RPS DEGREE COLLEGE

BALANA (MAHENDERGARH)-123029

Lab Manual

Botany (B.Sc.1st & 2nd Semester)

Department of Botany

INDEX

Experiment-1

NOSTOC

Aim - To study the different structure of specimen of NOSTOC

Classification

Division -Cyanophyta
Class -Cyanophyceac
Order -Nostocales
Family -Nostocaceae
Genus –Nostoc

External Features

- **The Thallus**

1. Thallus is colonial. Blue green bead like trichomes are tangled in a gelatinous envelop to form a colony
2. Each trichome is usually covered by own mucilaginous sheath.
3. Each trichome is unbranched filament consisting of large number of prokaryotic cells arranged one above the other like string of beads.
4. Structure of a cell is typically cyanophycean. Each cell is oval or cylindrical in shape which has double layered cell wall.
5. The protoplasm of each cell is distinguished into peripheral chromoplasm and colorless central centroplasm.
6. Nucleus being altogether absent. The centroplasm has a single circular DNA which forms the incipient nucleus.
7. The trichome besides having normal cells also possesses Heterocysts.
8. Heterocysts are intercalary and are double walled, pale yellow colored cell
9. Each heterocyst possesses two shining polar granules one each near the neighboring cell on either side.
10. Heterocysts are much of the same size or slightly bigger than the vegetative cells.

Reproductive Structures

(a) Hormogones

1. Hormogones are formed due to the rupture of trichome at places where heterocysts and vegetative cells adjoin.
2. These are pieces of trichomes.

(b) Akinetes

1. Akinetes are developed in mature colony. These occur in large number, in series between two heterocysts.
2.Akinetes are thick walled, sometimes ornamented, rich in reserves and cyanophycean granules.
3. Akinetes are liberated due to decay of colonial sheath. These germinate to form new thallus.

Experiment-2

VOLVOX

Aim - To study the different structure of specimen of VOLVOX

Classification

Division- Chlorophyta
Class -Chlorophyceae
Order -Volvocales
Family -Volvocaceae
Genus –Volvox

External Features

- **The Thallus**

1. Volvox is spherical multicellular, motile, coenobial alga.
2. Each coenobium is composed of a large number of cells embedded in colorless mucilage.
3. The coenobium is hollow in the middle and the cells are arranged in single layer towards periphery.
4. Layer of cells is surrounded by gelatinous mass which forms the outer and firm limiting layer.

- **The cell**

1. Each cell of the coenobium is connected with a few of the neighboring cells by thin and delicate cytoplasmic strand.
2. Each cell is enveloped by its own gelatinous sheath.
3. Each vegetative cell is biflagellate, ovoid or pear shaped uninucleate with single cup shaped chloroplast.
4 The flagella are anteriorly inserted. Near the base of flagella, two contractile vacuoles are present.
5. Cup shaped chloroplast occupies much of the posterior part in which single pyrenoid is present. Eye spot or stigma occupies antero-lateral position.
6. Single nucleus occurs in the cytoplasm in the cavity of the cup shaped chloroplast.

Reproductive Structures

(a) Asexual reproduction (Daughter colonies)

1. Asexual reproduction takes places by the formation of daughter colonies.
2. Daughter colonies are formed mostly in the posterior part of the colony.
3. Many small daughter colonies are embedded in the parent coenobium.
4 The daughter colonies are similar to parent coenobium except that these are smaller in size.
5. Daughter colonies are liberated by gelatinization of the parent colony.

(b) Sexual reproduction

1. Colony may be monoecious or dioecious.
2. Sexual reproduction is oogamous.
3. Sex organs arc distinct male antheridium and female oogonium.
4. Antheridia and oogonia developed mostly in posterior part of the colony.
5. The antheridia possess many yellow green and fusiform biflagellate antherozoids.
6. The oogonium is flask shaped or rounded structure. It contains single non motile egg.
7. As result of fertilization oospore is produced. It is thick walled perennating spore in which wall is differentiated into three layers: outer exosporium middle mesosporium and inner endosporium. It is orange in color due to the presence of haematochrome.

