SREE SIDDAGANGA COLLEGE
OF ARTS, SCIENCE and COMMERCE
B.H. ROAD, TUMKUR

(AFFILIATED TO TUMKUR UNIVERSITY)

BOTANY PAPER-IV

II BSC IV SEMESTER

Plant Anatomy,Morphology of Angiosperms and Plant propagation

SOLVED QUESTION BANK

IV-Semester Paper-IVPlant Anatomy, Morphology of Angiosperms, Plant Propagations Solved questions

Unit-1 :	Meristamatic tissues – structure, classification based on origin, position and function. Theories of Apical meristems -Histogen theory, Tunica-Corpus theory. Permanent tissues-Simple and Complex and Secretory tissues.	14 Hrs.
Unit-2:	Structure of Dicot & Monocot Root, Stem and Leaf.	8 Hrs.
Unit-3:	Secondary growth in Dicot stem, Anamalous secondary growth in Dracena and Boerhaavia. Wood anatomy-A brief account, types of wood (Spring, Autumn Duramen, Alburnum, Porus wood and Non Porous wood).	10 Hrs.
Unit-4:	Morphology of Angiosperms-Root System and its modifications, Shoot system and Stem modifications, Leaf and its modifications, Inflorescence, Floral morphology and Fruits.	20 Hrs.
Unit-5 :	Plant Propagation-Methods of Vegetative propagation- Natural-Rhizome, Tuber, Corm, Bulb, Sucker, Stolon and offset, Artificial-Stem Cutting, Grafting and Layering.	8 Hrs.

2 MARKS QUESTIONS

1. What is meristematic tissue?Classify them basaed on Origin.

Meristematic tissue is a group of cells that has power of continuous division.Cells are immature and young

Meristematic tissue is commonly called as meristems.

Types of meristematic tissue on the basis of origin:

- Promeristem (primodial meristem)
- Primary meristem
- Secondary meristem

2. Mention types of Parechyma.

It is the basic packaging tissue that fills the spaces between other tissues and is found most abundantly in plants.They have unspecialised/ undifferentiated cells with thin cell walls made of cellulose. they have large intercellular spaces as the cells are loosely packed. Cells have dense cytoplasm and nucleus and large vacuole. This tissue provide support to plants and parenchyma of stem and roots stores nutrients and water and is called as STORAGE PARENCHYMA.

3. What are sclerids? Mention their types.

Sclereids are a reduced form of sclerenchyma cells with highly thickened, lignified cellular walls that form small bundles of durable layers of tissue in most plants. The presence of numerous sclereids form the cores of apples and produce the gritty texture of guavas.

4. What is Sclerenchyma tissue? Mention its function.

The cells are long, narrow thick walled due to deposition of lignin. Such cell walls are called as lignified walls and have pits. These cells lack intercellular spaces due to deposition of lignin. The cells do not have a nucleus and cytoplasm and are dead. These cells provide rigidity and strength to plants and makes it hard and can bear stress and strains.

5. What are Complex tissue? Give example.

This type of tissue is made up of more than one type of cells that have a common origin and work together to do a common function. Its function is to transport water,minerals and food to all parts of the plant. Complex permanent tissue is of two types, 1. **XYLEM 2. PHLOEM**

6. Mention elements of Xylem.

The main components of xylem are:tracheae or vessels, fibres, called xylem fibres or wood fibres, and parenchyma, referred to as xylem or wood parenchyma.

7. List Components of Phloem.

Elements of phloem are sieve tubes, companion cells, phloem parenchyma and phloem fibres. Seive tubes are tube like structures, the end walls are called sieve plates and are perforated due to presence of pores. Companion cells help in efficient functioning of sieve tubes.

8. Differentiate between Spring wood and Autumn wood.

Spring wood: - spring wood is formed from 'Vascular cambium in DIcot stem during secondary growth in spring season of the year. It is composed of Xylem vessels with broader cavities.

Autumn wood: - Autumn wood is formed from Vascular cambium Vascular cambium in Dicot stem during secondary growth in Autumn season of the year. It is composed of Xylem vessels with narrow cavity.

One such Spring wood ring and Autumn wood ring will be produced once in a year. These two types of wood together constitute an **'Annual ring'.**

9. **What is an Annual ring?**

   Annular ring:-Concentric ring of secondary wood in Dicot stem formed during secondary growth is called "Annular ring" or 'Growth rings'. Each annular ring is composed of 'spring wood '(Early wood) and 'Autumn wood' (Late wood).By counting the number of annular rings in the secondary wood of stem, approximate age of the tree can be determined. Wood science that deals with the determination of approximate age of the tree by counting the number of Annual rings is called '**Dendrochronology'.**

10. **Differentiate between Heart wood and Sap wood.**

    Heart wood and Sap wood:- Secondary Xylem of Dicot Stem is called 'Wood'. In Dicot stem wood is differentiated into Heart wood and Sap wood**.**

    Heart wood (Duramen):- In secondary Dicot stem, the central dark colored, hard wood is called **'Heart wood' or 'Duramen'.** It is composed of dead elements of Xylem. It gives mechanical support to the plant. Xylem elements are filled with Tannins, Gums, and Resins etc. Hence it is dark coloured and hard. Heart wood vessels are clogged with Tyloses, hence it cannot perform conduction.

