Spirogyra

Very Short Answer Questions

1. **Why *Spirogyra* is called as Pond scum and Pond silk. ? March – 2010**
   Ans: *Spirogyra* is called as Pond scum because the filaments of spirogyra entangle with each other and float as large masses on the surface of water. It is also called as Pond Scum because the filaments slip and shine like silk due to continuous formation of mucilage due to dissolution of pectin of its cell wall.

2. **Why *Spirogyra* is named as such.**
   Ans: *Spirogyra* is named such based on spirally coiled nature of its chloroplast.

3. **Give the systematic position of Spirogyra?**
   Ans:
   Division: Thallophyta,
   Sub-division: Algae,
   Class: Chlorophyceae,
   Order: Conjugales,
   Family: Zygnemataceae,
   Genus: Spirogyra
4. **What is holdfast? What is its use? Mention the species of Spirogyra having holdfast?**
   Ans: It is basal most achlorophyllous cell of attached species of spirogyra. It helps in attaching to the substratum. Spirogyra adnata.

5. **How does holdfast cell differ from other vegetative cells of Spirogyra filament?**
   Ans: it differs from other cells in being colorless and not involving in cell division and reproduction.

6. **Why spirogyra filament is slimy to touch?**
   Ans: Spirogyra filament is slimy to touch because the pectin present in the outer layer of cell wall dissolves in surrounding water and forms slippery mucilage.

7. **Write about pyrenoids present in Spirogyra cell?**
   Ans: Pyrenoids are proteinaceous structures present in the chloroplast of Spirogyra which store starch around them and arranged in a single series in the mid axial line of chloroplast.

8. **How Spirogyra does reproduce vegetatively?**
   Ans: Spirogyra reproduces vegetatively by fragmentation. Fragmentation is breakage of filament into small segments with one or few cells. Each fragment develops into a new filament upon repeated divisions in its cells.
9. **Distinguish between akinetes and apanospores of Spirogyra.**

Ans:

Akinetes	Aplanospores
1. These are thick walled	1. Thin walled
2. Formed in unfavourable conditions	2. Formed in favourable conditions
3. Protoplast is not detached from parental cell wall	3. Protoplast is detached from cell wall
4. Larger in size	4. Smaller in size.

10. **Differentiate between the direct and indirect lateral conjugation in Spirogyra?**
    Ans:

Direct lateral conjugation	Indirect lateral conjugation
1. Only the cells present nearer to holdfast are involved	1. All cells of the filament except holdfast are involved.
2. Conjugation canals are absent	2. Conjugation canals are present
3. Protruberances are absent	3. Present
4. Male and female gametes are morphologically dissimilar	4. Morphologically similar
5. Male gamete has conical process	5. Not having conical process

11. **Where in zygospores are formed during isogamous and physiological anisogamous conjugation of Spirogyra.**
    Ans: In physiological anisogamous conjugation, the zygospore is formed in the female cell and in isogamous type it is formed in conjugation canal.

12. **Which type of conjugation in Spirogyra considered dioecious and which type monoecious?**
    Ans: Scalariform conjugation is dioecious conjugation and lateral conjugation is monoecious.

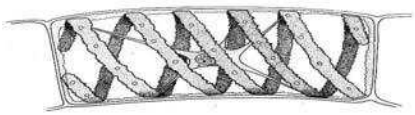
13. **Give one example each to the two types of lateral conjugation in Spirogyra.**
    Ans: Direct lateral conjugatin - Spirogyra jogensis, Indirect lateral conjugation – Spirogyra affinis.

14. **Distinguish between zygote and zygospore?**
    Ans: Zygote is relatively larger and thin walled structure formed after gametic union. Zygospore is thick walled structure formed after shrinkage of zygote protoplast.

Short answer Questions

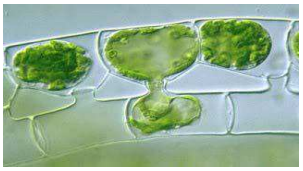
1. **Describe the cell structure in *Spirogyra*? March – 2009 and 2010**
   Ans: Cell of *Spirogyra* is cylindrical and longer than diameter. It has cell wall differentiated into outer pectic layer that forms mucilage and slippery (Pond silk or Water silk) and inner cellulose layer. Protoplast has a central vacuole that pushes the cytoplasm as thin layer at the periphery (primordial utricle). At the centre of the vacuole a haploid spherical nucleus is suspended by cytoplasmic threads. Primordial

utricle has 1-16 ribbon shaped anti-clock wisely coiled chloroplasts with several uniaxially arranged starch storing protein bodies called as pyrenoids at the centre. Only one chloroplast is present in S.venkataramanii.

2. **Elucidate the dioecious conjugation in *Spirogyra*. Draw well labeled diagrams? May – 2009**

   Ans: It is also called as Scalariform conjugation. It is seen in all dioecious species and some monoecious species. It takes place between the cells of two filaments. Male and female filaments come closer, align opposite to each other and come in contact. The contact stimulus promotes the secretion of more mucilage. The male cell gives out lateral outgrowth known as papilla towards the female cell. The female cell also gives out the papilla and both male and female papillae come in contact and at the point of contact the separation wall is dissolved to form a conjugation canal. In the meantime the protoplast of male and female cells transforms into gametes. These gametes are morphologically similar. The male gamete by amoeboidic movement enters into female cell through conjugation canal, fuses with the female gamete to form diploid zygote which eventually secretes a thick wall around it to transform into zygospore. Such fusion between morphologically similar and functionally dissimilar gametes is called as Physiological anisogamy. In some species the zygospore is formed in the conjugation canal and such species are isogamous as both the gametes are morphologically and physiologically similar. The two filaments with conjugation canals between them look like a ladder. Hence it is called as scalariform conjugation.



3. **Write about Monoecious conjugation in *Spirogyra*.**

   Ans: It is also known as lateral conjugation. It takes place between adjacent cells of the same filament. It is of two types. They are

   1. **Indirect Lateral conjugation**: It is seen in species like *Spirogyra affinis*. During this, small papillae are developed on the lateral wall of adjacent cells nearer to cross wall. These grow opposite to each other and come in contact. At the point of contact, the separating wall is dissolved to form a conjugation canal. In the meantime the protoplasts of adjacent cells transform into gametes. The male gamete of upper cell enters into female cell by amoeboid movement, fuses with female gamete to form zygote. It eventually transforms into zygospore. Now the filament is with alternate empty cells and cells with zygospore. The fusing gametes are morphologically similar but functionally different. Such gametic union is called as Physiological Anisogamy.

2. **Direct Lateral conjugation**: It is seen in species like *Spirogyra jogensis* and was first discovered by M.O.P. Iyengar. The cell present adjacent cell behaves as female cell which enlarges in size and its protoplast transforms into relatively larger female gamete. The upper cell protoplast transforms into a male gamete with conical process. This male gamete with its conical process drills a hole in the cross wall and enters into the female cell, fuses with the female gamete and forms diploid zygospore. The fusing gametes are morphologically and functionally different and such gametic union is called as Anisogamy.

