacket or Amphithecium ,(c)Endothecium

a. **Calyptra:** It is the outermost protective layer of the sporophyte. It is double layered and protects the sporophyte.
b. **Jacket or Amphithecium:** It is present just below the calyptra.It is composed of a single layer of barrel shaped thick walled cell. It encloses the endothecium and forms a protective sterile jacket.
c. **Endothecium:** It is inner most layer of the sporophyte. It is present just below the sterile jacket. It is composed of a mass of many similar diploid cells called sporogenous tissue or archesporium.

The diploid cells of the sporogenous tissue are also called the spore mother cells or sporocytes.
The spore mother cells undergo reduction division and result in to the formation of tetrads of haploid spores called the meiospores.Thus many haploid spore tetrads are formed in the mature sporophyte.

The sporophyte of Riccia no chloroplast and it has does not any absorptive organ like rhizoids hence the sporophyte is completely dependent for nutrition on the gametophyte. Hence the sporophyte is completely parasites.

Dehiscence of Sporogonium:

1. The spores are liberated by the decay of surrounding layer of the calyptras and the thallus tissue.
2. The thallus perishes in the dry season
3. The spore remains behind on the soil in the condition this may be dispersal by the wind. They remain alive in the same time
4. Finally they germinate with the onset condition are favorable for the growth

Structure of Mature spore:

Spore is the first cell of the gametophytic generation. Each spore is pyramidal or tetrahedral in shape with a clear triradiate mark at the proximal face. It consists of tiny mass of cytoplasm containing small haploid nucleus. The food is largely stored in the form oil globules. The protective spore wall which is known as sporoderm.

A mature spore is haploid, unicellular and uninucleate in shape. It is thick double layered wall and consists of tiny mass. The outer thick layer is called as exine and inner delicate layer as intine. The exine is black and sculptured. The spore germinates and gives rise to the new haploid gametophyte of Riccia.

Germination of spore and formation of the new haploid Gametophyte:

The spore germinates under favorable moist conditions. During germination the spore takes water and swells up, as a result the massive black exosporium bust and the thin endosporium enclosing the spore contents protrudes out in the form of a tubular outgrowth called the germ tube. The germ tube elongates and divides to form an eight celled germ disc. The rhizoid emerges out near the base of the germ tube. The cells of the germ disc soon divide and re-divide a multicellular thallus which remains fixed with the soil by rhizoids.