    Sap wood (Alburman): - In secondary Dicot stem, the peripheral zone of wood is soft, light colored called '**Sap wood' or 'Alburman'.** It is composed of both living and dead elements. It has less Tyloses (Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses). It gives mechanical support and also takes part in conduction.

11. **What are Tyloses? Mention its significance.**

    Tyloses are Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses. It is formed due to enlargement of pit membrane and protrusion of Xylem parenchyma cell into the cavity of Xylem vessel.

    Tyloses by blocking the cavity of Vessel obstruct the conduction of water and minerals through vessels. Sometimes it is advantageous as infectious agents like bacteria; fungi which move along with the fluids can not enter vessel and helps in longevity and durability of wood.

12. **What are Tylosoids? where are they found.**

    Epithellial cells that surround the Resin ducts enlarge and protrude into the cavity in the from of balloon. These are called 'Tylosoids. (False tyloses). They never protrude into the Vessel through pit. Ex: In Gymnosperms.

13. **Differentiate between porous wood and non porous wood .**

The secondary growth product of an Angiosperm in Dicot and Gymnosperm is called Wood. There are 2 types of wood. Namely 1) Porous wood and 2) Non- porous wood.

Porous wood: - In this type **t**he wood contains Xylem vessels which appear as circular pores in transverse section, it is called 'Porous wood'. Ex: Secondary wood of Dicot stem. The porous wood is divided into 2 types. they are:-

Ring porous wood: -In Ring porous wood, pores are arranged in concentric rings of spring wood and autumn wood. There is clear distinction between rings. Ex: Ulmus, Betula wood.

Diffuse porous wood: -In Diffuse porous wood, pores are scattered in the ring. As there is gradual increase in size of the pore from Autumn wood to Spring wood, there is no clear demarcation between Spring wood and Autumn wood. Ex: Juglans.

Non- porous wood: - In this type the wood contains only Tracheids. There will be no circular pores in transverse section. Ex: Gymnosperm wood. Presence or absence of pores, arrangement of pores helps in identification of type of wood.

SECRETORY TISSUES

14. What are secretory tissue. mention its types.

The non utilizable by product of metabolism which is isolated from the living protoplast or removed from the plant body are "Secretions**".** Ex: Gums, Resins, Latex, Essential oils, Nectar. The tissues concerned with non utilisable by product of metabolism such as Gums, Resins, and Latex are called **"Secretary Tissues".** These are widely distributed in the plant body.

Secretary tissues are grouped into 2 types. They are

A) Glandular tissue B) Laticiferous tissue.

15. What are Laticiferous tissues? Mention its types.

Thin walled, greatly elongated, much branched ducts containing a milky or yellowish or watery fluid called "Latex" is called "Laticeferous tissue". These are irregularly distributed in the mass of parenchymatous cells. They contain numerous nuclei. They are of 2 types. Namely a) Latex cell or Non – articulate Latex ducts.b) Latex Vessels or Articulate latex.

16. What is Dorsiventral leaf? Give example.

In Dicot plants Leaves grows Horizontal (at right angles) to stem, hence upper surface gets more light than lower surface. Due to this unequal illumination the leaves shoes differences between upper and lower (Dorasal and Ventral) surface both externally and internally. Hence it is called 'Dorsiventral leaf.'

17. What is meant by Iso bi lateral leaf? Give an example.

Isobilateral leaf. Ex: Monocot leaf. In Monocot plants grows parallel to stem, so they are equally illuminated on both the surfaces. Hence they do not show differences between upper and lower surfaces. Hence they are called "Iso bi lateral Leaves".

WOOD ANATOMY

18. What is meant by Ray and Fusiform initials.

Wood is the product of secondary growth in Dicots which takes place by, Vascular cambium in stelar region and Cork cambium in Cortex region.
Vascular cambium consists of 2 kinds of initials namely Fusiform and Ray initials.
Fusiform initials: - These are elongated, spindle shaped with wedge ends. It gives rise to vertical system of wood that is composed of Vessels, Fibers and Parenchyma.
Ray initials: - These are Isodiamatric cells. It gives rise to horizontal system wood that is composing of elongated Parenchyma cells.

19. Define cork cambium and its products.

Cork cambium (Phellogen):- In cortex parenchyma cells below epidermis become meristematic to form '**cork cambium or Phellogen'**. It divides tangentially to form '**Cork 'or 'Phellem' outside and' secondary cortex' or 'Phelloderm 'towards** inside.

5 MARKS QUESTIONS

1. Explain Meristematic tissue.

Meristematic tissue is a group of cells that has power of continuous division.Cells are immature and young Meristematic tissue is commonly called as meristems. each cell is oval, rounded, polygonal or rectangular.

Types of Meristematic tissue

- **Based on origin**
- **Based on position**
- **Based on function**

Types of meristematic tissue on the basis of origin:

1. Promeristem (primodial meristem)
2. Primary meristem
3. Secondary meristem

1. Promeristem:

- Origin: embryonic origin
- It is earliest and youngest meristematic tissue
- It is present in growing root and shoot tip.
- It give rises to primary meristem,

2. Primary meristem:

- Origin: from Promeristem
- Cell are always active and dividing
- Present below promeristem in the shoot and root tip, and also in intercalary position

- It give rises to secondary meristem, and primary permanent tissue.