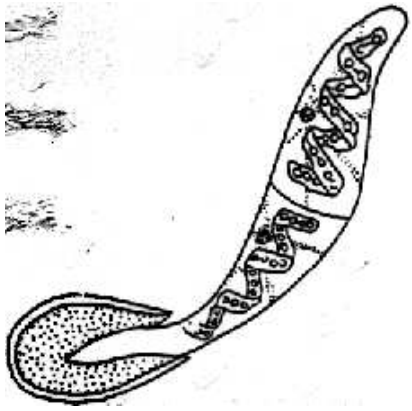


4. **Explain asexual methods of reproduction in Spirogyra?**
   Ans: Spirogyra asexually reproduces by Akinete and Aplanospore formation.
   Akinetes: these are resting spores formed due to thickening of the wall of vegetative cell that tides over unfavourable conditions. Each akinete germinates in favourable conditions and gives rise new filament. Ex: S.farlowii.
   Aplanospore: These are formed in few species like S.aplanosporum. The protoplast of the cell contracts and rounds up and develops a new wall of its own. Only one aplanospore is formed in the cell. It is released upon decay of parental cell wall and germinates to form a new filament.
5. **Differentiate between scalariform and lateral conjugation in Spirogyra?**
   Ans:

Scalariform conjugation	Lateral conjugation
1. It takes place between the cells of different filaments	1. it takes place between the cells of same filament.
2. Conjugation canals are formed between the cells of opposite filaments and appear like ladder.	2. Conjugation canals are formed between the cells of same filament.
3. After conjugation, usually the cells one filament is empty and the cells of other filament with zygospores.	3. Empty cells and cells with zygospores are formed alternately in the same filament.
4. It is advanced	4. It is primitive
5. It is isogamous or physiologically anisogamous	5. It is physiologically anisogamous or anisogamous.
6. The filaments must be free floating	6. Seen in free floating and attached species

6. **Write about germination of zygospore in Spirogyra?**

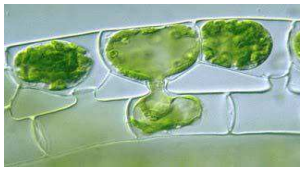
Ans: During germination, the zygospore absorbs water. The diploid nucleus is subjected to meiosis without cytokinesis to form four haploid nuclei. Three of the nuclei degenerate and only one is functional. The two outer layers of the zygospore wall are ruptured and the inner one comes out as a tube like structure. It is known as germ tube. The functional nucleus undergoes a mitosis and a cross wall is formed to form a two celled structure. In free floating forms the upper cell detaches from the lower cell and divides to form a free floating filament. In attached species, the basal cell behaves as holdfast and the upper cell divides to form a filament of Spirogyra.



Long Answer Questions

1. **Explain the different types of conjugation in Spirogyra?**

   Ans: **Scalariformconjugation** :It is also called as dioeciousconjugation. It is seen in all dioecious species and some monoecious species. It takes place between the cells of two filaments. Male and female filaments come closer, align opposite to each other and come in contact. The contact stimulus promotes the secretion of more mucilage. The male cell gives out lateral outgrowth known as papilla towards the female cell. The female cell also gives out the papilla and both male and female papillae come in contact and at the point of contact the separation wall is dissolved to form a conjugation canal. In the meantime the protoplast of male and female cells transforms into gametes. These gametes are morphologically similar. The male gamete by amoeboidic movement enters into female cell through conjugation canal, fuses with the female gamete to form diploid zygote which eventually secretes a thick wall around it to transform into zygospore. Such fusion between morphologically similar and functionally dissimilar gametes is called as Physiological anisogamy. In some species the zygospore is formed in the conjugation canal and such species are isogamous as both the gametes are morphologically and physiologically similar. The two filaments with conjugation canals between them look like a ladder. Hence it is called as scalariform conjugation.



Lateral conjugation:

It is also known as Monoeciousconjugation. It takes place between adjacent cells of the same filament. It is of two types. They are

3. **Indirect Lateral conjugation**: It is seen in species like *Spirogyra affinis*. During this, small papillae are developed on the lateral wall of adjacent cells nearer to cross wall. These grow opposite to each other and come in contact. At the point of contact, the separating wall is dissolved to form a conjugation canal. In the meantime the protoplasts of adjacent cells transform into gametes. The male gamete of upper cell enters into female cell by amoeboid movement, fuses with female gamete to form zygote. It eventually transforms into zygospore. Now the filament is with alternate empty cells and cells with zygospore. The fusing gametes are morphologically similar but functionally different. Such gametic union is called as Physiological Anisogamy.
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Rhizopus

Very Short Answer Questions

1. **Define Heterothallism. In which species of *Rhizopus* do you find it? June – 2010**
   Ans:It is fusion between gametangia are hyphae of mycelia belonging to different physiological strains. It is found in Rhizopus stolonifer.

2. **Define Coenocytic hyphae with examples? March – 2009 and 2010**
   Ans: A filament or hypha having several nuclei formed due to free nuclear divisions is called as coenocytic hypha. Ex: Hyphae of Rhizopus

3. **What are chlamydospores? How do they form in *Rhizopus*?**
   Ans: Chlamydospores are thick walled aplanospores formed in fungi during unfavourable conditions. These are formed in older stolons due to accumulation of protoplasm at certain regions followed by wall formation around the accumulated protoplasm.

4. **Give the names of Homothallic and Heterothallic species of *Rhizopus*?**
   Ans: Homothallic – *Rhizopussexualis*, Heterothallic – *Rhizopusstolonifer*.

5. **Why *Rhizopus* is called as Bread mould and Black mould?**
   Ans: Rhizopus is the most common type of fungus growing on bread as a mass of filaments. Therefore it is called as bread mould. At maturity, the sporangia appear in black colored during asexual reproduction. Hence it is also called as Black mould.

4. **Give the systematic position of Rhizopus?**
   Ans: Kingdom – Plant kingdom, sub kingdom – Cryptogamme, Division – Thallophyta, Sub-division – Fungi, Class – Zygomycetes, Order – Mucorales, Family – Mucoraceae.

5. **Why Rhizopus is called as weed of the laboratory and pin mould?**
   Ans: it is called as weed of the lab because it is the most common contaminent of microbial cultures. It is called as pin mould because its sporangiophore with apical sporangium resembles a pin.

6. **Define ceonocytic hypha with one example?**
   Ans: Hypha with several nuclei is called as coenocytic hypha. Ex: Rhizopus.

