



Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with 'A+' Grade by NAAC. Recognised by UGC Under Section 12B
Coimbatore - 641 043, Tamil Nadu, India

Bachelor's Degree Examination –November 2019
III Semester

Class : II UG
Major : Zoology

Time: 3 hours
Max. Marks: 100

18BZOI04 - Diversification of Plants

Part A

10 x 1 = 10

Choose the correct answer

- Which of the following are formed in pyrenoids?
a. Oil b. Glucose c. Starch d. Slica
- The life-cycle that switches between haploid and diploid is called
a. The sexual –asexual exchange b. The transposition cycle
c. An alternation of generation d. Algal transformation
- Fungi usually store the reserve food material in the form of
a. Lipid b. Starch c. Glycogen d. Protein
- Riccia* gametophyte is
a. Dioecious b. Monoecious c. Heterothatic d. Either Monoecious or Dioecious
- Pteridophytes are also called
a. Phanerogames b. Vascular cryptogams c. Amphibians of plant kingdom d. Spermatophytes.
- Coralloid roots are formed in
a. *Cycas* b. *Pinus* c. *Dryopteris* d. *Lycopodium*
- Female flowers are known as
a. Staminate b. Pistillate c. Staminode d. Pistillode
- Vivipary is
a. Seed germination with subterranean cotyledons
b. Seed germination with epiterranean cotyledons
c. Seed germination inside the fruit the fruit while attached to the plant
d. Fruit development without pollination
- Common name of family Euphorbiaceae is
a. Pea family b. Sunflower family c. Castor family d. Banana family
- Synandrous condition is common in the family
a. Umbelliferae b. Rosaceae c. Malvaceae d. Cucurbitaceae

Part B

5 x 6 = 30

Answer ALL questions
Each answer should not exceed 400 words or two pages

- 11.a. Sketch the structure of *Chlamydomonas*.
(or)
11.b. List out the general features of algae.
- 12.a. Outline the classification of Bryophytes.
(or)
12.b. Discuss about the life cycle pattern of *Saccharomyces*.
- 13.a. Give a detailed account on the internal structure of *Lycopodium* stem.
(or)
13.b. Outline the general classification of Gymnosperms.
- 14.a. Compare the simple and aggregate fruits.
(or)
14.b. Discuss about vivipary.
- 15.a. Illustrate the floral diagram of Rutaceae .
(or)
15.b. List the economic importance of five plants of the family Euphorbiaceae.

Part C

5 x 12 = 60

Answer ALL questions
Each answer should not exceed 800 words or four pages

- 16.a. Describe the life cycle of *Oscillatoria*.
(or)
16.b. Explain the sexual reproduction in *Dictyota*.
- 17.a. Give an account on *Penicillium* and its importance.
(or)
17.b. Outline the general classification of fungi.
- 18.a. Describe the anatomical and reproductive features of *Cycas*.
(or)
18.b. Discuss about the sexual reproduction in *Adiantum*.
- 19.a. Explain the types of germination found in Bean and Paddy.
(or)
19.b. Describe the types of dry dehiscent and dry indehiscent fruits.
- 20.a. Write a detailed account on Asclepiadaceae.
(or)
20.b. Explain the salient features of Cucurbitaceae.

Scheme of Evaluation Set I

Part A

1. c. Starch
2. c. An alternation of generation
3. c. Glycogen
4. d. Either Monoecious or Dioecious
5. b. Vascular cryptogams
6. a. *Cycas*
7. b. Pistillate
8. c. Seed germination inside the fruit the fruit while attached to the plant
9. c. Castor family
10. d. Cucurbitaceae

Part B

11. a. Structure of *Chlamydomonas*:

Chlamydomonas is unicellular, motile green algae. The thallus is represented by a single cell. It is about 20 μ in length and 20 μ in diameter. The shape of thallus can be oval, spherical, oblong, ellipsoidal or pyriform. The pyriform or pear shaped thalli are common, they have narrow anterior end and a broad posterior end.

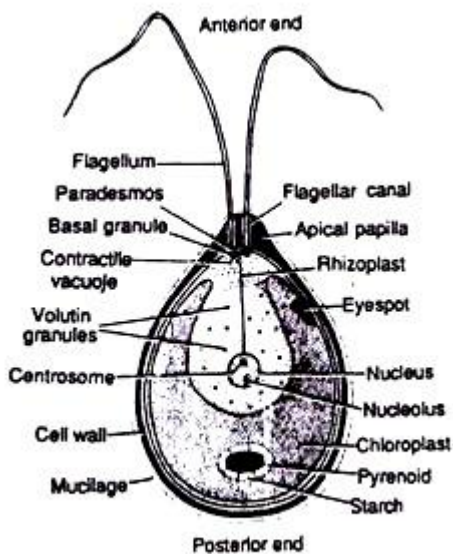


Fig. 1. Thallus of *Chlamydomonas*

11.b GENERAL CHARACTERISTICS OF ALGAE

1. Algae are the simplest multicellular plants. Some are unicellular eg. *Chlamydomonas*
2. Pant body: known as Thallus and they are avascular
3. Habitat: Algae are usually aquatic, either freshwater or marine and some are terrestrial.
4. Algae are eukaryotic thallophytes.
5. Algae are photoautotrophs.
6. Storage form of food: Starch
7. Reproduction: Algae reproduce either by vegetative, asexual or sexual method
8. Vegetative method: fragmentation, hormogonia
9. Asexual spore: zoospores, aplanospores, hypnospores, akinetes, azygospore
10. Sexual method: isogamous, anisogamous, and oogamous gametic fusion

12.a Classification of Bryophytes:

According to the latest recommendations of ICBN (International Code of Botanical Nomenclature), bryophytes have been divided into three classes.

1. Hepaticae (Hepaticopsida = Liverworts)
2. Anthocerotae (Anthocertopsida = Hornworts)
3. Musci (Bryopsida = Mosses)

Class 1. Hepaticae or Hepaticopsida:

1. Gametophytic plant body is either thalloid or foliose. If foliose, the lateral appendages (leaves) are without mid-rib. Always dorsiventral.
2. Rhizoids without septa.
3. Each cell in the thallus contains many chloroplasts; the chloroplasts are without pyrenoi.
4. Sex organs are embedded in the dorsal surface.
5. Sporophyte may be simple (e.g., Riccia) having only a capsule, or differentiated into root, seta and capsule (e.g., Marchantia, Pallia and Porella etc.)
6. Capsule lacks columella.
7. It has 4 orders:
 - (i) Calobryale
 - (ii) Jungermanniales
 - (iii) Sphero carpales
 - (iv) Marchantiales.