3. Secondary meristem:
   - Origin: from primary meristem
   - It is developed later on life
   - It give rises to secondary permanent tissue

Types of Meristematic tissue on the basis of position:

a) Apical meristem
b) Intercalary meristem
c) Lateral meristem

a. Apical Meristem:

- Position: present at apical parts of plant such as root tip and shoot tip
- It helps in increase in height of plants.
- Apical meristem has two distinct zone:
- Promeristem zone: contains group of dividing cell (apical initials)
- Meristematic zone: contains protoderms (epiderm), procambium (primary vascular tissue) and ground meristem (cortex and pith).

b. Intercalary Meristem:

- Position: present in intercalary position in the leaves and internode
- It is a part of apical meristem
- It also adds to height of plants
- Commonly present in monocots, grass and pines

c. Lateral Meristem:

- Position: present on lateral side of stem and root
- It helps in increases the diameter or thickness of plants.
- Example: vascular cambium (primary meristem) and cork cambium (secondary meristem)

Types of meristematic tissue on the basis of function

a. Protoderm
b. Procambium
c. Ground meristem

a) Protoderm:

- Function: protection from mechanical injury
- It gives rise to epidermis layer.
- It is the outermost meristematic tissue

b) Procambium:

- Function: transport of water and nutrition
- It gives rise to vascular tissue (xylem and phloem)
- It is the innermost meristematic tissue

c) Ground meristem:

- Function: various functions
- It gives rise to cortex, endodermis, pericycle and pith in dicot and hypodermis, ground tissue in monocot.

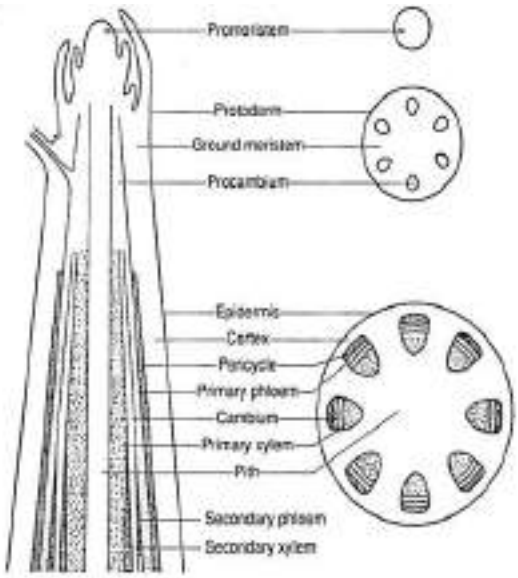


Fig. 5.40 : Diagrammatic representations of meristems in plant body and their gradual differentiation in L.S. with corresponding transverse views in T.S.

2. <u>Describe Parechyma.</u>

It is the basic packaging tissue that fills the spaces between other tissues and is found most abundantly in plants.They have unspecialised/ undifferentiated cells with thin cell walls made of cellulose. they have large intercellular spaces as the cells are loosely packed. Cells have dense cytoplasm and nucleus and large vacuole.

FUNCTION- This tissue provide support to plants and parenchyma of stem and roots stores nutrients and water and is called as STORAGE PARENCHYMA. when it contains chloroplast having chlorophyll and performs photosynthesis, it is called CHLORENCHYMA. In aquatic plants, parenchyma has large air spaces to provide buoyancy to plants to help them float and exchange gases, it is called AERENCHYMA.

LOCATION- This type of tissue found in non woody or soft parts of roots,stem,flowers,leaves and fruits.

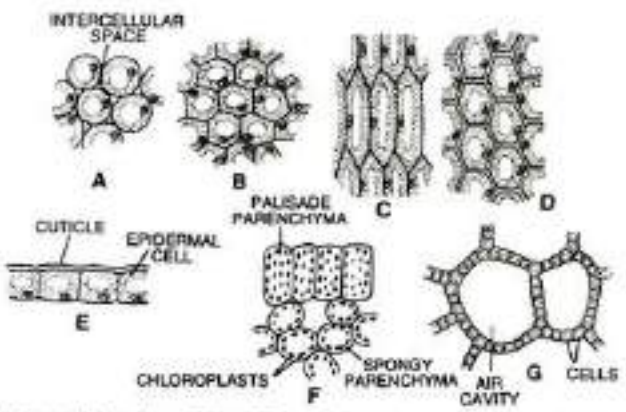


Fig. 6.7. Types of Parenchyma Cells. A–B, normal parenchyma cells; A, rounded; B, angular; C, prosenchyma; D, xylem parenchyma; E, epidermal cells; F, mesophyll; G, aerenchyma

3. **Give an account of Collenchyma.**

The cells are living, elongated and irregularly thick at the corners made of cellulose or pectin they have very less or no intercellular spaces. The cells have a nucleus, dense cytoplasm and Large vacuole.