Experiment-3

OEDOGONIUM

Aim- To study the different structure of specimen of OEDOGONIUM

Classification

Division-Thallophyta
Class -Chlorophyceae
Order -Oedogoniales
Family -Oedogoniaceae
Genus- Oedogonium

External Features

- **The Thallus**

1. The thallus is multicellular, filamentous and unbranched.
2. The basal cell of the filament functions as a hold fast. The lower part of the hold fast is either disc like or finger shaped. The basal part is non green due to the absence of green pigment.
3. The apical cell of the filament is rounded at its free surface.
4. All other cells except hold fast and apical cell are elongated cylindrical and arranged end to end. These are intercalary cells which are swollen at their upper ends.
5. A few intercalary cells show ring like striations towards their distal ends. These annular rings are called and the cells which possess caps are called cap cell.

- **The cell**

1. Each cell of the filament is long, cylindrical and possesses a thick rigid cell wall.
2. The cell wall is three layered.
3. Each cell is uninucleate and the nucleus lies in the peripheral cytoplasm.
4. The cell possesses single, large, reticulate chloroplast that runs parallel to the long axis of the cell. Many pyrenoids are present in the chloroplast.

Reproductive structures

- **Oogonium**

1. Oogonia occur in intercalary or terminal in position.
2. Oogonia may be solitary or occur in a row of 2:3 or even more.
3. Oogonia generally show one or more cap cells at its upper end, indicating its development from a old cell.
4. It is spherical or oval in shape and is larger than that of the vegetative cell.
5. At the base of the oogonium supporting or suffulatory cell is present.
6. Inside the oogonium there is single large egg or ovum.
7. A receptive pore is present on one side on the wall of the oogonium.
8. Just opposite the receptive pore colorless area is present in the oogonium. It is called receptive spot.

- **Antheridium**

1. Antheridia are commonly intercalary in position.
2. Antheridia are arranged in a series in the form of a long chain.
3. Each antheridium has two nuclei lying side by side surrounded by dense cytoplasmic contents. Each then metamorphoses into a multiflagellate antherozoid.

- **Dwarf male or Mannandrium**

1. It is the characteristic of nannandrous species.
2. It is produced by germination of androspore which are produced inside androsporangia.
3. Androsporangia occur in the form of long chain, intercalary in the filament.
4. Each androsporangium produces a single multiflagellate androspore.
5. Androspore germinates to produce a dwarf male or nannandria which is attached either wall of the oogonium or to the supporting cell.
6. A dwarf male has a stalk cell and a terminal row of 2-3 cells.
7. The terminal row has antheridia. Each antheridia has two multiflagellate antherozoid.

Experiment-4

CHARA (Stone-wort)

Aim - To study the different structure of specimen of CHARA

Classification

Division -Chlorophyta
Class- Chlorophyceae
Order -Charales
Family -Characeae
Genus –Chara

External features

1. Thallus is large, macroscopic, branched and multicellular.
2. It is attached to the substratum by multicellular rhizoids which bear an erect and branched main axis above.
3. The rhizoids are branched, multi cellular, uniseriate, septate with oblique septa. They arise from the low nodes of the main axis.
4. The main axis is erect and branched. It is differentiated into nodes and internodes.
5. Internodes are long, single celled.
6. The nodes are short; consist of a group of regularly arranged cells.
7. The main axis bears two kinds of lateral branches - (i) branches of limited growth (short laterals) and (ii) Branches of unlimited growth (long laterals) and internodes.
8. Branches of limited growth arise in whorl from each node of the main axis. It has limited numbers of nodes.
9. From the nodes of short laterals, secondary short laterals are produced which are small, one celled spine like branches also called stipules.
10. Branches of unlimited growth arise in the axil of short laterals. It is termed as primary lateral. Each branch possesses nodes; inter nodes, cortication, primary branch of limited growth laterals like that of main axis.

- **The Cell**

1. In the centre is large central, axial or internodal cell.
2. The intermodal cell has a big central vacuole surrounded by a thin layer of cytoplasm.
3. The cytoplasm contains a large mumber of small disc shaped chloroplasts. Pyrenoids are absent.
4. The cells are uninucleate.
5. The cell wall is cellulosic with the deposition of calcium carbonate towards the outer gelatinous layer.

Reproductive structures

- **Sex organs**

1. Most of the species are homothallic while few are heterothallic
2. The male reproductive organ is called antheridium or globule while female sex organ in called oogonium.
3. Both sex organs are borne at one point on the nodes of short laterals which bear stipules
4. The nucule lies above the globule on the node.