Class 2. Anthocerotae or Anthocerotopsid:

1. Gametophytic plant body is simple, thalloid; thallus dorsiventral without air chambers, shows no internal differentiation of tissues
2. Scales are absent in the thallus.
3. Each cell of the thallus possesses a single large chloroplast with a pyrenoid.
4. Sporophyte is cylindrical only partly dependent upon gametophyte for its nourishment. It is differentiated into bulbous foot and cylindrical capsule. Seta is meristematic.
5. Endothecium forms the sterile central column (i.e., columella) in the capsule (i.e. columella is present).
6. It has only one order-Anthocerotales.

Class 3. Musci or Bryopsida:

1. Gametophyte is differentiated into prostrate protonema and an erect gametophores
2. Gametophore is foliose, differentiated into an axis (=stem) and lateral appendages like leaves but without midrib.
3. Rhizoids multi-cellular with oblique septa.
4. Elaters are absent in the capsule of sporangium.
5. The sex organs are produced in separate branches immersed in a group of leaves
6. It has only three orders:
 - (i) Bryales,
 - (ii) Andriales and
 - (iii) Sphagnales.

12.b. Life Cycle Patterns of Saccharomyces:

Three patterns of life cycle are found in yeast:

Haplobiontic, diplobiontic and haplodiplobiontic:

1. Haplobiontic Type:

This type of life cycle is characterised by more elaborate haploid phase than the diploid phase, found in *Schizosaccharomyces octosporus*. The diploid phase is restricted only in the zygote. The vegetative cells are haploid and behave as gametangia.

Two such gametangia fuse together and form a diploid cell. The diploid cell behaves as an ascus whose nucleus divides first meiotically, then mitotically; results in the formation of eight ascospores. After maturation, the ascospores liberate by bursting the ascus wall. The ascospores then behave as vegetative cell and continue multiplication through budding.

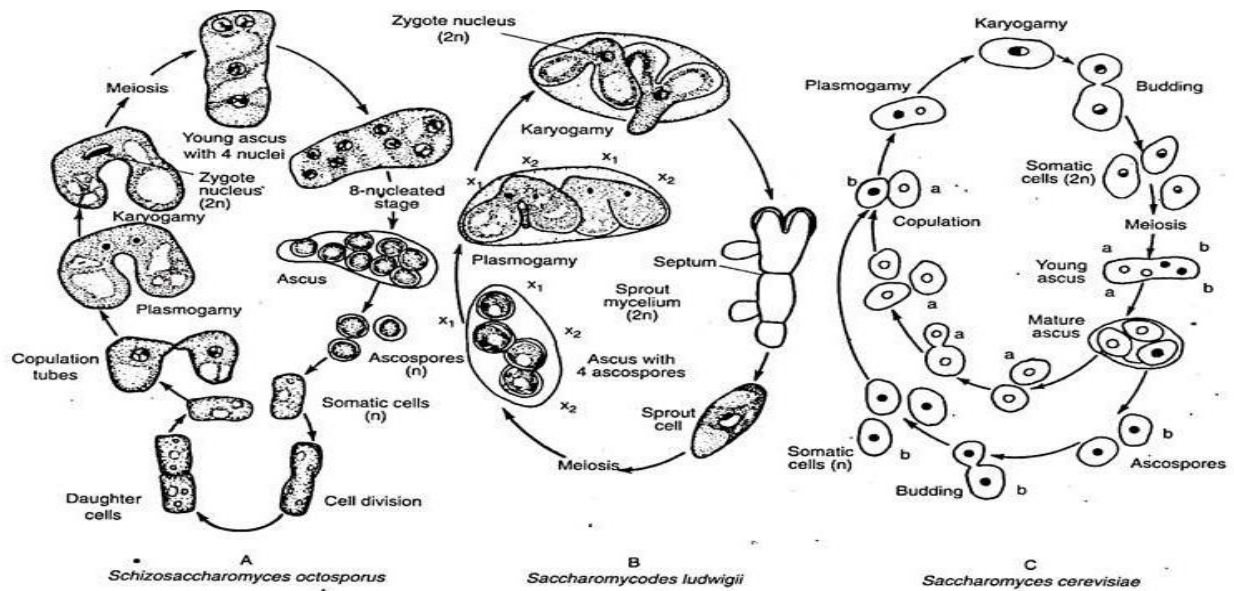


Fig. 4.41: Life cycles of three types of yeasts : A. Haplobiontic (*Schizosaccharomyces octosporus*). B. Diplobiontic (*Saccharomyces ludwigii*). C. Haplo-diplobiontic (*Saccharomyces cerevisiae*).

2. Diplobiontic Type:

This type of life cycle is characterised by more elaborate diploid phase than the haploid phase, found in *Saccharomyces ludwigii*. The haploid phase is restricted only in ascospore, with short duration. The ascospores behave as gametangia and, without liberating from ascus, they unite in pair. The paired gametangia after fusion produce diploid zygote.

The zygote then germinates by producing germ tube which comes out through the ascus wall. The germ tube becomes multicellular from which diploid sprouts develop by budding. After detachment from the mother, the diploid sprouts function as asci and produce four ascospores by reduction division.

3. Haplo-Diplobiontic Type:

This type of life cycle is represented by haploid and diploid phases, of more or less equal duration, found in *Saccharomyces cerevisiae*. The haploid cells of opposite mating type normally multiply by budding. Two such cells of opposite mating type behave as gametangia and undergo fusion. The fused gametangia develop a diploid zygote.

The diploid zygote like the haploid cells undergoes budding and forms many diploid cells. With the scarcity of food, the diploid cell behaves as an ascus and by reduction division it forms four haploid ascospores. After liberating from the mother wall, the ascospores undergo budding and form many haploid somatic cells.

13.a Anatomically, the stem is differentiated into epidermis, cortex and stele. The outermost layer is a uniseriate epidermis, the walls of which are thick and cuticularised. The cortex is highly variable in thickness and structure.

In some species it becomes homogeneous made up of parenchymatous cells (e.g., *L. phlegmaria*, *L. serratum*), and in others the cells of specific regions undergo sclerification. In some species, e.g., *L. clavatum*, the outer and inner portions of the cortex are composed of thick-walled sclerenchymatous cells whereas the middle portion consists of large, thin-walled parenchymatous cells.

In *L. cernuum*, on the other hand, the middle portion is sclerenchymatous in nature, while the inner and outer zones are parenchymatous. The endodermis is the inner-most layer of the cortex showing characteristic casparian bands. The endodermis is followed by pericycle which is 2-6 layered thick. The transition from pericycle to cortex in some species (e.g., *L. clavatum*) is abrupt because the walls of the cortical cells are thick.