FUNCTIONS- These cells provide flexibility (elasticity) and mechanical support to the aerial parts of the plants and allows them to bend. LOCATION- This type of tissue is found in leaf stalks, below epidermis of leaves and stem

4. **Explain strcucture , types and functions of Sclerenchyma tissue.**

CHARACTERISTICS- The cells are long, narrow thick walled due to deposition of lignin. Such cell walls are called as lignified walls and have pits. These cells lack intercellular spaces due to deposition of lignin. The cells do not have a nucleus and cytoplasm and are dead. There are two types in it: fibres and **sclereids**.

Fibres: Fibers or bast are generally long, slender, so-called prosenchymatous cells, usually occurring in strands or bundles. Such bundles or the totality of a stem's bundles are colloquially called fibers.,. The fibers of flax (Linum usitatissimum) have been known in Europe and Egypt for more than 3,000 years, those of hemp (Cannabis sativa) in China for just as long. These fibers, and those of jute (Corchorus capsularis) and ramie (Boehmeria nivea, a nettle), are extremely soft and elastic and are especially well suited for the processing to textiles. Their principal cell wall material is cellulose.

Sclereids: are a reduced form of sclerenchyma cells with highly thickened, lignified cellular walls that form small bundles of durable layers of tissue in most plants. The presence of numerous sclereids form the cores of apples and produce the gritty texture of guavas.

Although sclereids are variable in shape, the cells are generally isodiametric, prosenchymatic, forked, or elaborately branched. They can be grouped into bundles, can form complete tubes located at the periphery, or can occur as single cells or small groups of cells within parenchyma tissues. An isolated sclereid cell is known as an

idioblast. Sclereids are typically found in the epidermis, ground tissue, and vascular tissue.

FUNCTIONS -These cells provide rigidity and strength to plants and makes it hard and can bear stress and strains.

LOCATION- This type of cells are found in stems,around vascular bundles,in the veins of leaves.

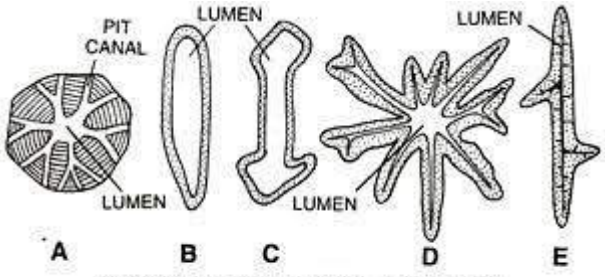


Fig. 6.10. Types of Sclereids. A, stone cell. (branchysclereid) with pit canals; B, macrosclereid; C, osteosclereid; D, astrosclereid; E, filiform sclereid.

6. <u>Give an account of Complex tissue</u>

This type of tissue is made up of more than one type of cells that have a common origin and work together to do a common function. Its function is to transport water,minerals and food to all parts of the plant. Complex permanent tissue is of two types,

A. XYLEM

B. PHLOEM

XYLEM: The cells have thick walls.Elements are tracheids,vessels,xylem parenchyma,and xylem fibres Vessels are the most important elements and are shorter and wider than tracheids. Vessels and tracheids have tube like structures that help in transporting water and minerals vertically efficiently. Conduction takes place in one direction. Xylem parenchyma stores food and helps in lateral conduction of water. In addition to transporting water and mineral salts from roots to leaves, xylem also provides support to plants and trees because of its tough lignified vessels. In xylem, only the Xylem parenchyma is living and all other elements are dead

Xylem- It consists of tracheids, vessels, xylem parenchyma and xylem fibres. Tracheids and vessels are hollow tube-like structures that help in conducting water and minerals. The xylem conducts only in one direction i.e vertically. The xylem parenchyma is responsible for storing the prepared food and assists in the conduction of water. Xylem fibres are supportive in function.

PHLOEM: Phloem- It consists of four of elements: sieve tubes, companion cells, phloem fibres and the phloem parenchyma. Unlike the xylem, phloem conducts in both directions. It is responsible for transporting food from the leaves to the other

parts of the plant. Phloem contains living tissues except for fibres that are dead tissues.

Elements of phloem are sieve tubes,companion cells,phloem parenchyma and phloem fibres. Seive tubes are tube like structures, The end walls are called seive plates and are perforated due to presence of pores. Companion cells help in efficient functioning of sieve tubes. Phloem transports the prepared

7. **<u>with neat diagram explain elements of Phloem .</u>**

Phloem: The other specialised complex tissue forming a part of the vascular bundle is phloem. It is composed of sieve elements, companion cells, parenchyma and some fibres. Sclerotic cells may also be present. Two terms, bast and leptome, have been used for phloem,

Sieve Elements: The most important constituents of phloem are the sieve elements, the sieve tubes and sieve cells. From ontogenetic point of view a sieve tube resembles a vessel and a sieve cell a tracheid.

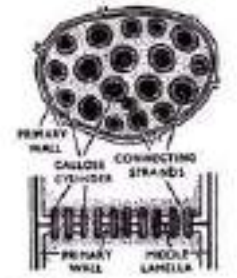


Fig. 543. Sieve tube. Structure of sieve area of an angiosperm in surface (upper) and sectional (lower) views (diagrammatic).

Sieve tubes: are long tube-like bodies formed from a row of cells arranged in longitudinal series where the end-walls are perforated in a sieve-like manner. The perforated end-walls are called the sieve plates, through which cytoplasmic connections are established between adjacent cells.