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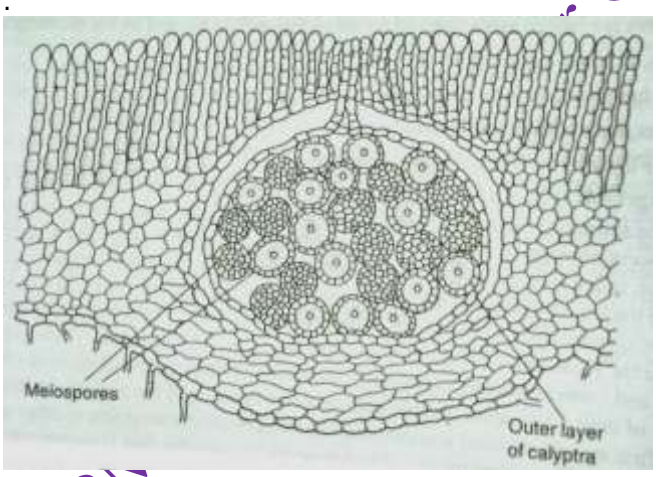
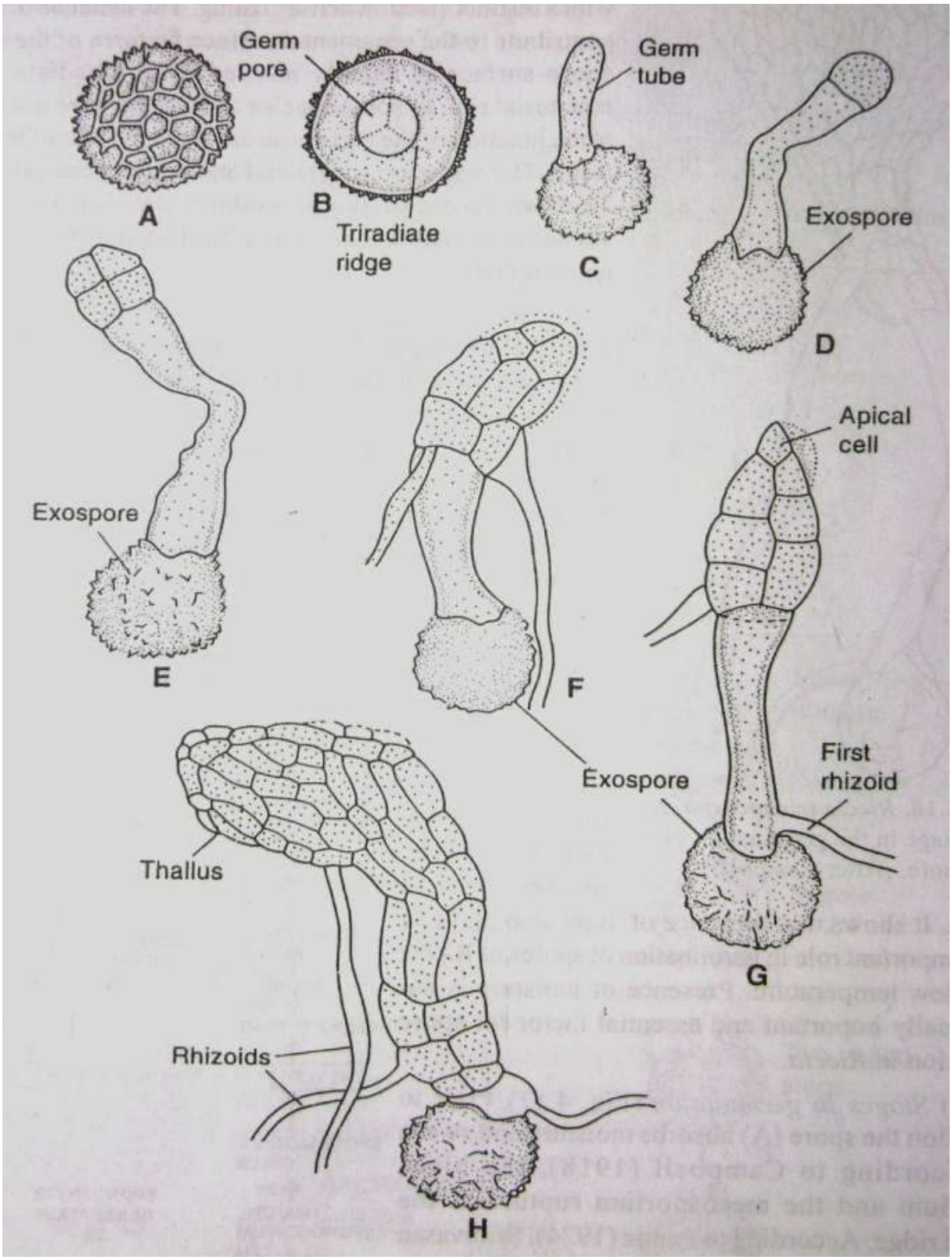


Life cycle:

In the life cycle of Riccia the haploid gametophytic generation is independent and is the main vegetative body. It reproduces both vegetatively and sexually. The asexual reproductive phase i.e. sporophytic generation is dependent upon the gametophyte and is embedded within it. It is represented only by the sporogenous tissues which are diploid cells. Mature sporophyte or sporogonium is made up of haploid cells only, it is a peculiar condition found only in Riccia



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