7. **Describe the nutrition in Rhizopus?**
   Ans: Rhizopus is usually saprophytic because it grows on dead bodies of plants and animals and their excreta. Such nutrition is hetertrophic. Some species of rhizopus

grow as week parasites on fruit trees. Such parasites are described as facultative parasites. Rhizopus absorbs nutrients with the help of its hyphae.

8. **How does Rhizopus reproduce vegetatively?**
   Ans: It reproduces vegetatively by fragmentation. Usually the stolon is broken into pieces and each piece develops into a mycelium upon reaching suitable substratum by striking rhizoides.

9. **Define columella in rhizopus?**
   Ans: Columella is central vacuolated region of Rhizopus sporangium consisting of few nuclei. It helps in breaking sporangial wall at the time of spore dispersal.

10. **What are chlamydospores? How do they form in Rhizopus?**
    Ans: These are thick walled asexual spores formed in stolon of Rhizopus. During unfavourable conditions, the protoplasm of older stolons is accumulated at certain places,secrete a thick wall to separate it from adjacent empty cell. Such thickwalled structures are called as aplanospores.

11. **Differentiate between sporangiospores and chalmydospores?**
    Ans:

Sporangiospores	Chalmydospores
1. These are thin walled	1. Thick walled
2. Formed in groups	2. Formed singly
3. Formed in specialized hyphae	3. Formed in older stolons
4. Forme in favourable conditions	4. Formed in unfavourable conditions

12. **Define gametangium, progametangium and suspensor in Rhizopus?**
    Ans: Gametangiumis terminal swollen nucleated structure of progametangium separated from suspensor by the septum. It lacks vacuoles. Progametangium is the branch of zygophore that forms gametangium. Suspensor is the basal slender and short structure progametangium with vacuoles.

13. **Distinguish Zygophore and Zygospore of Rhizopus?**
    Ans: Zygophore is the sexual hypha of rhizopus formed from stolon during sexual reproduction and gives rise progametangium. Zygospore is the thickwalled diploid structure formed after fusion of two gametangia of different strains.

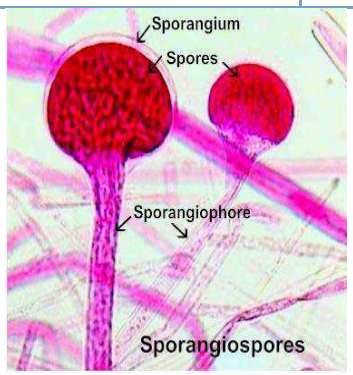
14. **What is promycelium? From where it develops in Rhizopus?**
    Ans: Promycelium is the hypha that has germsporangium. It is formed from zygospore of Rhizopus.

15. **Define homothallism. In which species of Rhizopus it is seen?**
    Ans: it is fusion between gametangia of the same mycelium or same strain. It is seen in Rhizopussexualis.

Short answer Questions

1. **Differentiate between Sporangiosporangium and Germ sporangium of *Rhizopus*?**

Spornagiosporangium	Germ sporangium
1. Involved in asexual reproduction	1. Formed during sexual reproduction.
2. Formed singly at the apex of sporangiophore	2. Formed at the apex of Promycelium
3. Has columella	3. Has no columella
4. Spores are 2-10 nucleated, rarely uninucleated	4. Always uninucleate at the beginning.
5. These are formed as result of mitosis	5. Formed after meiosis.
6. All the spores belong to only one strain	6. Half of the spores belong to + strain and the remaining half – strain.

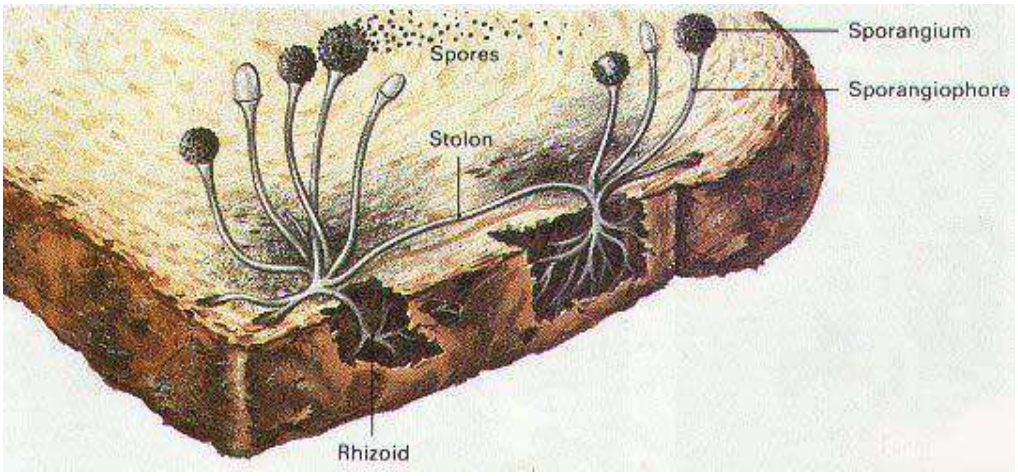


2. **Write about the three types of hyphae of *Rhizopus* mycelium.*?**
   Ans: Mycelium of Rhzopus is branched filamentous and aseptate in vegetative stage. Septa are formed in reproductive structures irrespective of nuclear divisions. It has 3 types of hyphae i.e. Rhizoids, Stolons and Sporangiophores. Stolons and Rhizoids do not have septa but sporangiophores have septa.

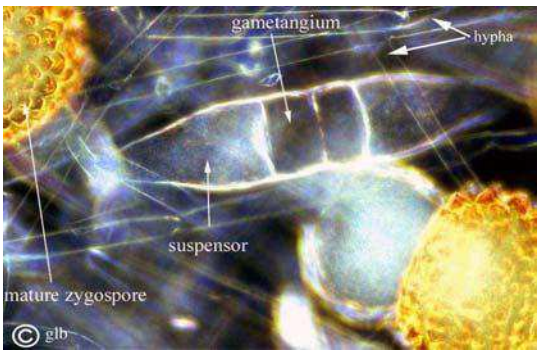
   Rhizoids: These are profusely branched vegetative hyphae that arise from lower surface of stolon opposite to sporangiophores. These are positively geotropic, enter into the substratum and secrete digestive enzymes, absorb them from the substratum. They also fix the mycelium in the sub stratum.

   Stolons: These are horizontally growing stout hyphae of rhizopus present on the substratum with branching at a distance. These are involved in vegetative, asexual and sexual reproductions. It is the most extensively developed mycelium.