Sieve cells, which may be compared to the tracheids, are narrow elongated cells without conspicuous sieve areas. They usually have greatly inclined walls, which overlap in the tissue, sieve areas being more numerous in the ends.Sieve cells are more primitive than the sieve tubes.

Companion Cells: Companion cells remain associated with the sieve tubes of angiosperms, both ontogenetically and physiologically. These are smaller elongate cells, having dense cytoplasm and prominent nuclei. Starch grains are never present. They occur along the lateral walls of the sieve tubes. A companion cell may be equal in length to the accompanying sieve tube element or the mother cell may be divided transversely forming a series of companion cells . The companion cells are so firmly attached to the sieve tubes that they cannot be normally separated.

Parenchyma: Besides companion cells and albuminous cells, a good number of parenchyma cells remain associated with sieve elements. These are living cells with cellulose walls having primary pit fields. They are mainly concerned with storage of organic food matters. Tannins, crystals and other materials may also be present.

8. **<u>Explain Components of Xylem.</u>**

The main components of xylem are:tracheae or vessels, fibres, called xylem fibres or wood fibres, and parenchyma, referred to as xylem or wood parenchyma.

Tracheids: A tracheid is a very much elongate cell occurring along the long axis of the organ. The cells are

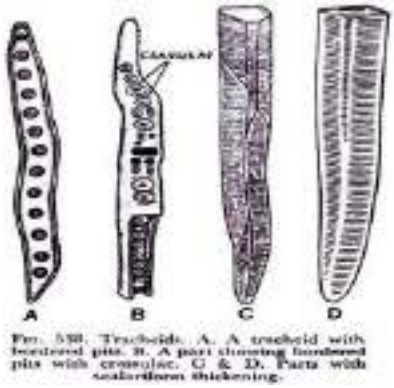


Fig. 538. Tracheids. A. A tracheid with bordered pits. B. A part showing bordered pits with crassulae. C & D. Parts with scalariform thickening.

devoid of protoplast, and hence dead. A tracheid has a fairly large cavity or lumen without any contents and tapering blunt or chisel-like ends. The wall is hard, moderately thick and usually lignified. Secondary walls are deposited in different manners, so that the tracheids may be annular, spiral, reticulate, scalariform or pitted.

Xylem Fibres: Some fibres remain associated with other elements in the complex tissue, xylem, and they mainly give mechanical support. As previously stated, fibres are very much elongated, usually dead cells with lignified walls. In the specialisation of the xylem fibres adapted for more efficient support there has been steady increase in thickness of the wall leading to decrease in cell-lumen.

Xylem Parenchyma: Living parenchyma is a constituent of xylem of most plants. In primary xylem they remain associated with other elements and derive their origin from the same meristem. Parenchyma is abundant in the secondary xylem of most of the plants, excepting a few conifers like Pinus, Taxus and Araucaria. These are the only living cells in xylem.The cells may be thin-walled or thick-walled

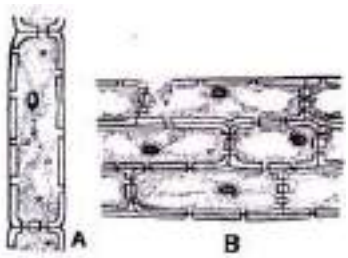


FIG. 541. Xylem Parenchyma.
A. Parenchyma. B. Ray cells.

9. Explain theories of meristematic tissues.

Several theories are proposed to explain the origin of Apical meristem. They are as follows: - 1. Apical cell theory 2. Histogen theory 3. Tunica – corpus theory

a) Apical cell theory

Nageli 1858 coined the term 'Meristem' and put forward this theory.

According to this theory Apical meristem consists of a single, large, inverted pyramid like apical cell called 'Apical initial' which is structural and functional unit of Apical meristem.

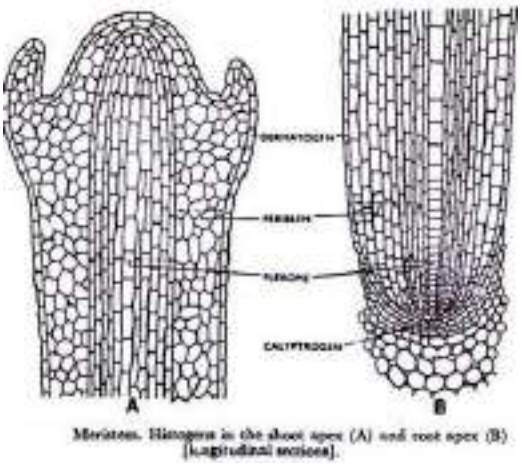
Sequence of cell division in apical cell is responsible for the formation of different members of the body.

Criticism: - Apical cell theory is true for Thallophytes and Vascular cryptogams. In higher plants (Phanerogams) different parts of a plant body have independent origin. Hence it is proved to be wrong.

b) Describe Histogen theory.

In 1868 Hanstein formulated "Histogen Theory". According to this theory the tissues of a plant body originate from a mass of meristem which is divisible into 3 zones. Namely Outer Dermatogen, Middle Periblem and Inner Plerome.