- **Antheridium or globule**

l. A globule is a small, spherical and red or yellow structure attached to the node by a long stalk cn most wall of the globule is ornamented, composed of eight, large, curved and plate tike colls the shield setles.
3. Each shield cell is attached to a long handle or a rod shaped cell-manubriam
4. The tip of each manubrium has two groups of six cells each. These groups respectively called primary capitulum and secondary capitulum.
5. Each secondary capitulum bears 2-4 long unbranched antheridial filaments.
6. Each antheridial filament possesses about me to two hundred cells.
7. Each cell produces singlc elongated, coiled and biflagellated antherozoid.

- **Oogonium or nucule**

1. Nucleus is oval in shape and is situated above the globule at the node.
2. Each nucleus has single large oogonium which is surrounded by five tube cells.
3. The tube cells are spirally coiled around the oogonium in a clockwise manner
4. At the apex of the nucule is a corona of five small cells arranged in one tier
5. The oogonium encloses single large egg, which is filled with starch and oil.
6. The egg is uninucleate. Single nucleus lies at the base. The special part is colorless called apex
7. After fertilization the nucleus gets modified into a zygote.

Experiment-5

VAUCHERIA

Aim - To study the different structure of specimen of VAUCHERIA

Classification

Division -Xanthophyta
Class -Xanthophyceae
Order -Heterosiphonales
Family -Voucheriaceae
Genus –Vaucheria

- **The Thallus**

1. The thallus is composed of yellowish green, cylindrical or tubular filaments branched at irregular intervals.
2. The branching is lateral but appears dichotomous.
3. Cross wall absent so that filaments are without any septation (aseptate filaments).
4. If terrestrial in habitat a few colorless rhizoidal branches are present which penetrate in the soil.

- **Structure of the filament**

1. Filament bounded by wall which is two layered.
2. In the centre lies a big vacuole, continuous throughout the length of filament.
3. The cytoplasm ties between vacuole and the cell wall.
4. Cytoplasm contains numerous small oval, circular or elliptical chromatophores arranged in outer layer.
5. Inner to chromtophores many minute nuclei are present forming inner layer.
6. The reserve food material is in the form of small oil droplets.

Reproductive structures

- **Zoosporangia**

1. Zoosporangia are elongated club shaped multinucleate structures which develop at the end of a side branch.
2. It is separated rest of the filament by a septum.
3. Each zoosporangium has single multinucleate, multiflagellate zoospore.

- **Antheridia**

1. Antheridia are situated terminally which are strongly curved, hook like and cylindrical.
2. Antheridia are cut off from the main filament by a transverse septum.
3. The antheridium contains numerous, minute, oval, biflagellate sperms
4. The liberation of antherozoids is through a small pore at the tip of the antheridium

- **Oogonium**

1. Oogonia are oval or spherical structure and terminate into a short beak
2. It is sessile or subsessile.
3. It contains single large nucleus present in the centre and a number of chromatophores.
4. The protoplasmic contents round off to form a single large egg cell or ovum.
5. Near the beak, at the apical part, the protoplasm leaves a small colorless area known as receptive spot.
6. Zygote formed as a result of fertilization to thick walled.

Experiment-6

ECTOCARPUS

Aim- To study the different structure of specimen of ECTOCARPUS

Classification

Division -Phacophyta
Class -Phacophyceae
Order-Ectcarpales
Family -Ectocarpaceae
Genus –Ectocarpus

External Features

- **The Thallus**

1. The thallus is branched filamentous multicellular and brownish in color.
2. Filaments show heterotrichous habit being differentiated into (a) prostrate portion (b) an erect portion.
3. In some species prostrate portion is irregularly and profusely branched. It helps in fixation
4. Lateral branches arise just beneath the septum and tapers into a point. Ultimate branches give an appearance of hair
5. The branches and main axis are uniseriate consisting of only one row of cells placed one over the other.

- **The Cell**

1. The cells are uninucleate, cylindrical and rectangular in shape.
2. The cell wall is two layered.
3. Chromatophore may be single or many. They are brown in color which differ in shape and in number. They may be disc shaped or ribbon like structures
4. Cytoplasm fills up the cell. Nucleus is situated in the centre, being hold up by

thin and delicate cytoplasmic strands.