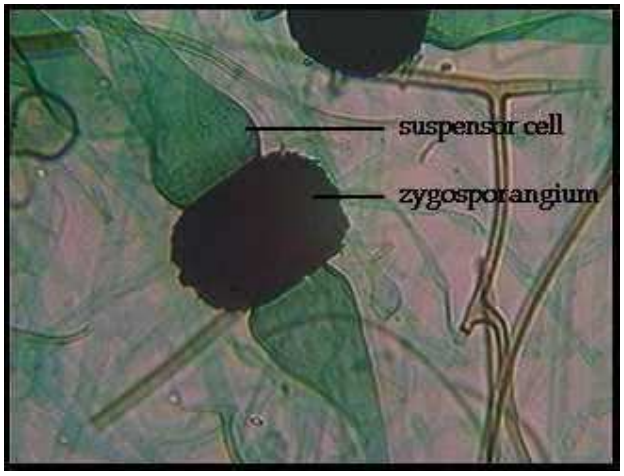
   Sporangiophores: These are unbranched asexual hyphae arise as fascicles opposite to rhizoids on the stolons. They have sporangia at the apices which produce spores.



3. **Describe the structure of hypyha of Rhizopus?**
   Ans: Hypha of Rhizopus is transparent, tubular, branched and coenocytic. It is usually aseptate. Each hypha has cell wall made of chitin. Protoplast has several central vacuole that push the cytoplasm with the nuclei towards the periphery. Since the growth of hypha is apical, dense protoplast without vacuoles is present at the apex. Cytoplasm has all euckaryotic cell organelles except plastids. Reserve food is stored as glycogen and oil. At the time of reproduction and due to injury septa are formed in hyphae.



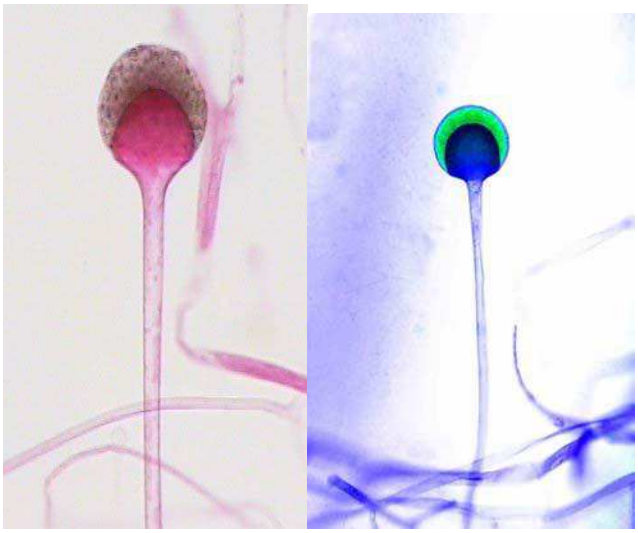
4. **Write about germination of zygospre of Rhizopus?**
   Ans: zygospre of Rhizopus germinates in favourable conditions after a period of 5-9 months dormancy. It absorbs water and its exospre is split during which the diploid nuclei undergo meiosis to form haploid nuclei. The intine with protoplast contents come out as a tube like structure known as promycelium or germ tube. The haploid nuclei migrate from zygospore and swells and the swollen structure is called as germ sporangium in which the germ spores are formed like in asexual reproduction by sporangiospore formation. Germ sporangium lacks columella. Each germ spore is uninucleate at the beginning but eventually becomes coenocytic due to free nuclear divisions. The germ sporangial wall degenerates to liberate the germ spores. Half of the germ spores belong to + strain and the remaining half to –strain.



5. **Describe the sexulity of Rhizopus?**
   Ans: Rhizopus has both homothallic and heterothallic species. R. sexualis is homothallic and R.stolonifer is heterthallic. Fusion between gametangia of different mycelia belonging to different strains is called as heterothallism. Such gametangia are morphologically similar and biochemically different. Such sexual process is called as Physiological anisogamy. In homothallic species, the gametangiaare physiologically and morphologically similar and such gametic union is called as isogamy. Heterothallism was discovered by Blakeslee.

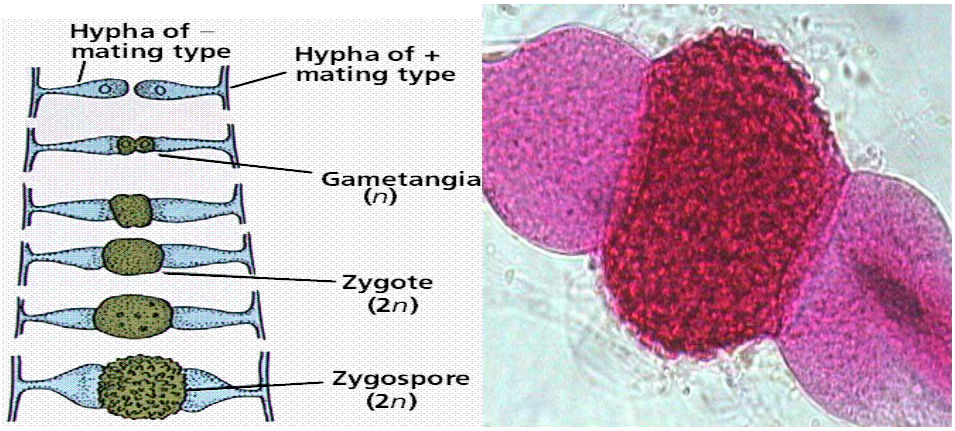
Long Answer Questions

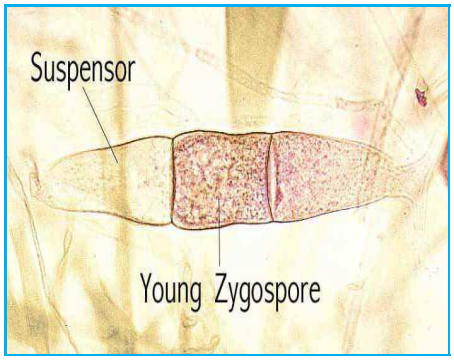
1. **Explain the mode of asexual reproduction in Rhizopus?**
   Ans:Rhizopus asexually reproduces by sporangiospore formation and chlamydospore formation.
   Sporangiospores: These are formed in favourable conditions. In favourable conditions, small papilla like outgrowths is formed on stolon opposite to Rhizoids. These are called as sporangiophores. They grow length wise and the tip is swollen. The swollen tip is called as sporangium. At the beginning, nuclei and vacuoles are randomly arranged in the sporangium and eventually the nuclei move towards the periphery and vacuoles at the centre. The nucleated region is called as sporoplasm and vacuolated region as columelloplasm. Separating these two regions a layer of vacuoles are arranged as dome, which fuse and form a cleft in which cell wall material is deposited to form a cross wall. Now the vacuolated free nucleated central region is called as columella. The sporoplasm is cleaved into few nucleated bits due to the invagination of plasma membrane. Each such bit secretes a thin wall around it to transform into a spore. After maturation of spores, the columella increases in size, exerts pressure over the sporangial wall and the wall is ruptured irregularly and appears as a collar around the columella. The liberated spores reach suitable substratum by wind or water or insects, germinate and give rise new mycelium.