The stele is protostelic in nature; however, the arrangement of the vascular tissues, i.e., xylem, phloem and associated parenchyma within the stele, varies greatly from species to species and even within the same species:

(a) Actinostele:

Xylem is star-shaped with protoxylem at the tips of the star-shaped projections and phloem completely surrounds the xylem e.g., *L. selago*, *L. serratum*, *L. phlegmaria*.

(b) Plectostele:

Xylem breaks up into separate plates. Phloem not only surrounds the xylem but also is distributed between the plates of the xylem e.g., *L. volubile*, *L. clavatum*, *L. camplanatum*.

(c) Mixed Protostele:

The xylem and phloem are intermixed and xylem form scattered masses e.g., *L. cernuum*, *L. laterale*.

(d) Stellate Form:

Stellate xylem cylinder is irregularly broken up into several strands e.g., *L. annotinum*; *L. lucidulum*.

With the exception of ferns, *Lycopodium* is the only lower vascular plant which exhibits such variations in the pattern of primary xylem and phloem in stems.

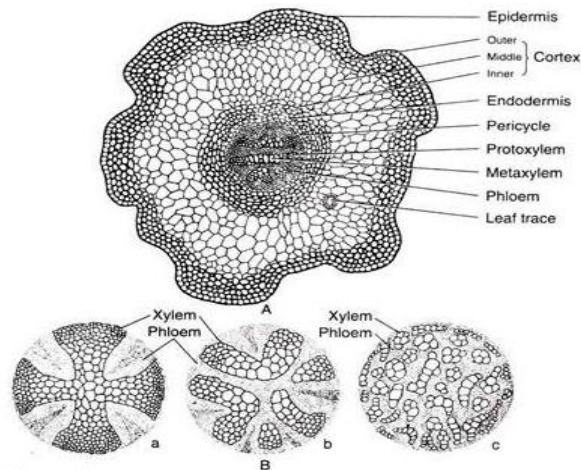


Fig. 7.25 : A. T.S. of *Lycopodium clavatum* stem. B. T.S. of stellate regions of stems of (a) *L. serratum*, (b) *L. annotinum* and (c) *L. cernuum*

13.b. Classification

The current formal classification of the living gymnosperms is the "Acrogymnospermae", which form a monophyletic group within the spermatophytes. The wider "Gymnospermae" group includes extinct gymnosperms and is thought to be paraphyletic. The fossil record of gymnosperms includes many distinctive taxa that do not belong to the four modern groups, including seed-bearing trees that have a somewhat fern-like vegetative morphology. When fossil gymnosperms such as these and the Bennettitales, glossopterids, and Caytonia are considered, it is clear that angiosperms are nested within a larger gymnospermae clade, although which group of gymnosperms is their closest relative remains unclear.

The extant gymnosperms include 12 main families and 83 genera which contain more than 1000 known species.

Subclass Cycadidae

Order Cycadales

Family Cycadaceae: *Cycas*

Family Zamiaceae: *Dioon*, *Bowenia*, *Macrozamia*, *Lepidozamia*, *Encephalartos*, *Stangeria*, *Ceratozamia*, *Microcycas*, *Zamia*.

Subclass Ginkgoidae

Order Ginkgoales

Family Ginkgoaceae: *Ginkgo*

Subclass Gnetidae

Order Welwitschiales

Family Welwitschiaceae: *Welwitschia*

Order Gnetales

Family Gnetaceae: *Gnetum*

Order Ephedrales

Family Ephedraceae: *Ephedra*

Subclass Pinidae

Order Pinales

Family Pinaceae: *Cedrus*, *Pinus*, *Cathaya*, *Picea*, *Pseudotsuga*, *Larix*, *Pseudolarix*, *Tsuga*, *Nothotsuga*, *Keteleeria*, *Abies*

Order Araucariales

Family Araucariaceae: *Araucaria*, *Wollemia*, *Agathis*

Family Podocarpaceae: *Phyllocladus*, *Lepidothamnus*, *Prumnopitys*, *Sundacarpus*, *Halocarpus*, *Parasitaxus*, *Lagarostrobos*, *Manoao*, *Saxegothaea*, *Microcachrys*, *Pherosphaera*, *Acropyle*, *Dacrycarpus*, *Dacrydium*, *Falcatifolium*, *Retrophyllum*, *Nageia*, *Afrocarpus*, *Podocarpus*

Order Cupressales

Family Sciadopityaceae: *Sciadopitys*

Family Cupressaceae: *Cunninghamia*, *Taiwania*, *Athrotaxis*, *Metasequoia*, *Sequoia*, *Sequoiadendron*, *Cryptomeria*, *Glyptostrobus*, *Taxodium*, *Papuacedrus*, *Austrocedrus*, *Libocedrus*, *Pilgerodendron*,

Widdringtonia, Diselma, Fitzroya, Callitris, Thujopsis, Thuja, Fokienia, Chamaecyparis, Callitropsis, Cupressus, Juniperus, Xanthocyparis, Calocedrus, Tetraclinis, Platycladus, Microbiota

Family Taxaceae: Austrotaxus, Pseudotaxus, Taxus, Cephalotaxus, Amentotaxus, Torreya.

14.a Simple fruit:

These fruits develop from the monocarpellary ovary or multicarpellary syncarpous ovary. Only one fruit is formed by the gynoecium. Simple fruits are of two types

Fleshy Fruits: In fleshy fruits, fruit wall is differentiated into epicarp, mesocarp and endocarp. These fruits develop from superior or inferior syncarpous gynoecium.

Dry Fruits: The pericarp of simple dry fruits is usually quite dry and hard. It is not differentiated into the three layers of epicarp, mesocarp and endocarp. In some dry fruits, this pericarp is broken down and the seeds are scattered or dispersed. These fruits are dehiscent fruits.

In some fruits, pericarp is further arranged into one or more seeded segments. Such fruits are schizocarpic fruits. In some fruits, pericarp is not observed to be dehiscent even after maturing/ripening. Such fruits are indehiscent Fruits.

Aggregate Fruits

These are the fruits that develop from the multicarpellary apocarpous ovary. It becomes a fruitlet because each carpel is separated from one another in the apocarpous ovary. These fruits make a bunch of fruitlets which is known as etaerio.

Etaerio of follicles: Each fruit of etaerio is a follicle. Eg. Calotropis, Catharanthus, Magnolia -e. In calotropis, the stigma is fused or joined in bicarpellary ovary and ovaries of ovule are separated. It means only two follicles are present in etaerio.

Etaerio of achenes: In this aggregate fruit, each fruit is an achene. Eg. Ranunculus, Strawberry, Rose, Lotus. In lotus, the thalamus becomes spongy and some achenes are embedded in it. In strawberry, the thalamus is fleshy and we can find small achenes on its surface.