Reproductive Structures

- **Unilocular sporangia**

1. These always occur on diploid plants, and are bodies of asexual reproduction.
2. These are globular structures present at the apices of short lateral branches.
3. The sporangia may be sessile or stalked.
4. In younger stage, sporangium is single celled with many uninucleate protoplasmic bodies.
5. In mature condition each sporangium has many biflagellate meiozoospores.

- **Plurilocular sporangia**

1. These occur on both haploid and diploid plants.
2. These are elongated structures present at the apices of the lateral branches.
3. They may be stalked or sessile.
4. Plurilocular sporangium is divided into large number of cells.
5. Each cell of the sporangium gives raises a bifalgellate mitozoospore.

Experiment-7

POLYSIPHONIA

Aim- To study the different structure of specimen of POLYSIPHONIA

Classification

Division -Rhodophyta
Class -Rhodopyceae
Order- Ceramiales
Family -Rhodomelaceae
Genus –Polysiphonia

External features

- **The Thallus**

1. The plant body exhibits a bushy or feathery appearance.
2. The thallus is filamentous, branched, miltiaoxial (poly siphonous) and heterotrichous differentiated into prostrate and erect system.
3. The prostrate system creeps over the substratum. The branches of the prostrate system are firmly attached to the substratum by means of thick walled unicellular and lobed rhizoids.
4. The erect system is much branched. It consists of main axis and lateral branches. The branches are of two types- (i) branches of unlimited growth and (ii) branches of limited growth or trichoblast.
5. Trichoblasts arise from apical part of main axis and long branches. They are uniseriate dichotomously branched.
6. The main axis and the branches of unlimited growth terminate into an apical cell, followed by a flat.
7. The polysiphonous thallus consists of a large central siphon surrounded by 4-20 pericentral siphons.

- **The Cell**

1. Under low power of microscope, the thallus shows several tiers of cells placed end to end.
2. Each cell is uninucleate and possesses a big central vacuole surrounded by cytoplasm.
3. There are numerous discoid chromatophores in each cell.
4. The reserve food is in the form of floridean starch.
5. The cell wall in two layered.
6. The whole thallus is surrounded by a common gelatinous sheath the thallus.

Experiment-8

PHYTOPTHORA

Aim- To study the different structure of specimen of PHYTOPHORA

Classification

Division -Mycota
Class -Oomyeetes
Order -Peronosporales
Family -Pythiaceae
Genus- Phytopthora
Species - infestens

Phytopthora infestens parasitizes potato and causes a disease called potato blight or late bright of potato.

- **Vegetative structure**

I. The mycelium in endophytic, branched, aseptate, coenocytic hyaline and intercellular.
2. Septa develop inodd hyphae at the time of reproduction.
3. Hyphae vary in diameter and develop rounded or branched haustoria which enter the cells of the host.
4. Internal structure of the hypha shows the presence of large number of nuclei scattered evenly in the cytoplasm.
5. The cytoplasm also possesses mitochondria, endoplasmic reticulum, ribosomes and oil drops.

Reproductive structures

(a) Asexual reproductive structures-sporangia

1. Asexual reproduction is by means of sporangia.
2. The sporangia are produced on branched sporangiophores coming out through the stomata in groups on the lower surface of the infected leaves.
3. Each sporangium has many biflagellate uniform uninucleate zoospores.

(b) Sexual reproductive structures- Oogonia and antheridia

1. The antheridia may be paragynous i.e. at the side of the oogonium or amphigynous i.e. at the base of the sporangia are rounded or lemon shaped. At the apex of the sporangium a papilla is present.
2. The oogonium is spherical to pear shaped. Internally it is differentiated into central dense ooplasm and peripheral vacuolated periplasm.
3. Single large egg nucleus lies in the centre of the ooplasm.
4. The antheridium is irregular collar shaped found at the base of the oogonium.
5. Single male nucleus lies in the antheridium.

Experiment-9

PENICILLIUM

Aim - To study the different structure of specimen of PENICILLUM

Classification
Division- Mycota
Class -Ascomycetes
Order -Aspergillales
Family -Arpergillacess
Genus –Pencillium

- **The Thallus**

1. The mycelium is profusely branched and septate and each cell is multinucleate.
2. A single filament or branch or the mycelium is called hypha.
3. Cell walls of the hyphae are thin.