Dermatogen: - (In greek Derma means 'Skin') It is the single, outermost layer of meristem.The cells divide by radial walls only.i,e. at right angles to the surface of the stem and increase in



Meristem. Histogen in the shoot apex (A) and root apex (B) [Longitudinal sections].

circumference , thus keeping pace with the increasing growth of the underlying tissues. It gives rise to Epidermis of Root and stem.

In Root, apex is covered over and protected by many layered tissue called Root cap. Apical meristem lies behind the root cap. Promeristem differentiates into Dermatogen, periblem and plerome. Dermatogen is single layered.it cuts off many new cells outside called "Calyptrogen". By repeated division it gives rise to root cap. Periblem gives rise to cortex and plerome gives rise to Vascular bundle.

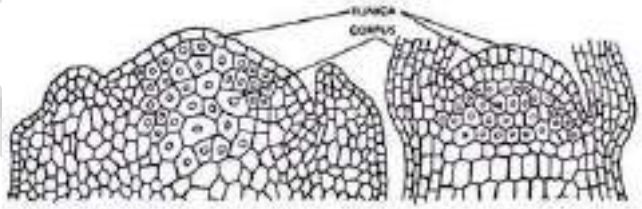
Periblem: - (In Greek 'Peri' means around,'blema' means 'Clothing' or'covering'). It occurs internal to dermatogens but peripheral to Plerome. It is single layered at apex and multilayered towards lower down. It gives rise to Cortex of root and shoot and inner tissues of leaves.

Plerome: - (In Greek it means' Fills) It is composed of irregular cells. It is the central core of stem covered by Periblem and Dermatogen. It gives rise to Procambium which ultimately differentiates into vascular cylinder (Xylem and Phloem elements, Pericycle, medullary rays, pith) of root, Stem.

c) Describe Tunica – corpus theory

Schmidt in 1924 proposed Tunica corpus theory. According to this theory there are two zones of Apical meristem. Tunica and Corpus.

Tunica: - Tunica is the outer zone consisting of one or more peripheral layers of small uniform cells normally divide anticlinally (Perpendicular to the Surface).In Dicots it is 1to 5 layered, in Monocots it is 1 to 4 layered. It is responsible for the surface growth in the apex as a sheet but not in thickness. To increase in thickness it has to divide periclinally. Normally it does not occur except at the point of origin of leaf primordium and axillary bud.



Meristem. Longitudinal section of shoot apex to show tunica (one-layered in A and two-layered in B) and corpus.

Cytological 2 zones are recognized in Tunica. The first one is central apical zone and second is occurs between Central apical zone and leaf primardium.

Corpus:- Corpus is the inner zone of shoot apex composed of undifferentiated mass of larger cells enclosed by Tunica. It divides in all palnes to increase volume of shoot apex. It gives rise to cortex and Vascular tissue. It consists of several zones such as: Central mother cells: - It is the uppermost zone of Corpus; Pith rib meristem: - Occurs below the Central mother cell zone; Flank meristem: - It surrounds both Central mother zone and pith rib meristem.

Merits of Tunica corpus theory.

- It deals with planes of cell division, description of meristem becomes precise.

- It explains growth pattern clearly in shoot apex of Angiosperms.
- It enables to understand development of leaves as they arise close to apex.
- Specific variation of number of Tunica layer may be of Taxonomic importance as in Grass.
- It has topographical value in the study of development of different tissue system in plants.
- The destiny of derivatives of corpus is not predetermined.

10. Explain Glandular tissue.

The glandular tissue consists of special structures; the Glands which contain some secretary or Excretory products. A Gland may consist of isolated cells or small group of cells with or without central cavity. They are of various types. They may be internal or external. It can be classified into 2 types. They are a) Secretary cells b) Glands.

Secretory cells :(**Internal Glands):-**

- Secretary cells are found in members of Umbelliferae, Rutaceae. These cells contain inconspicuous cytoplasm and cell is filled with secretion which does not exude.
- Oil gland secreting essential oils, as in Fruits, leaves of Orange, Lemon Eucalyptus etc.
- Mucilage secreting glands, as in the Betel leaf.
- Special water secreting glands at the tip of the Veins.
- Some secretary cells contain granular cytoplasm with prominent Nucleus. These exude the secretion such as Gum. These are called **"Excretory cells'.**