Etaerio of berries: It is an aggregate of small berries. Eg. Polyalthia, Annona squamosa (Custard-apple). In etaerio of Annona, all the berries are arranged densely on the thalamus.

Etaerio of drupes: In this type of fruit, many small drupes develop from different carpels. Eg. Raspberry. In this type carpel of apocarpous ovary form drupe fruit.

14.b. In plants, vivipary occurs when seeds or embryos begin to develop before they detach from the parent. Plants such as some Iridaceae and Agavoideae grow cormlets in the axils of their inflorescences. These fall and in favourable circumstances they have effectively a whole season's start over fallen seeds. Similarly, some Crassulaceae, such as Bryophyllum, develop and drop plantlets from notches in their leaves, ready to grow. Such production of embryos from somatic tissues is asexual vegetative reproduction that amounts to cloning.

Description

In some species of mangroves, for instance, the seed germinates and grows from its own resources while still attached to its parent. Seedlings of some species are dispersed by currents if they drop into the water, but others develop a heavy, straight taproot that commonly penetrates mud when the seedling drops, thereby effectively planting the seedling. This contrasts with the examples of vegetative reproduction mentioned above, in that the mangrove plantlets are true seedlings produced by sexual reproduction.

In some trees, like jackfruit, some citrus, and avocado, the seeds can be found already germinated while the fruit goes overripe; strictly speaking this condition cannot be described as vivipary, but the moist and humid conditions provided by the fruit mimic a wet soil that encourages germination. However, the seeds also can germinate under moist soil.

Reproduction

Vivipary includes reproduction via embryos, such as shoots or bulbils, as opposed to germinating externally from a dropped, dormant seed, as is usual in plants.

15.a Characters of Rutaceae:

Leaves gland dotted, simple or compound; flower hermaphrodite, hypogynous, actinomorphic with a disc below the ovary; corolla polypetalous; stamens ten, obdiplostemonous; carpels 5 or many, ovary superior, multilocular; fruit capsule or berry; aromatic odour is present.

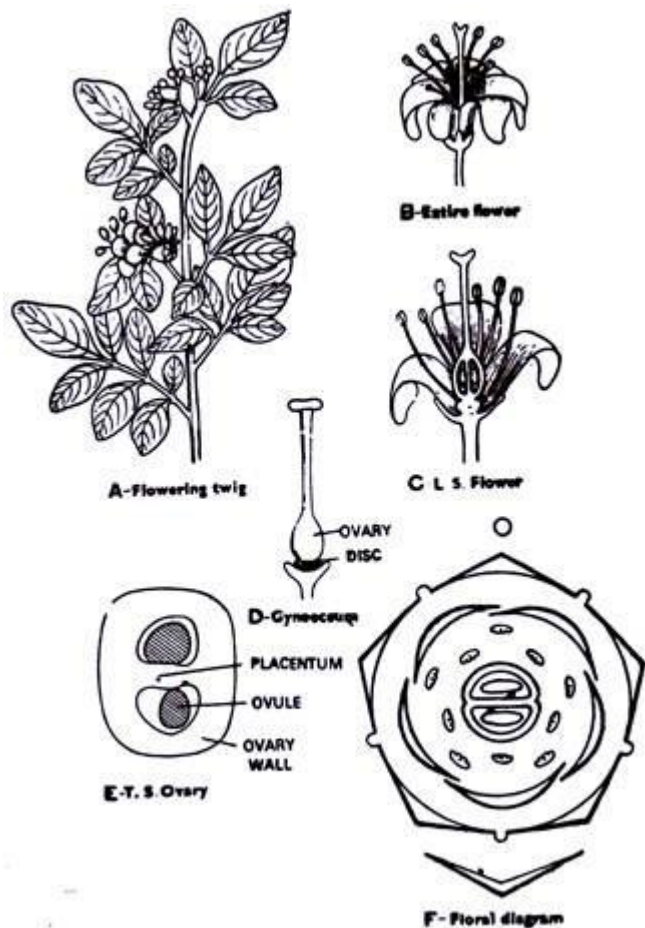


Fig. 45.4. *Murraya paniculata*.

Habit:

The plant are generally shrubs (*Murraya*, *Limonia*, *Zanthoxylum*), trees (*Aegle*, *Citrus*, *Feronia*), rarely herbs (*Ruta graveolens*) with strong fragrance *Paramignya* is a shrub but climbs by means of axillary thorns.

Root:

Tap root, branched often infected with fungus.

Stem:

Woody (*Citrus*, *Feronia*), erect, cylindrical, branched, solid often thorny (*Citrus*), gland dotted

Leaves:

Alternate (*Citrus*, *Murraya*) or opposite (*Evodia*), petiolate, petiole may be winged (*Citrus aurantium*), simple or compound-pinnate (*Murraya*), palmate (*Aegle* and *Citrus*) smooth gland dotted, glands with essential oils, exstipulate, margin entire or serrate, unicostate reticulate venation. In *Citrus* petiole is winged.

15.b 1. *Acalypha hispida*; An ornamental herb.

2. *Acalypha wilkesiana*- (Eng. -Garden Acalypha). Grown in the gardens as ornamental plant.
3. *Bischofia Javanica*; (Eng.-Bishop wood; Verna-Bhillar)- A tree. A red dye, obtained from the bark is used to stain rattan baskets. The bark is also used as a tan. The wood is extremely resistant to water effect and therefore, largely utilized in the construction of bridges and boats.
4. *Bridelia retusa*, (Verna-Ekdania, Khaja)-A tree, found in Rajasthan, Madhya Pradesh, the Western Peninsula and Bihar. The bark is used for tanning. The fruits are edible and the leaves are used as fodder.
5. *Cleistanthus collinus* (Verna-Garari)-A small tree, found in Tamil Nadu, Malabar, Bihar, Orissa and Madhya Pradesh. The bark, leaves and green fruits are used as tan.
6. *Croton aromaticus*; An aromatic shrub or small tree found in Andhra Pradesh produces a gum-resin, which is used in varnishes.
7. *Croton oblongifolius*; (Verna-Chuka) – The seeds yield an oil, which is used as a purgative and also as an insecticide.
8. *Croton tiglium*; (Verna-Jamalgota)-A shrub or small tree, native of South East Asia but cultivated in Assam, Bengal and South India. The seeds are the source of croton oil, which is used as a purgative.
9. *Baccaurea courtallensis*: Found in the Western Ghats. The fruits are edible.
10. *Baccaurea sapida*- (Verna-Lathua)-Found in Assam, Bengal and Andaman Islands The fruits are edible.

Part C

16.a Oscillatoria reproduces only by the vegetative method. Reproduction by the formation of zoospores or by gametes is unknown. Each filament does not grow indefinitely in length, but regularly breaks up into short fragments, called hormogones, each containing 2, 3 or several cells.