- **Conidia**

1. Conidia are asexual spores bone on long, erect and branched conidiophores.
2 The conidiophores are septate and the cells are multinucleate.
3. Each conidiophores grow vertically from the mycelium and branches at its upper end.
4. The sterigmata bear eonidia in basigenous chain.
5. The eonidia are globose to ovoid in shape.

- **Ascopores**

1. Acospores are formed in Asci.
2. Asci lie seattered in fruiting body called cleistothecium
3. Each ascus has eight ascospores.

Experiment-10

PUCCINIA

Aim - To study the different structure of specimen of PUCCINIA

Classification
Division -Mycota
Class -Basidiomycetes
Order -Uredinales
Family -Pucciniaceae
Genus –Puccinia

Pacinia obligate parasites on some of the important cereals viz, wheat, maize, oat, bajra and jowar.

Pathogen

Paccinia garminis tritci

1. It is hetcroecices fungus which infeet wheat (*Triticum valgare*) the primary host, and berberry (*Berberis valgaris*) the alternate host.
2. The fungus shows dikaryophase on the primary host and haplophase on the secondary host.
3. The mycelium is well developed, branched and septate which is generally intercellular and some time shows globular haustoria.
4. Following spore stages are found in the two different hosts.

Primary host - *Tritcum vulgare*

(a) Uredineal stage (b) Telial

Secondary host - *Berberis vulgaris*

(a) Pycnidial (b) Aecial

- **Uredineal stage**

Symptoms: Uredopustules appear as red, oval or lemon shaped lesions on the leaves and leaf sheath.

- **Uredospores**

1. Its section reveals the host epidermis ruptured due to the presence of underlying uredospore.
2. The dikaryotic mycelium aggregates beneath the epidermis.
3. The medospores are produced in bunches from this mycelium.
4. Eachurodosporc is stalked structure, oval in shape and reddish brown in colour
5. The uredospore is binuucleate with outer thick spinous wall exine and inner thin smooth wall intine.
6. Each uredospore provided with four germ pores.

- **Telial Stage**

Symptoms : Teleuto pustules pear on leaves, leaf sheaths and steam as black pustules that fuse to form patches.

- **Telestesorus and Telentospores**

1. The host epidermis is ruptured due to the pressure of underlying teleutospores at maturity, the antheridium pierces the oogonium by a fertilization.
2. Each teleutospore is elongated, back bicelled structure attached to the mycelium by a stalk.
3. Each cell is binucleate and has a germ spore
4. The apex of teleutospore is pointed and has a very thick exine and delicate thin intine.

Experiment-11

AGARICUS

Aim - To study the different structure of specimen of AGARICUS

Classification

Division- Mycota
Class -Basidiomycetes
Order -Agaricales
Family -Agaricaceae
Genus -Agaricus

- **Vegetative structure**

1. The mycelium is underground and consists of much branched hyphae.
2. Hyphae are septate, hyaline containing vacuoles and thin cytoplasm.
3. Some of the hyphae are interwoven into thick rope like strands known as rhizomorphs.
4. The aerial portion constitutes the fruiting body.

- **Fructification (Basidiocarp)**

1. It is umbrella shaped differentiated into stalk like portion the stipe and expanded cap like pileus
2. In young basidiocarp the edge of the pileus is connected to the stipe by a thin sheet of tissue the inner veil or velum.
3. With the growth of basidiocarp, the velum reptures and in mature basidiocarp it remains in the form of ring (annulus) on the stipe.
4. The upper surface of pileus is flesh colored.
5. The pileus on the underside bears many lamellae or gills.
6. The gill in transverse section exhibits a trama a subhymernium and hymenium.
7. The hymenium consists of the fertile cells - the basidia, intermingled with sterile paraphyses.
8. Each basidia bears four basidiospores on sterigmata.
9. Each basidiospore is uninucleate and oval in shape.

Experiment-12

LICHENS

Aim - To study the different structure of specimen of LICHENS

The lichens are dual organisms consisting of an alga (Phycobiont) and a fungus (mycobiont) to lead symbiotic way of life. According to external shape and habitat, the ascolichens are classified into three principal groups: Crustose lichens, foliose lichens and fruticose lichens.

A. CRUSTOSE LICHENS

- **External structure of thallus**

1. Crustose lichens occur as hard, granular crusts on rocks and barks, adhering very closely to the substratum.
2. The surface of the thallus in usually divided into more or less hexagonal arcs called the areolie.
3. Crustose lichens show very little differentiation between the upper and lower surfaces.