Chlamydospore formation: During unfavourable conditions, the protoplsmic contents accumulate at certain regions and the interveing parts become empty. Each accumulation secretes a thick wall around it to become a multinucleated chalmydospre. The chalmydospore survives during adverse condtions and germinates on the arrival of favourable conditions to produce new mycelium.

2. **Elucidate the sexual reproduction in Rhizopus?**
   Ans: It takes place by gametangial copulation usually at the end of growing season. Some species are homothallic and some are heterothallic. In heterothallic species, when mycelia of compatible strains are growing together, sexual reproduction is initiated by the secretion of sex hormones called trisporic acids. The terminal hyphae of stolons transform into sexual hyphae are called zygophores. + and – strain hyphae grow towards each other and come in contact. At the point of contact they give out lateral branch called progametangium. The progametangium has terminal swollen nucleated region and basal vacuolated sterile region. Separating these two regions, a cross wall is formed. Now the terminal one is called as gametangium and the basal one as suspensor. The two gametangia fuse at the point of contact and the cytoplasms of the gametangia fuse. The + and – strain nuclei pair and the unpaired nuclei degenerate. The paired nuclei fuse to form diploid nuclei in the zygospore. The zygospore is suspended by the two suspensors.





The zygospore has thick wall differentiated into outer thick warty exospore and inner thin smooth endospore. It is multinucleated and diploid. It undergoes a period of dormancy for 5-9 months. . It absorbs water and its exospore is split during which the diploid nuclei undergo meiosis to form haploid nuclei. The intine with protoplast contents come out as a tube like structure known as promycelium or germ tube. The haploid nuclei migrate from zygospore and swells and the swollen structure is called as germ sporangium in which the germ spores are formed like in asexual reproduction by sporangiospore formation. Germ sporangium lacks columella. Each germ spore is uninucleate at the beginning but eventually becomes coenocytic due to free nuclear divisions. The germ sporangial wall degenerates to liberate the germ spores. Half of the germ spores belong to + strain and the remaining half to –strain. Upon reaching suitable substratum the germ spore germinates and gives rise rhizopus mycelium of respective strain.

Important questions

VSAQ

1. Define Heterothallism. In which species of *Rhizopus* do you find it?
2. Define Coenocytic hyphae with examples.
3. Give the names of Homothallic and Heterothallic species of *Rhizopus*.
4. Why Rhizopus is called as weed of the laboratory and pin mould.
5. Define columella in rhizopus.
6. What are chlamydospores? How do they form in Rhizopus?

SAQ

1. Differentiate between Sporangiosporangium and Germ sporangium of *Rhizopus*.
2. Write about germination of zygospre of Rhizopus.
3. Describe the sexuality of Rhizopus

Funaria

Very Short Answer Questions

1. **Why Funaria is called as Myxohydric moss? June - 2010**
   Ans: Funaria is called as Myxohydric moss because the mineral water is conducted internally through the central cylinder of stem as well as in the capillary spaces formed between adjacent gametophores.
2. **What is apophysis in Funaria? Mention its function. March – 2009**
   Ans:It is basal sterile region of Funaria capsule. It is involved in exchange of gases and photosynthesis. It helps in conduction of mineral water and organic food.
3. **Funaria has no true stem and leaves. Why?**
   Ans: Its stem and leaves are not true stem and leaves because these structures do not have vasculature and belong to gametophytic (haploid) generation.
4. **Distinguish between Gemmae and Tubers in Funaria?**
   Ans: Gemmae are multicellular vegetatively propagating structures formed at the apex of stem, wounded regions of leaves and on Rhizoids, which on germination give rise gametophores. Tubers are resting buds formed on rhizoidal branches of Funaria that develop into protonema upon detachment.
5. **What are Paraphyses in Funaria? Mention its functions?**
   Ans: The uniseriate green haploid structures present around the archegonia and antheridia of Funaria are called as Paraphyses. They help in providing protection to sex organs and performing photosynthesis in both male and female branch of Funaria. In male branch they also aid in discharge of male gametes from the antheridium by secreting mucilage which exerts pressure on antheridia.
6. **Define autocious condition in Funaria?**
   Ans: it is presence of male and female sex organs on different branches of same gametophore in Funaria.
7. **What is the systematic position of Funaria?**
   Ans: Division Bryophtta, class bryopsida, order Funariales and family Funariaceae.
8. **Where does Funaria grow?**
   Ans: It grows in moist shady localities such as moist soils, barks, walls as dense green patches.
9. **What are perichaetial leaves of Funaria? What is their function?**
   Ans: the vegetative leaves present around the antheridia and paraphyses of male branch and archegonia and paraphyses of female branch are called as perichaetial leaves. They carry out photosynthesis and protect the antheridia. They are outwardly spread in male branch and inwardly cover the archegonia and protect the archegonia.
10. **How many cells do you find in the neck and venter of Funariaarchegonium?**
    Ans: Neck of archegonium has several jacket cells, 6 or more neck canal cells. Ventre has double layered jacket, a venter canal cell and an egg cell.

11. **What are paraphyses? Mention their function?**
    Ans: These are uniseriate, multicellular, green structures present around sex oragans which protect the antheridia and archegonia. They also aid in discharge of male gametes in male branch by secreting mucilage. In male branch these are capitates.
12. **Distinguish between paraphyses and Apophysis in Funaria?**
    Ans:

Paraphyses	Apophysis
1.Associated with male and female branches	1.Associated with sporophyte
2.Multicellular and unseriate	2. Parenchymatous
3. Secrete mucilage	3. Do not secrete
4. Photosynthetic in function	4. Conduction, photosynthesis, exchange of gases in function.

13. **How do Calyptra form in Funaria? Mention its functions?**
    Ans: Cayptra is formed from ventre jacket of archegonium after fertilization due to divisions in jacket cells. It protects the zygote, embryo and young sporophyte. It is transversly broken and remains as a cap over operculum.

14. **Why the sporophyte of Funaria is is partially parasite on the gametophyte, but not completely?**
    Ans: The sporophyte of Funaria derives only mineral water from the sporophyte. It carries out photosynthesis due to the presence of green spongy in the apophysis and theca of sporophyte.

15. **Define columella of Funaria?**
    Ans: it is central parenchymatous region of theca extended into the operculum. It provides mechanical support and conducts substances to operculum.

16. **Mention the thickness of outer and inner sporesac of Funaria?**
    Ans:Outer spore sac is 3-4 celled in thickness and inner spore sac is one celled in thickness.

17. **What is apophysis in Funaria? Mention its functions?**
    Ans: It is basal sterile region of Funaria capsule. It has stomata in its epidermis and involved in exchange of gases. Its green spongy tissue takes part in photosynthesis. It has central colorless tissue that helps in conduction.