Before separation, the hormogones are delimited in the filament by the formation of double concave disks of gelatinous consistency between the hormogones. Each hormogone may develop into a new filament by division.

The most characteristic feature of *Oscillatoria* is the fact that the filaments, particularly the hormogones, are capable of swaying or oscillating movements to which the plant owes its name.

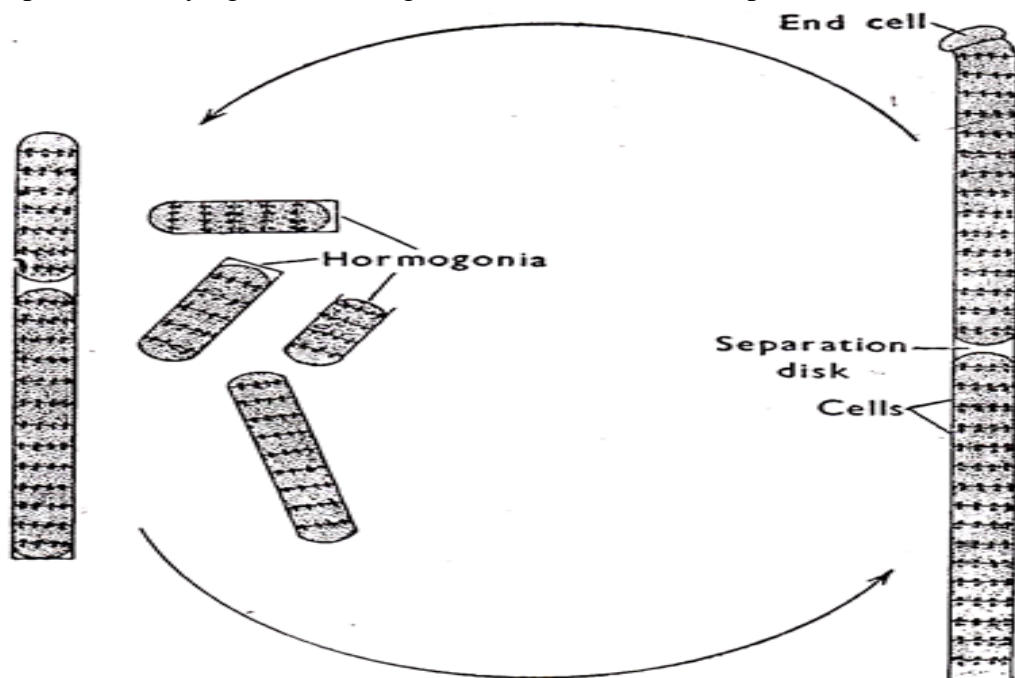


Fig. 106. Life cycle of *Oscillatoria*.

16.b Sexual reproduction is oogamous. The gametophytes are normally heterothallic. The sex organs are differentiated in groups of sori on the male plants, each sorus being enclosed by a well-defined involucre.

Each white and glistening antheridial sorus consists of about 100-200 antheridia, and each antheridium forms about 1500 unflagellate sperms. The oogonial sori are deep brown in colour and are also invested by individual rudimentary involucre.

Each oogonial sorus contains about 25-50 oogonia, each producing a single egg. On maturity, the apex of the oogonium becomes gelatinized and dehisces, thereby liberating the egg. There is a marked periodicity, usually correlated with the fortnightly sequence of spring and neap tides of the lunar month, in the development of sex organs and gametes.

When sperms and eggs are discharged in sea-water, the latter secrete a substance which attracts the sperms and fertilization is effected very soon. The fertilized egg or oospore readily germinates into a diploid asexual plant. In rare cases, an unfertilized egg secretes a wall around it and germinates parthenogenetically.

It is to be noted that *Dictyota* possesses an isomorphic alternation of generations.

17.a Penicillium Ascomycetes fungi are of major importance in the natural environment as well as food and drug production.

Some members of the genus produce penicillin, a molecule that is used as an antibiotic, which kills or stops the growth of certain kinds of bacteria. Other species are used in cheesemaking. According to the Dictionary of the Fungi, the widespread genus contains over 300 species.

Economic value

Several species of the genus *Penicillium* play a central role in the production of cheese and of various meat products. To be specific, *Penicillium* molds are found in Blue cheese. *Penicillium camemberti* and *Penicillium roqueforti* are the molds on Camembert, Brie, Roquefort, and many other cheeses. *Penicillium nalgioense* is used in soft mold-ripened cheeses, such as Nalžovy cheese, and to improve the taste of sausages and hams, and to prevent colonization by other molds and bacteria.

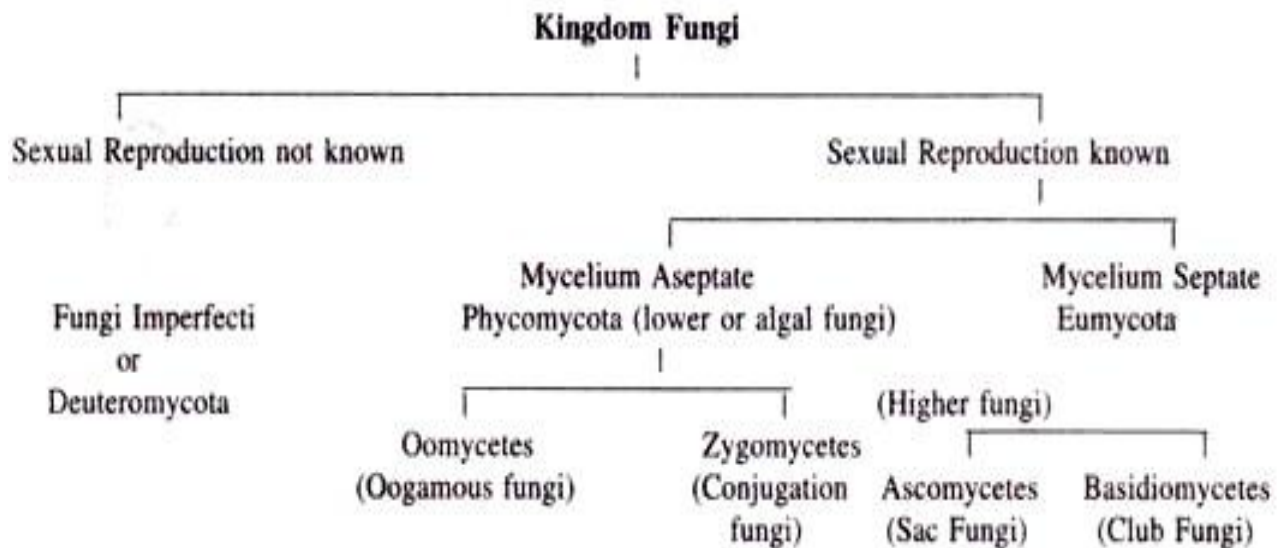
In addition to their importance in the food industry, species of *Penicillium* and *Aspergillus* serve in the production of a number of biotechnologically produced enzymes and other macromolecules, such as gluconic, citric, and tartaric acids, as well as several pectinases, lipase, amylases, cellulases, and proteases. Some *Penicillium* species have shown potential for use in bioremediation, more specifically mycoremediation,

because of their ability to break down a variety of xenobiotic compounds. Penicillium also prevents bacteria from affecting the body.