Glands :-(External Glands):-

- External glands are commonly short hairs tipped by glands.
- In Plants Gland is defined as a Plant structure located on or near the plant surface or externally which secretes one or more products.Ex: Glandular hairs, Nectaries.
- Glandular hairs secreting Gum like Substances as in Tobacco, Plumbago etc.
- Hydathodes are Water secreting Gland. (Water contains Salts, Sugars and organic substances).
- Glandular hairs secreting irritating, Poisonous substances as in Nettles (Utrica dioica-Utricaceae, stinging perennial herb.
- Honey secreting glands called" Nectaries" (Sugary fluid derived from phloem). As in Euphorbia.
- Fragrance emitting glands called "Osmophores" as in members of Araceae and Asclepiadaceae. Or produced from volatile oil distributed through out Epidermis of Petals.
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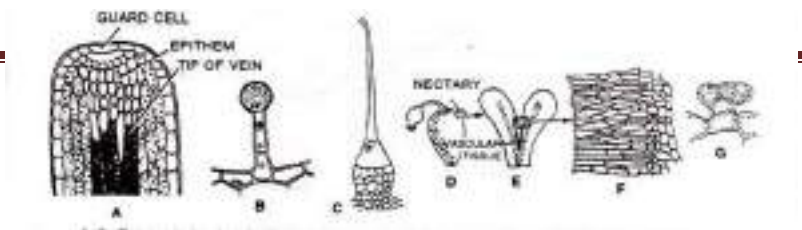
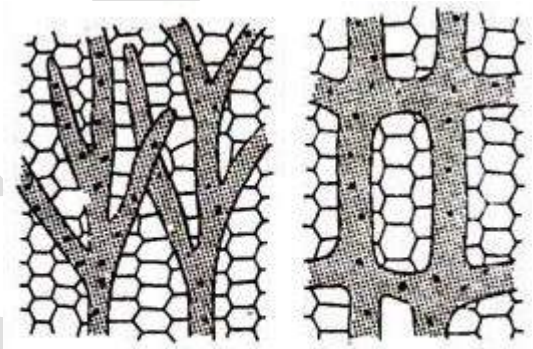


11. Explain Laticiferous tissues.

Latex cell or Non – articulate Latex ducts. Thin walled, greatly elongated, much branched ducts containing a milky or yellowish or watery fluid called "Latex" is called "Laticeferous tissue". These are irregularly distributed in the mass of parenchymatous cells. They contain numerous nuclei. They are of 2 types. Namely

Latex cell or Non – articulate Latex ducts And Latex Vessels or Articulate latex.



Laticiferous Tissue. A. Latex cells ; B. Latex vessels

Laticiferous cells originate from Promeristem. The cell wall is thick, encloses many Nuclei. These are independent units which extend as branched structures for long distances in the plant body. They originate as minute structures, elongate quickly and by repeated branching ramify in all directions but do not fuse together.Ex: Vinca rosa, Calotropis. Euphorbia.

Latex Vessels or Articulate latex. Latex vessels originate from Meristem, grow more or less as parallel ducts which by branching and frequent anastomise to form a complex network. These are found in members of papavaraceae, Moraceae, Compositeae, Euphorbiaceae.etc.

Functions:-Laticiferous tissue may act as food storage organs or Reservoir of waste products.They may also act as translocatory tissue.

12. With neat labelled diagram explain internal structure of Dicot root.

Transverse section of Cicer root shows following Anatomical features:-

Epiblema: Epiblema is the outermost layer of Root. It is consists of single layer of compactly arranged, rectangular, thin walled cells. Some of the cells develop into unicellular, tubular cells called **'Root hair'. It is meant for absorption.**

Cortex: Cortex is composed of many layers of Parenchyma cells with intercellular spaces. **Endodermis** is innermost layer of the cortex. It consists of single layer of barrel shaped cells with casparian strips on their radial walls. Few endodermal cells opposite to ProtoXylem are thin walled called **'Passage cells".**

Stele: Stele is composed of Pericycle, Vascular bundle, Conjunctive tissue and Pith.

Pericycle: Pericycle is the outermost layer of stele present next to endodermis. It is made up of single layer of parenchyma cells.

Vascular bundle: - Vascular bundle is Radial, Tetrarch and Exarch.(Radial- Xylem and Phloem are present alternately at different radii**, Tetrarch-** There are 4

patches of Xylem alternating with 4 patches of Phloem**,Exarch-** Protoxylem is present towards pericycle and Meta Xylem towards Pith.)

Conjunctive tissue: - Parenchyma tissue present between Vascular bundle is called '**Conjunctive tissue'.**

Pith:-Central region of stele made up of parenchyma tissue is constitutes **'Pith'.** It is small.

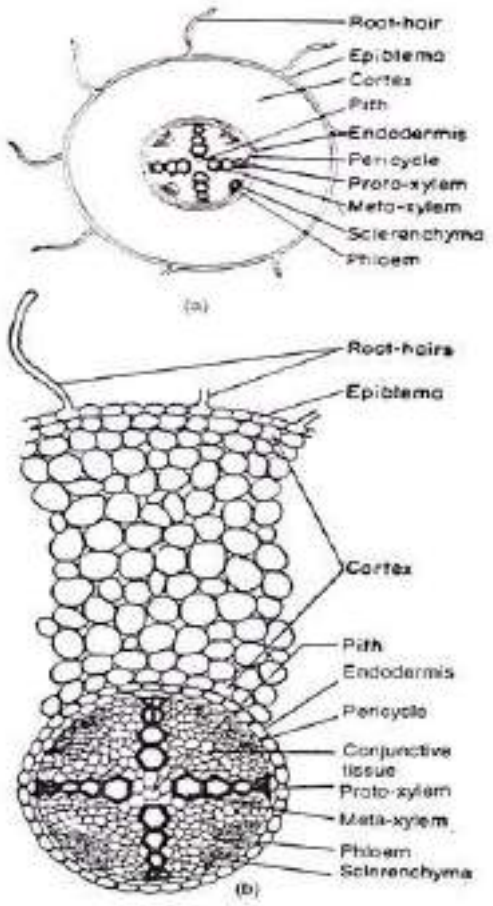


Fig. 6.7 : T.S. of root of gram : (a) Diagrammatic, (b) A portion of T.S. under magnification