18. **Name the middle part of Funaria sporophyte. Mention its functions?**
    Ans: It is seta. It is elongated, slender and helps in conduction, projecting the capsule out of the calyptra and shows coiling to help in spore dispersal.

19. **Write two sentences about trabaculae of Funaria?**

Ans: These are multicellular, uniseriate, green structures that connect the capsule wall with the spore sac and traverse the air cavity. These act as shock absorbers and perform photosynthesis.

20. **Write about peristome in Funaria? Give its functions?**
    Ans: It is hygroscopic structure articulated to rim of Funaria capsule and consists of 32 teeth with 16 in the outer ring and 16 in the inner ring. Exostomal teeth are hygroscopic and contribute for spore discharge. Endostomal teeth act as sieve. Exostomal teeth are larger than endostomal teeth.

21. **Distinguish between chloronemal and rhizoidal branches of Funaria?**
    Ans:

Chloronema branches	Rhizoidal branches
1.Aerial branches of protonema	1.Underground branches of protonema
2.Green and photosynthetic	2.Non-green, involved in absorption and conductin of mineral water.
3.Has buds that develop into gametophores	3.May develop bulbils that give rise new protonema.
4.Have transverse walls	4.Oblique walls

22. **What is bryokenin? What is its function?**
    Ans: it is cytokinin like substance of mosses like Funaria. It helps in differentiation of buds on protonema that eventually develop into gametophores.

Short answer Questions

1. **Describe the antheridial branch of Funaria?**
   Ans: It is the main axis of Funaria gametophore. Its apex has antheridia, paraphyses and perichaetial leaves. Antheridia are club shaped, has biseriate multicellular stalk and single layered jacket that encloses several biflagellated sickle shaped male gametes. Surrounding these structures, uniseriate multicellular green photosynthetic capitate structures known as paraphyses are present. These paraphyses take part in photosynthes, secrete mucilage that protect the antheridia and help in discharge of pollen grains. Surrounding these structures, there are vegetative leaves that spread outwardly like petals are present. All these three structures together are known as perichaetium.

2. **Describe the internal structure of Funaria stem?**
   Ans: Internally Funaria stem is clearly demarcated into epidermis cortex and central cylinder. Epidermis is single layered, with chloroplasts, without stomata. Cortex is multilayered, parenchymatous, peripheral region is chlorenchymatous in younger stems and inner one is colorless. In older stems the outer region becomes thick walled and colorless. Central cylinder has narrow elongated thin walled dead cells that help in conduction of mineral water. These cells are called as hydroids.

3. **Elucidate the methods of vegetative propagation in Funaria?**

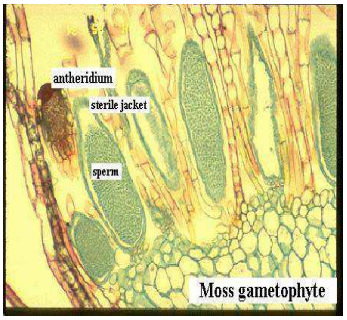
   Ans: Funaria vegetative reproduces by secondary protonema, Gemmae and Tubers. Protonema developed from detached injured portions of gametophores surrounded by moist air are called as secondary protonema. It develops buds that develop into gametophores.

   Gemmae are small multicellular structures that may develop from rhizoids, broken leaves or from the stem tips. They easily get detached and give new gametophores, directly without forming buds.

   Tubers are subterranean resting buds developed from rhizoids. They produce protonema. From buds of protonema, gametophores are developed.

4. **Describe the antheridium of Funaria?**

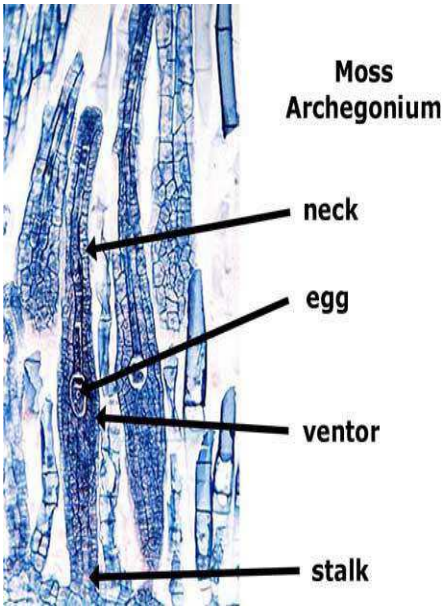
   Ans: Antheridium has a multicellular biseriate stalk and body. Body is club shaped, and surrounded by a single layered jacket. One, two or more cover cells are present at the tip of antheridium. These cells are relatively larger. The jacket encloses a mass of androgonial cells which ultimately form androcyte mother cells. Each androcyte mother cell divides obliquely to form two androcytes. Each androcyte transforms into a sickle shaped biflagellate antherozoid. At maturity, the cover cells rupture and the antherozoids are liberated en-masse through the perforation. Each antherozoid is haploid and bears two equal flagella at the anterior end. They spread out into the surrounding water and swim towards the archegonial branch.

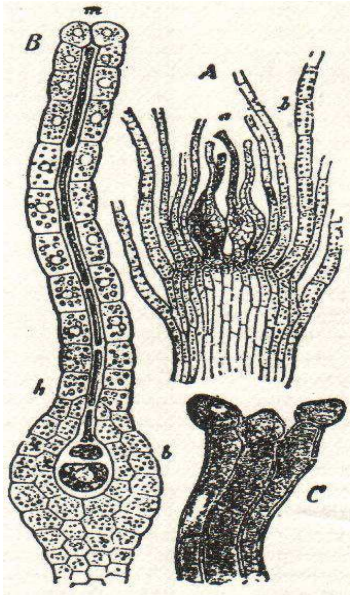




5. **Explain the structure of archegonial branch of Funaria?**

   Ans: Archegonial branch is the lateral branch of Funaria. It has a cluster of archegonia at its apex. These are surrounded by perichaetial leaves. They overlap and close to the top to protect the archegonia. The archegonia cluster with the surrounding perichaetial leaves constitute the perichaetium. The archegonia in the cluster are at different developmental stages. In between archegonia, a large number of multicellular, uniseriate filamentous sterile hairs called Paraphyses are present. They maintain moisture around archegonia and give protection to them besides performing photosynthesis.





Archegonium is a flask shaped structure with a basal stalk, median swollen ventre, and a terminal long twisted neck. The stalk is multicellular and multiseriate. The venter is double layered and contains an egg and a ventral canal cell inside. The neck is several cells in height and made of six vertical rows of cells. It encloses six or more neck canal cells. The neck is capped by four cover cells. In mature archegonium, the VCC and NCC degenerate and form mucilage rich in sugar secreted out as a droplet. The sugars help in attracting the male gametes.