The genus includes a wide variety of species molds that are the source molds of major antibiotics. Penicillin, a drug produced by *P. chrysogenum*, was accidentally discovered by Alexander Fleming in 1929, and found to inhibit the growth of Gram-positive bacteria. Its potential as an antibiotic was realized in the late 1930s, and Howard Florey and Ernst Chain purified and concentrated the compound. The drug's success in saving soldiers in World War II who had been dying from infected wounds resulted in Fleming, Florey and Chain jointly winning the Nobel Prize in Medicine in 1945.

Griseofulvin is an antifungal drug and a potential chemotherapeutic agent that was discovered in *P. griseofulvum*. Additional species that produce compounds capable of inhibiting the growth of tumor cells in vitro include: *P. pinophilum*, *P. canescens*, and *P. glabrum*.

17.b Classification of Fungi



18.a Anatomy of Vegetative Parts of *Cycas*:

(i) Normal Root (Young):

It is circular in outline and resembles structurally with dicotyledons (Fig. 8.16). Outermost layer is epiblema or exodermis, which surrounds the large parenchymatous cortex. Epiblema consists of tangentially elongated cells. From some of its cells arise root hairs.

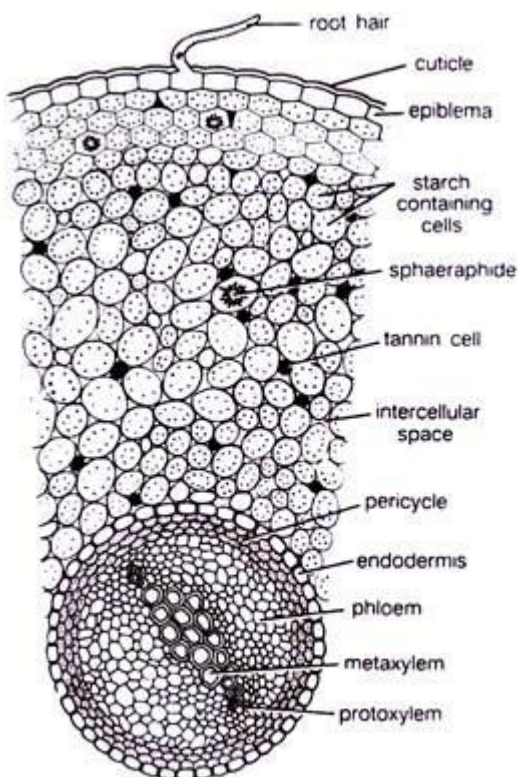


Fig. 8.16. *Cycas revoluta*. T.S. normal root (Young).

In the wide zone of parenchymatous cortex there are present many intercellular spaces. Cells of the cortex remain filled with starch. Some tannin-filled cells, mucilage cells and sometimes sphaeraphides are also

present in the cortex. The cortex is delimited by a single-layered endodermis. Casparian steps are present in the barrel-shaped cells of the endodermis.

Endodermis is followed by multilayered pericycle. Xylem and phloem bundles in the roots are radially arranged, i.e. present on different radii. The roots are usually diarch but sometimes the number of protoxylem strands range between 3 to 8.

The protoxylem consists of spiral tracheids while the metaxylem consists of scalariform tracheids. Vessels are absent. Phloem is present alternately with xylem groups and consists of sieve tubes and phloem parenchyma. Pith is generally absent.

(iii) Coralloid Root:

Anatomically, the coralloid roots (Fig. 8.18) resemble normal roots except some under mentioned differences:

1. The secondary vascular tissue in coralloid roots is either totally absent or poorly-developed.
2. The cortex is wider in comparison with the normal root.
3. Presence of a greenish algal-zone in the middle of the cortex. But according to Chaudhary and Akhtar (1931) the algal-zone is not of universal occurrence in the coralloid roots of *Cycas*. It may be absent in such coralloid roots which go very deep in the soil. According to these workers only those coralloid roots are negatively geotropic which are infected by algal members.

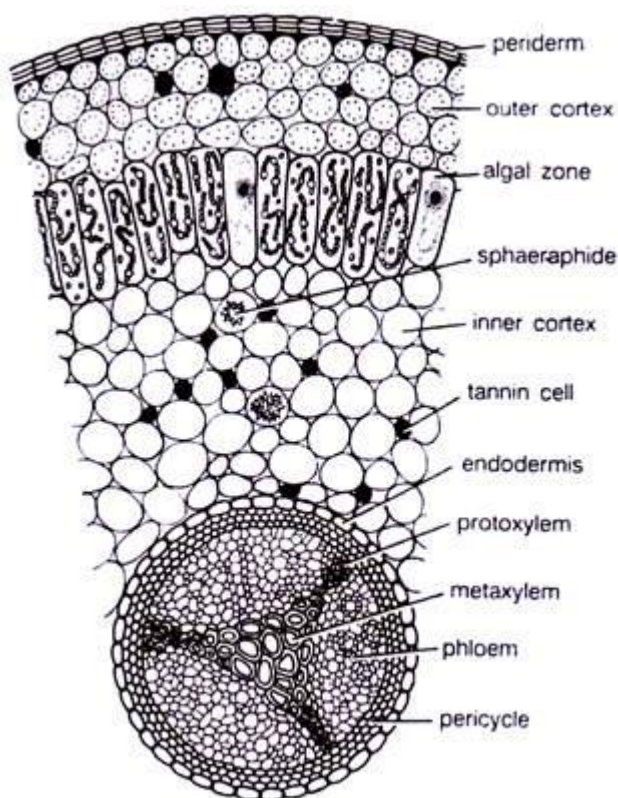


Fig. 8.18. *Cycas revoluta* T S. coralloid root.

Algal-zone consists of radially elongated, large, thin-walled cells having large intercellular spaces occupied by algae. Life (1901) opined that these spaces are formed because of the retardation of growth of such cells which are already infected by fungi and bacteria.

Such infected cells cannot keep pace with the neighbouring cells, and a tension is produced which results in the formation of air spaces by breaking of certain cells. These spaces are further widened by the algal infection. But according to Chaudhary and Akhtar (1931) the alga is mainly responsible for the formation of these large intercellular spaces.