B. FOLIOSE LICHENS

Classification

Division- Mycota
Class -Lichens
Sub class- Ascolichens
Order -Parmeleales
Family -Parneliaceae
Genus –Parmelia

- **External structure of the thallus**

1. The foliose lichens have a flat leaf like lobed or deeply incised thallus.
2. The thallus to the substeratum by rhizines which arise from the under surface.
3. The thallus may be attached either by single rhizome or several rhizomes.
4. Cup shaped apothecia are present on upper surface of the thallus.

C. FRUTICOSE LICHENS

Classification

Division -Mycota
Class -Lichens
Subclass -Ascolichens
Order -Parmeleales
Family -Usneaceae
Genus –Usnea

- **External structure of the thallus**

1. The fruticose lichens have much branched, cylindrical to ribbon shaped shrub like body.
2· The body is attached by narrow basal portion only, and drooping down.
3. The apothcia are present at the terminal ends of the branches.

V.S. Thallus of Lichen

1. In V. S., the thallus of lichen shows differentiation into four regions
2. The uppermost region consists of vertical hyphae without intercellular spaces. This is known as cortex which is externally bounded by an epidermis like layer of hyphae.
3. Beneath upper cortex is Algal region which consists of numerous algal cells held together in the hyphae.
4. Below it in the medulla composed of loosely bound hyphe.

Reproductive structures

- **Soredia**

1. The commonest method of vegetative reproduction is by Soredia.
2. Soredia develop as bud like outgrowths either over the entire surface or in localized patches called soralia.
3. A soredium consists of one or more algal cells enclosed by a few hyphae.

- **Pycniospores**

1. Pycniospores are produced in pynidia, on the upper surface of the thallus.
2. Each pyenidium is flask shaped with a small opening at the apex called ostiole.
3. Hyphac lining the cavity produces many pycniospores.

- **Ascospores**

1. Ascospores are formed in Asci borne in Apothecia.
2. Apothecia are cup shaped fruiting bodies.
3. It has palisade like layer of cells called hymenium.
4. The hymenium consists of the asci, intermixed with sterile hyphae-the paraphyses.
5. Each Ascus has eight ascospores.

Experiment-13

ANTHOCEROS

Aim - To study the different structure of specimen of ANTHOCEROS

Classification

Division -Bryophyta
Class -Anthocerotopsida
Order -Anthocerotales
Family -Anthocerotaceae
Genus –Anthoceros

External features

1. The plant body is gameotophyte.
2. Thallus is dichotomously branched and without definite mid ribs.
3. The upper surface is smooth
4. The ventral surface has large number of unicellular, smooth walled rhizoids that attach the thallus to substratum
5. Small, rounded blue green thick areas are also present on the ventral surface these nostoc colonies.
6. Sporophytes or sporogonia are present on the dorsal surface of the thallus.

- **Internal structure of thallus (V.S.)**

1. The thallus is many layered thick.
2. There is no differentiation in assimilatory and storage regions.
3. Whole thallus is made up of soft parenchymatous cells which are compact and uniform. Upper and lower epidermal layers are not distinct.
4. Each parenchymatous cell has a large chloroplast.
5. On the ventral surface there are mucilage filled cavities which open by slime pores.

Reproductive structures:

- **Vegetative structures**

Tubers

l. These are vegetative reproductive structures.
2. Tubers are formed on the dorsal surface along the margin thallus.
3. A tuber has 2-3 surface layers made up of cells with corky walls.
4. The inner cells store starch, oils & proteins.
5. Tubers perennate during dry season and develop into new thalli on the onset of favorable season.

Sexual reproduction structure

- **Antheridia**

1. The antheridia are formed in antheridial chambers which are closed cavities. Thus they are endogenous.
2. Each antheridial cavity has two cell layered thick root.
3. Each antheridium has an ovoid body and multicellular slender stalk.
4. The antheridial body has an antheridial wall or Jacket. It encloses a mass of androcytes which give rise to sperms.
5. The mature antheridium is orange colored due to chromoplasts in its wall cells.