6. **Differentiate antheridial and archegonial branch?**

Ans:

Antheridial branch	Archegonial branch
1. It is main stem and has antheridial cluster	1. It is lateral branch and has archegonial cluster.
2. Paraphyses have subspherical apical cell	2. They do not have subspherical apical cell
3. Antheridia are club shaped	3. Archegonia are flask shaped.
4. It is also called as moss flower due to the rosette arrangement of perichaetial leaves	4. The perichaetial leaves are spread out.

7. **Describe the external morphology of sporophyte in Funaria?**

Ans:The sporophyte of Funaria is divided into three parts as Foot, Seta and Capsule.

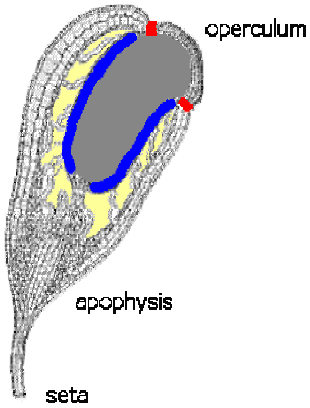
Foot: It is the basal small, conical structure inserted in the apex of female branch. It functions as anchorage and absorbing organ. It absorbs minerals and water from the gametophore and supplies them to capsule via seta.

Seta: It is the slender elongated tough structure present between the foot and capsule. It is hygroscopic, twists and curls during dry conditions and helps in spore dispersal. It conducts mineral water to the capsule.

Capsule: It is apical pear shaped fertile structure that produces spores and covered by upper half of calyptra. It has three regions called Apophysis, Theca and Operculum.



8. **Describe the apophysis of Funaria?**



Ans:

It is the basal sterile region of Funaria capsule. It has single layered epidermis with stomata that help in exchange of gases, a multilayered green spongy tissue involved in photosynthesis and a central strand with conducting tissue with thin elongated, thin walled colorless cells which has contact with columella on one side and seta on the other side.

9. **Describe the theca of Funaria capsule?**

Ans: it is the middle fertile region of capsule which produces spores and urn shaped. It has single layered epidermis with few stomata and continuous with the epidermis of apophysis, 2-layered parenchymatous hypodermis with colorless cells and one or two layered spongy chlorenchyma layers in its wall. Below this there is a big air cavity traversed by multicellular, uniseriate green structures called trabeculae. These act as shock absorbers and perform photosynthesis. It is in contact with spore sac on the inner side.

Spore sac is barrel shaped structure with 3-4 layered outer sporesac, 2-4 layered spore sac proper with spore mother cells, single layered inner spore sac. Spore mother cells undergo reduction division and form haploid spores. Interior to spore sac there is Columella with colorless parenchyma cells which help in providing mechanical support and conduction.

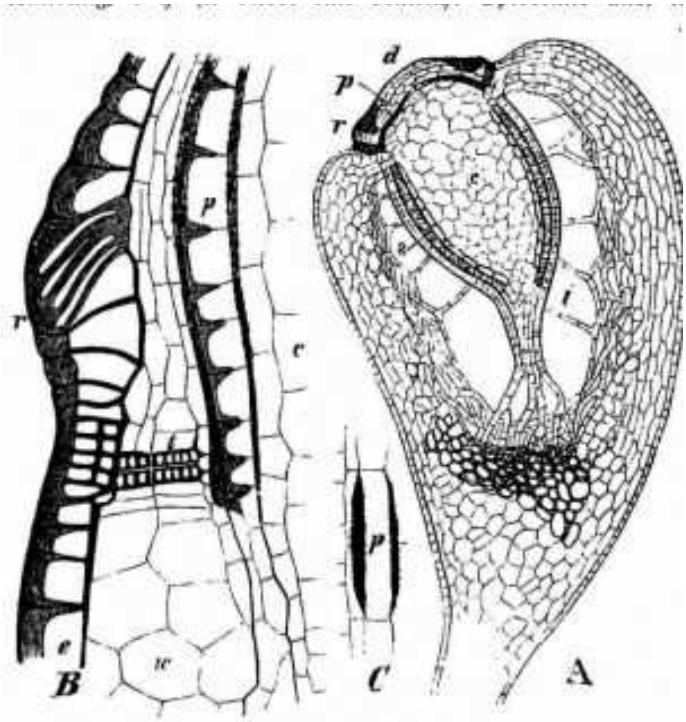
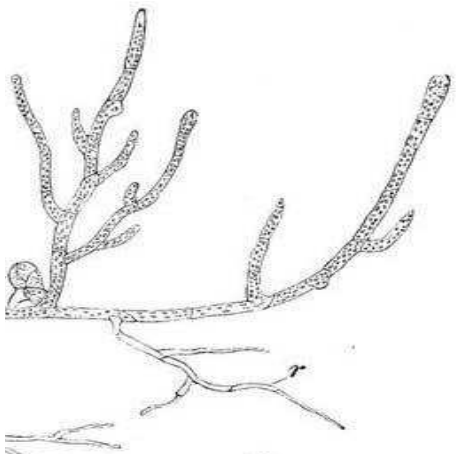


Fig. 204. ***Funaria hygrometrica.***

A Längsschnitt einer nicht ganz reifen Kapsel (Vergr. 30 mal). B Längsschnitt aus der unteren, äußeren Region des Deckels derselben. C Stück eines Querschnittes aus dem Inneren von B. i Intercellularraum zwischen Wand und Sporensack s. c Columella. d Deckel. r Ring. p Peristom. e Epidermis der Kapselwand. w Die innere Grenzschicht der letzteren. t Dickwandige Zellen zwischen Wand und Peristom. (Nach Lucrssen.)

10. Describe protonema of Funaria?

Ans: It is juvenile gametophyte of Funaria. It is prostrate and formed from spore. It is branched filamentous, septate, uniseriate and resembles an alga. It has aerial green filaments with transvere walls called chloronemal branches and underground colorless filaments called rhizoidal branches. Rhizoids have oblique cross walls. Rhizoidal branches may expose to light and become green. On chloronemal branches buds are formed by the influence of growth factor called Bryokenin. These buds eventually develop into Gametophores.