18. b. Gametophyte of *Adiantum*:

Gametophyte of *Adiantum* has heart like shape. It has a notch, where growing point reside. Gametophyte of *Adiantum* is many cell thick from centre and only one cell thick at margins. Rhizoids are produce from underside of Gametophyte for anchorage and absorption of water and nutrients. Gametophyte contains chloroplast, so carried out photosynthesis. Gametophyte is independent. Two kinds of organs antheridia and archegonia are produce on gametophyte.

Archegonia is flask shaped structure with two portions i.e. ventre and neck. Ventre contain egg while neck contains neck canal cells. Antheridia are globose structures, in which many antherozoids are produced. Antherozoids when get mature has two flagella for movement in water.

Antherozoids after releasing from antheridia travel through water chemotactically towards archegonia. Antherozoids fertilize the egg inside archegonia. Resultant zygote develops into embryo. Embryo starts divisions to form sporophyte. Sporophyte remains dependent on gametophyte at start but soon it becomes independent.

19.a Hypogeal Germination:

In this kind of germination, the cotyledons do not come out of the soil surface. In such seeds the epicotyl (i.e., part of embryonic axis between plumule and cotyledons) elongates pushing the plumule out of the soil. All monocotyledons show hypogeal germination. Among dicotyledons, gram, pea, groundnut are some common examples of hypogeal germination.

In monocotyledons (e.g., wheat, maize, rice, coconut) radicle and plumule come out by piercing the coleorrhiza and coleoptile respectively. The plumule grows upward and the first leaf comes out of the coleoptile. The radicle forms the primary root which is soon replaced by many fibrous roots.

Germination of Pea Seed:

The seed imbibes water and swells. The radicle comes out and first penetrates the soil and forms root system by giving out secondary branches. It is the epicotyls which grow first. It arches out and carries the plumule above ground. The plumule soon forms the aerial shoot. The cotyledons remain under the soil throughout.

19.b DRY DEHISCENT FRUITS

Aquilegia, *Columbine*, an example of a follicle

Follicle

A Follicle is a dry dehiscent fruit which splits on one side only. It may contain one or many seeds.

This is the fruit of a *Columbine* (*Aquilegia*). Other fruits of this type are: *Delphinium* (*Delphinium*), *Larkspur* (*Consolida*), *Love in a Mist* (*Nigella damascena*), *Milkweed* (*Asclepias*), *Peony* (*Paeonia*).

Lathyrus odoratus, *Sweet Pea*, an example of a legume Legume

A Legume is a dry dehiscent pod that splits on two sides.

This is the fruit of a *Sweet Pea* (*Lathyrus odoratus*). Other fruits of this type are all in members of the Pea Family (*Leguminosae/Fabaceae*): *Acacia* (*Acacia*), *Alfalfa* (*Medicago sativa*), *Liquorice* (*Glycyrrhiza glabra*), *Flamboyant* (*Delonix regia*), *Pea* (*Pisum sativa*), *Peanut* (*Arachis hypogaea*), *Redbud* (*Cercis occidentalis*), *Runner Bean* (*Phaseolus coccineus*), *Wisteria* (*Wisteria*).

Laburnum, *Golden Chain Tree*, an example of a lomentum

Lomentum

A Lomentum is a dry dehiscent fruit, a legume constricted between the seeds.

This is the fruit of a *Golden Chain Tree* (*Laburnum anagyroides*). Other fruits of this type are: *Sophora* (*Sophora*), *Tick Trefoil* (*Desmodium*).

Cheiranthus, Wallflower, an example of a silique

Silique

A Silique is a dry dehiscent fruit. It is long and thin, splits down the two long sides, and has a papery membrane (the septum) between the two halves.

This is the fruit of a Wallflower (*Erysimum cheiri*). Other fruits of this type are all in members of the Cabbage Family (*Brassicaceae*): Aubrieta (*Aubrieta x cultorum*), Cabbage (*Brassica oleracea*), Honesty (*Lunaria annua*), Radish (*Raphanus sativus*).

A silique which is less than twice as long as broad is called a Silicula.

Capsule

A Capsule is the most common fruit type. A Capsule is a dry fruit which splits open to release the seeds.

These plants all have fruit capsules: Cotton (*Gossypium*), Eucalyptus (*Eucalyptus*), Horse Chestnut (*Aesculus hippocastanum*), Jimson Weed (*Datura*), Mahogany (*Azadirachta indica*), Witch Hazel (*Hamamelis*).

There are several types of Capsule, depending on how the fruit splits.

Silene, Campion, an example of a valvate capsule

Valvate Capsule

A Valvate Capsule is a dry dehiscent fruit in which the tips of the seed capsule split.

This is the fruit of a Campion (*Silene*). Other fruits of this type are: Jacob's Ladder (*Polemonium*), Pink (*Dianthus*), Primrose (*Primula*).

Papaver, Poppy, an example of a porose capsule Porose Capsule

A Porose Capsule is a dry dehiscent fruit, opening with pores or holes around the top.

This is the fruit of a Poppy (*Papaver*). Other fruits of this type are: Blue Poppy (*Meconopsis*), Prickly Poppy (*Argemone*).

iris foetidissima, Stinking Gladwyn, an example of a loculicidal capsule

A Loculicidal Capsule is a dry dehiscent fruit, splitting along the locule (midrib of each ovary).

This is the fruit of Stinking Gladwyn (*Iris foetidissima*). Other fruits of this type: Evening Primrose (*Oenothera*), Valotta (*Cyrtanthus elatus*), and members of the Violet and Lily Families.

Circumscissile Capsule

A Circumscissile Capsule is a dry dehiscent fruit, opening by splitting through the centre of the fruit, so that the top of the capsule lifts off like a lid. An example of this type of fruit is Pimpernel (*Anagallis*)

A Septicidal Capsule splits along the septa (joints of the ovary) as in the Foxglove (*Digitalis*).

DRY INDEHISCENT FRUITS

Helianthus annuus, Sunflower, an example of an achene Achene

An Achene is a single-seeded dry indehiscent fruit in which the seedcoat is not part of the fruit coat.

This is the fruit of a Sunflower (*Helianthus annuus*). Other fruits of this type are: Buttercup (*Ranunculus*), Clematis (*Clematis*), Coreopsis (*Coreopsis*), Dahlia (*Dahlia*), English Marigold (*Calendula*), Zinnia (*Zinnia*).

Taraxacum, Dandelion, an example of a cypsela

Cypsela

A Cypsela is a single-seeded dry indehiscent fruit that develops from a one part inferior ovary (on the stalk side of the flower). They are sometimes included with Achenes.