- **Archegonia**

1. These are deep seated in the flashy thallus on its upper surface.
2. They are present close to growing point in regular rows.
3. An archegonium consists of only a row of neck canal cells a ventral canal cell and an egg.
4. The tip of archegonium is formed of a rosette of cover cells. The cover cells just project above the upper surface of thallus.
5. The archegonumthus immersed in the thallus and is indirect contact with the thallus tissue.

- **Sporogonium**

1. A sporogonium develops from a fertilized zygote. Sporogoniums grow in groups from the upper surface of the thallus
2. Each sporogonium is narrow, elongated structure, surrounded by a sheath called involucre at its base. The basal part of sporogonium is immersed in the thallus.
3. It is differentiated into three parts (i) Foot (ii) Intercalary zone (iii) Capsule
4. Foot is bulbous and cup shape structure. It is embedded in the thallus tissue.
5. Seta like structure is absent.
6. Capsule is long and has an outer wall, central columella and archesporium in between the wall and columella.
6. The capsule wall is 4-6 layered, the outer most layer being the epidermis. It has stomata.
7. The archesporial cells give rise to sporemother cell and pseudoelaters
8. The pseudoelaters are 2-3 celled elongated, branched or unbranched structures

Experiment-14

FUNARIA

Aim - To study the different structure of specimen of FUNARIA

Classification
Division- Bryophyta
Class -Bryopsida
Order -Funariales
Family- Funariaceae
Genus -Funaria (Moss)

External characters

1. The plant body is a gametophore (gametophyte) which is about 1-3 cm in height.
2. The gametophore is differentiated into (i) erect stem like structure called cauloid, (ii) leaves like structures called phyloids, and (iii) root like structures called rhizoids.
3. The main axis (cauloid) is erect, slender and branched.
4. Leaves are small, simple, sessile and arranged spirally
5. The leaves at the tip of axial branches are crowded to form a bud like structure.
6. Each leaf is thin flat, ovate green colored with a distinct mid rib.
7. Many rhizoides arise from the base of stem axis. These are branched and multicellular.
8. Mature rhizoids are brown in color and have oblique septa.

- **Internal structure**

T.S. of Axis or stem: A transverse section of axis or 'stem' shows circular outline of it.
1. The outer most layer is epidermis. It is made up of tangential elongated thick walled cells containing chloroplasts.

2. Next to epidermis is multilayered cortex which consists of parenchymatous cells
3. The central part is the central cylinder made up of vertically elongated small cells with slightly thick walls.
4. These cells lack protoplasm and perform the function of conduction.

- **V.S. of leaf**

1. The vertical section of the leaf shows that it is made up of single layer of cells having chloroplasts.
2. The mid rib part is 3-4 layered and the cells are slightly thick walled.

Reproductive structures:

- **Antheridial branch and Antheridia**

1. Antheridia are present in groups at the top of main axis that acts as male branch
2. The tip of the branch is somewhat convex receptacle and bears a group of closely packed antheridia
3. The antheridia are surrounded by leaves called perigonial leaves
4. Paraphyses are also present amongst the antheridia.
5. A paraphysis is unbranched, multicellular, green filament like structure with swollen terminal cell
6. A mature antheridium has a stalk with club shaped body
7. The body is covered by a single layer of cells containing chloroplasts
8. The operculum present at the top helps in the liberation of antherozoids produced inside.

- **Archegonial or female branch and Archegonia**

1. The female shoot arises from the base of male shoot.
2. Archegonia are present in groups at the top of the female shoot the female receptacle.
3. They are intermixed with green multicellular unbranched, filamentous structures called paraphyses.

4. The archegonia are surrounded by large leaves called perichactial leaves. Each archegonium has stalk, a massive venter and a long neck.
5. The neck encloses six and even more neck canal cells.
6. The venter has one venter canal cell and an egg or oosphere.

- **Sporogonium or Sporophyte of Moss**

1. The sporogonium is present at the tip of the female shoot.
2. It is differentiated into three parts foot Seta and capsule.
3. Foot is embedded into the tissue of female short.
4. The seta is much elongated and has capsule on its tip.
5. The mature capsule is yellow orange in color.

- **Internal structure of capsule**

The L.S. of a capsule shows the following structures. It has three main parts:

(i) Apophysis, (i1) Theca, and (ii) Operculum

1. Apophysis:

1. It is the basal part and is in continuation with seta.
2. Its central part has conducting strand.
3. The outermost layer is an epidermis with stomata.
4. In between the epidermis and central part, there are a few layers of cells containing chloroplasts.