11. Differentiate between Protonema and Gametophore?

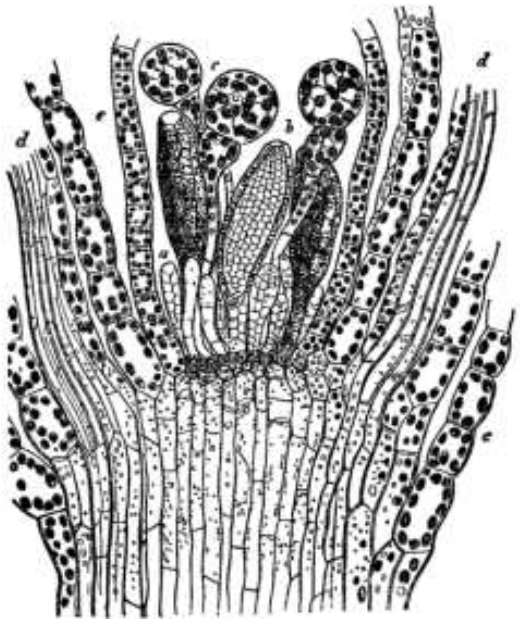
Ans:

Protonema	Gametophore
1. Juvenile gametophyte formed form spore	1. Adult gametophyte formed from buds of protonema.
2. It is multicellular, branched filamentous, septate and resembles an alga.	2. It is multicellular and demarcated into stem, rhizoids and leaf.
3. Reproduces vegetatively by budding	3. Reproduces sexually by producing antheridia and archegonia.
4. It is short lived	4. Long lived
5. Sporophyte is not parasitic on it	5. Sporophyte is parasitic.

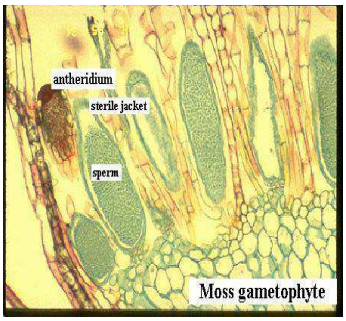
Long Answer Questions

1. **Describe the male and female reproductive branches of Funaria?**

   Ans:It is the main axis of Funaria gametophore. Its apex has antheridia, paraphyses and perichaetial leaves. Antheridia are club shaped, has biseriate multicellular stalk and single layered jacket that encloses several biflagellated sickle shaped male gametes. Surrounding these structures, uniseriate multicellular green photosynthetic capitate structures known as paraphyses are present. These paraphyses take part in photosynthes, secrete mucilage that protect the antheridia and help in discharge of pollen grains. Surrounding these structures, there are vegetative leaves that spread outwardly like petals are present. All these three structures together are known as perichaetium.

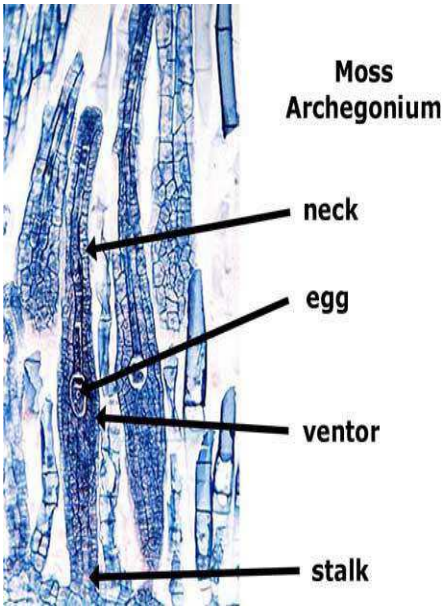


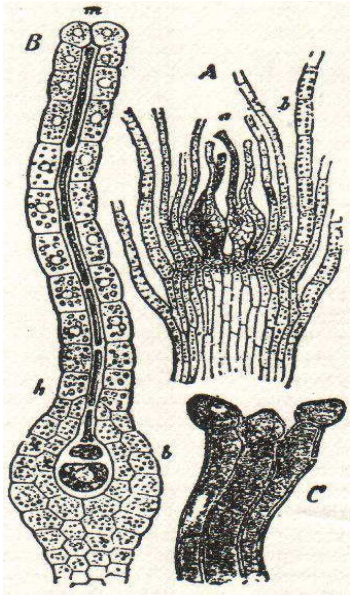
Antheridium has a multicellular biseriate stalk and body. Body is club shaped, and surrounded by a single layered jacket. One, two or more cover cells are present at the tip of antheridium. These cells are relatively larger. The jacket encloses a mass of androgonial cells which ultimately form androcyte mother cells. Each androcyte mother cell divides obliquely to form two androcytes. Each androcyte transforms into a sickle shaped biflagellate antherozoid. At maturity, the cover cells rupture and the antherozoids are liberated en-masse through the perforation. Each antherozoid is haploid and bears two equal flagella at the anterior end. They spread out into the surrounding water and swim towards the archegonial branch.





Archegonialbranch: Archegonial branch is the lateral branch of Funaria. It has a cluster of archegonia at its apex. These are surrounded by perichaetial leaves. They overlap and close to the top to protect the archegonia. The archegonia cluster with the surrounding perichaetial leaves constitute the perichaetium. The archegonia in the cluster are at different developmental stages. In between archegonia, a large number of multicellular, uniseriate filamentous sterile hairs called Paraphyses are present. They maintain moisture around archegonia and give protection to them besides performing photosynthesis.





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2. **Describe the internal structure of Funaria capsule?**
   Ans: Internally Funaria Capsule is demarcated into Apophysis, Theca and Operculum.

   Apophysis:It is the basal sterile region of Funaria capsule. It has single layered epidermis with stomata that help in exchange of gases, a multilayered green spongy tissue involved in photosynthesis and a central strand with conducting tissue with thin elongated, thin walled colorless cells which has contact with columella on one side and seta on the other side.

   Theca: it is the middle fertile region of capsule which produces spores and urn shaped. It has single layered epidermis with few stomata and continuous with the epidermis of apophysis, 2-layered parenchymatous hypodermis with colorless cells and one or two layered spongy chlorenchyma layers in its wall. Below this there is a big air cavity traversed by multicellular, uniseriate green structures called trabeculae. These act as shock absorbers and perform photosynthesis. It is in contact with spore sac on the inner side.

   Spore sac is barrel shaped structure with 3-4 layered outer sporesac, 2-4 layered spore sac proper with spore mother cells, single layered inner spore sac. Spore mother cells undergo reduction division and form haploid spores. Interior to spore sac there is

Columella with colorless parenchyma cells which help in providing mechanical support and conduction.

Operculum: It is present above the theca and also known as lid. It is obliquely placed on the theca. It is separated from the theca by two rings called outer Annulus and inner Rim. A peristome is present in the operculum with radially arranged peristomial teeth. The peristomial teeth are 32 and arranged in two rings with each ring having 16 teeth. The outer ring is exostome and inner one is endostome. Exostomal teeth have tangential bands made of lignin due to which they show hygroscopic movements. These help in spore dispersal in dry atmosphere. The opeinging of spore sac is closed by these teeth. The operculum proper is two celled in thickness.

Important questions

Very short answer questions.

1. What is Bryokenin? What is its function?
2. Define autocious condition in Funaria.
3. Why Funaria is considered as Myxohydric moss?
4. What are perichaetial leaves of Funaria? What is their function?

Short Answer questions

1. Elucidate the methods of vegetative propagation in Funaria.
2. Describe protonema of Funaria.
3. Differentiate antheridial and archegonial branch of Funaria.

Long Answer Questions

1. Describe the internal structure of Funaria capsule.