This is the fruit of a Dandelion (*Taraxacum officinale*). Other fruits of this type are found in the same plant family, the Daisy Family (*Asteraceae*).

Castanea, Chestnut, an example of a nut

Nut

A Nut is a large single hardened achene.

This is a Chestnut (*Castanea sativa*). Other fruits of this type are: Acorn (*Quercus*), Hazel (*Corylus avellana*), Hickory (*Carya*).

Salvia, Sage, an example of a nutlet

Nutlet

This is not a classification that seems to be recognised everywhere, but the Mint Family (*Lamiaceae*) is a very large plant family, and has a particular type of seed which is not quite any of the normal ones, so I thought it should be included somewhere.

The fruits of this family are single-seeded achene-like nutlets, which are held at the bottom of the calyx.

This is the fruit of a Salvia (*Salvia*). All members of the Mint Family (*Lamiaceae*) have this type of fruit.

Zea mays, Sweetcorn, an example of a caryopsis

Caryopsis

A Caryopsis is a simple dry indehiscent fruit, like an achene, but with the seedcoat fused with the fruit coat.

This is the fruit of Sweetcorn (*Zea*). Other fruits of this type are all members of the Grass Family (*Poaceae*): Barley (*Hordeum*), Oats (*Avena*), Rice (*Oryza*), Rye (*Secale*), Wheat (*Triticum*).

Acer, Maple, an example of a samara

Samara

A Samara is an independent dry indehiscent fruit which has part of the fruit wall extended to form a wing (i.e. not a winged seed inside another type of seed pod).

This is the fruit of a Maple (*Acer*). This is a Schizocarpic Samara, because the fruit splits into its separate Samaras. Other fruits of this type are: Ash (*Fraxinus*) - also Schizocarpic, Elm (*Ulmus*).

20.a Characters of Asclepiadaceae:

Plants herbs, shrubs, mostly twiners and rarely trees; leaves opposite, simple, entire margin rarely alternate; inflorescence cymose or racemose; flowers hermaphrodite, pentamerous; calyx of 5 sepals, imbricate; petals 5, gamopetalous, corona arising as outgrowth of petals or stamens; stamens 5, fused with stigmatic disc forming gynostegium; pollens forming pollinia; carpels bicarpellary, syncarpous, ovaries and style free, only stigma fused to form disc, marginal placentation, fruit follicles.

Distribution of Asclepiadaceae:

The family Asclepiadaceae is commonly known as 'Milk weed family'. It includes 320 genera and 2,000 species of world wide distribution, but mostly confined to tropics and sub-tropics. In India 332 species belonging to 35 genera are found.

Economic Importance of Asclepiadaceae:

1. Food:

Gymnema lactiferum yields latex which is used as food in Ceylon.

2. Fibres:

Some plants like *Daemia extensa*, *Calotropis procera*, *C. gigantea*, *Marsdenia* and *Leptadenia* etc. yield silky fibres which are used for making ropes, mat, stuffing pillows etc.

3. Medicinal:

The source of medicine in the family is latex from which alkaloids are extracted. The roots of *Oxystelma esculentum* are specific for jaundice. The roots of *Pentatropis* are used in gonorrhoea. *Hemidesmus indicus* is used in leucorrhoea, rheumatism and in snake bites. *Daemia extensa* is used in cough; asthma and diarrhoea.

4. Rubber:

Cryptostegia grandiflora is a natural source of rubber in India.

5. Poison:

Some species of *Asclepias* are important as live-stock poison. The sap of *Matelea* has been used as an arrow poison.

6. Ornamental:

Asclepias, *Cryptostegia*, *Hoya*, *Huernia*, *Ceropegia*, *Periploca* etc. are cultivated for ornamental purposes.

Primitive characters:

1. Plants mostly shrubs rarely herbs.

2. Leaves simple.

3. Flowers hermaphrodite, hypogynous, actinomorphic.
4. Calyx polysepalous in some species.
5. Gynoecium partly apocarpous.
6. Marginal placentation.
7. Fruits usually etaerio of follicles.
8. Seeds endospermic.

Advanced characters:

1. Leaves exstipulate and usually opposite.
2. Corolla gamopetalous.
3. Corona present.
4. Stamens epipetalous and filaments fused to form a tube around the gynoecium.
5. Anthers coherent with stigmatic disc to form gynostegium.
6. Pollen grains are grouped to form pollinia.
7. Carpels two.
8. Seeds covered with hygroscopic hairs.

20.b General Information:

Common name: Cucumber/Pumpkin family

Number of genera: This family includes 110 genera and about 640 species

Propagation type: Fruit or seed

Distribution: The species of this family are distributed throughout the world. In India this family is represented by about 37 genera and 97 species distributed throughout the country. The chief centre of distribution of these members is Eastern Himalayas.

Vegetative characters

Habitat: Members of this family are mostly mesophytes and some xerophytes are also known to exist in this family.

Habit: The plants are mostly succulent, trailing, decumbent annual or perennial herbs. These plants climb by means of laterally spirally coiled, simple or branched tendrils.

Root system: These plants have woody tap root system.

Stem: The stem is usually herbaceous, branched, hairy and five angular with two alternate rings of five vascular bundles each.

Leaf: The leaves are simple, alternate, exstipulate, long petioled, and frequently cordate. The leaves are often palmately or pinnately lobed. The petioles are often hollow and stipules are absent.

Floral characters

Inflorescence: Inflorescence is cymose type. It may be axillary and bears a solitary female flower. The male flowers may be solitary or in the form of racemes, corymbs or panicles. The plants are monoecious or sometimes dioecious as in *Coccinia cordifolia* and *Mimordica dioca*.

Flower: The flowers are yellow or white, unisexual (rarely bisexual), actinomorphic, pentamerous and epigynous (rarely perigynous as in *Actinostemma*). The thalamus forms a cup above the ovary.

Calyx: The calyx is of 5 sepals forming a tube, which is wholly adnate to the ovary in female flowers. The aestivation is imbricate or valvate.

Corolla: The corolla consists of 5 petals which are united to form a tube or nearly free (*Trichosanthes*). The corolla is campanulate (*Coccinia*, *Cucurbita*), rotate or salver form. The lobes are imbricate or induplicate valvate. Petals are white or yellow in color. The petals are free in *Luffa*, *Trichosanthes*.

Economic Importance of Cucurbitaceae

The fruits of some species of *Benincasa* and *Lagenaria* with hard pericarp are used for making musical instruments and decorative items.

Dried fibrous tissue of fruit rind of these plants is used as loofah sponge.

Some of the members like *Ecballium*, *Cyclanthera*, *Coccinia* and *Sechium* are grown as ornamental plants.

The members of this family provide large number of fruits which could be eaten raw or cooked. They are nutritious and tasty.