2. Theca:

1. It is the fertile part of capsule.
2. It has a central columella.
3. It is connected with central strand of apophysis.
4. Around the columella there is a spore sac.
5. The outer wall of spore sac is three to four layered and the inner one is single layered.
6. Mass of spores is present in the spore sac.

7. Elaters are absent.
8 An air cavity is present outside the spore sac.

3. Operculum:
1. It is the top most cap like part of capsule.
2. Inside the operculum there are two rows of peristominal teeth, each row has sixteen teeth.
3. The outer peristome teeth are thick walled and hygroscopic
4. They help in the dispersal of spores from the spore sac of capsule.

Experiment-15

SELAGINELLA (SPIKE MOSS)

Aim- To study the different structure of specimen of SELAGINELLA

Classification
Division -Pteridophyta
Class -Lycopsida
Order -Selaginellales
Family -Selaginellaceae
Genus – Selaginella

- **External features**

1. The plant body has true roots, stem and leaven
2. The stem may be dorso-ventral prostate and may be sub erect to erect.
3. It is branched repeatedly and the branches are lateral.
4. The main axis and branches are equally vigorous in growth and it is difficult to differentiate between main axis and its branches.
5. Leaves are small, simple and ovate in shape. They are thin and delicate with an unbranched vein.
6. In Heterophyllum, the leaves are of two types and are arranged in four longitudinal rows on the stem.
7. The upper or dorsal leaves are smaller and lower ones are large.
8. Each leaf, at itasbase has a ligule, Bach ligule in differentiated into two parts glossopodium and body of ligule all rots present in an adult plant are adventitious Those are delicate and dichotomously branched in alternate planes.

Reproductive structures

- **Spike or strobilus**

1. Strobili are generally present at the shoot apices.
2. Sporangia are produced in the axils of sporophylls of strobili.
3. Sporophylls are arranged spirally on the axis of the strobilus. These are similar to ligulate vegetative leaves.
4. Two types of sporangia are borne in the axils of sporophylls.
5. The sporophylls having microspergia in their axils are called microsporophyte and those with megasporangia are called megasporophyte.
6. Salaginella is a heterosporous and two types of spores that is large megaspore and very small microspores
7. Microspores are present in microsporangia and megaspores in megaspores.
8. Both types of sporangia are stalked and possess two cell thick jacket (wall). The cells of outer layer are chlophyllous.
9. The tapetal layer present inside degenerate and is nutritive in nature.
10. The megasporangium is much larger in size, four lobed and has only four megaspores in it.
11. The microsporangium is smaller in size, red colored, and has many microspores.
12. In some species megasporangia are on one side and microsporangia on other side of the axis.
13. In other, megasporangia are at the base and microsporangia above them.
14. Megaspores are tetra hedral in shape. The megaspore wall is very heavy. It has an outer thick layer called exospore and inner thin endospore.
15. The micropores are spherico tetrahedral with two spore coats: a thick outer exine and thin inner intine.

Experiment-16

PTERIS

Aim - To study the different structure of specimen of PTERIS

Classification

Division -Pteridophyta
Class -Pteropsida
Order -Filicales
Family- Polypodiaceae
Genus – Pteris

- **External Structure**

1. The stem is underground, unbranched rhizome. It grows obliquely and is covered with scales.
2. A large number of adventitious roots arise from the lower part of rhizome
3. The leaves are large and pinnately compound also called as fronds.
4. Each pinna is sessile having a mid rib. Lateral veins arising from mid rib are forked. Thus the venation is furcate type.

Reproductive structures

- **Sporophylls, sori and sporangia**

1. The mature leaves bearing reproductive structures are called sporophyllus.
2. The sori are born on the lower margins of fertile pinnae or leaflets
3. The distinct sori with groups of sporangia are not present Thus there is a continuous sorus in which large number of sori are placed closely.
4. The sorus is protected by a covering called false indusium. The false indusium is framed by the down folding of leaf margin.
5. Each sporangium has a long stalk made up of three rows of cells. The biconvex capsule is the main body of sporangium.
6. The wall or jacket of the sporangium is single layered. There is a group of thick walled annular cells forming the annulus with jacket.
7. About 32-64 spores are enclosed inside the capsule wall. All these are similar in shape, size etc. and hence Pteris is a homosporous fern.