13. **With neat labelled diagram explain internal structure of monocot root.**

Transverse section of Canna root shows following Anatomical features:-

Epiblema: Epiblema is the outermost layer of Root. It is consists of single layer of compactly arranged, rectangular, thin walled cells. Some of the cells develop into unicellular, tubular cells called **'Root hair'. It is meant for absorption.**

Cortex: Cortex is composed of many layers of Parenchyma cells with intercellular spaces. **Endodermis** is the innermost layer of the cortex. It consists of single layer of barrel shaped cells with casparian strips on their radial walls. Few endodermal cells opposite to Proto Xylem are thin walled called **'Passage cells".**

Stele: Stele is composed of Pericycle, Vascular bundle, Conjunctive tissue and Pith.

Pericycle: Pericycle is the outermost layer of stele present below endodermis. It is made up of single layer of parenchyma cells.

Vascular bundle: - Vascular bundle is Radial, Polyarch and Exarch.(Radial- Xylem and Phloem are present alternately at different radii**, Polyarch-** There are many patches of Xylem alternating with equal number of Phloem Patches **,Exarch-** Protoxylem is present towards pericycle and Meta Xylem towards Pith.)

Conjunctive tissue: - Parenchyma tissue present between Vascular bundle is called 'Conjunctive tissue'.

Pith:-Central region of stele made up of parenchyma tissue is constitutes **'Pith'. It is very large.**

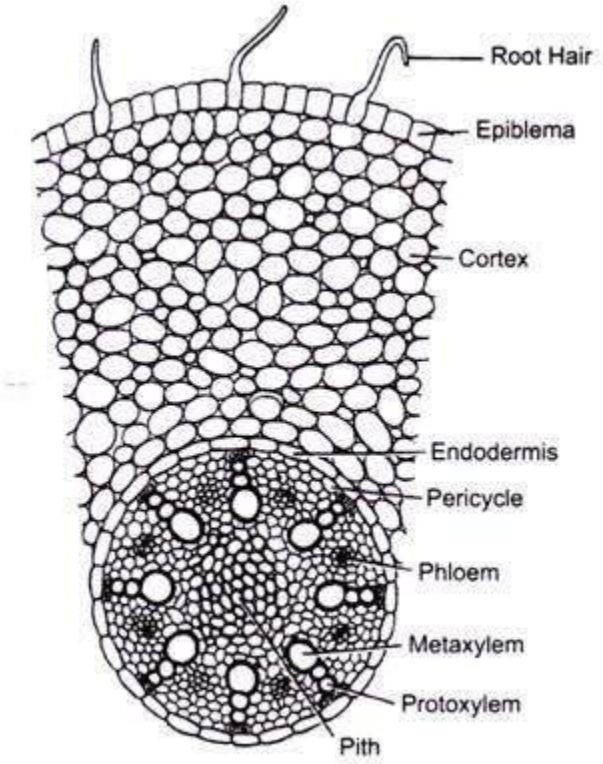


Fig. 4.5 ii Detailed structure of a portion of T.S. of Maize root (Monocot root)

14. Differentiate the anatomical features of Monocot and Dicot root.

Sl. no	Dicot root	Monocot root
1	Well defined Exodermis is absent	Well defined Exodermis is Present
2	Pericycle gives rise to Lateral roots and cambium	Pericycle gives rise to Lateral roots only

3	Vascular bundles vary from 2 to 6	Vascular bundles are numerous
4	Pith is absent or Very small	Pith is large

15. Describe the internal structure of Dicot stem with the help of neat labelled diagram.

Transverse section of Dicot stem shows following Anatomical features:-

Epidermis: - Epidermis is the outermost, single layer of compactly arranged, tubular cells with cuticle on their outer walls. It bears multicellular epidermal hairs.

Cortex: - Cortex is present internal to Epidermis. The outer zone of Cortex present below the epidermis consists of few layers of Collenchyma cells called "Hypodermis". Inner to Hypodermis is several layers of thin walled parenchyma cells. Its Outer cells contain
chlorophyll. The innermost layer of the cortex is called Endodermis. It is made up of a single layer of barrel shaped cells with abundant starch and hence, called "Starch sheath".

Stele: - Stele is composed of Pericycle, Vascular bundle, Medullary rays and Pith.

Pericycle:-Pericycle is the outer layer of stele. It is sclerenchymatous in nature. There are more layers of Sclerenchyma opposite to Vascular bundles.

Vascular bundle:-Several Vascular bundles are arranged in a ring (Eustele). Each Vascular Bundle is Conjoint, Collateral , Open with Endarch xylem.(**Conjoin**t-Xylem and Phloem are in a compact bundle, **Collateral- xylem and Phloem lie in same radius, open** – Strip of Cambium is present between Xylem and Phloem ,**Endarch-** Protoxylem towards pith and Meta xylem towards Pericycle.,) Phloem is outer and Xylem is inner in position. (Xylem contains Vessels, Tracheids, Parenchyma and Fibers).

Pith (Medulla):- Centre of the stem is occupied by well developed parenchymatous Pith.

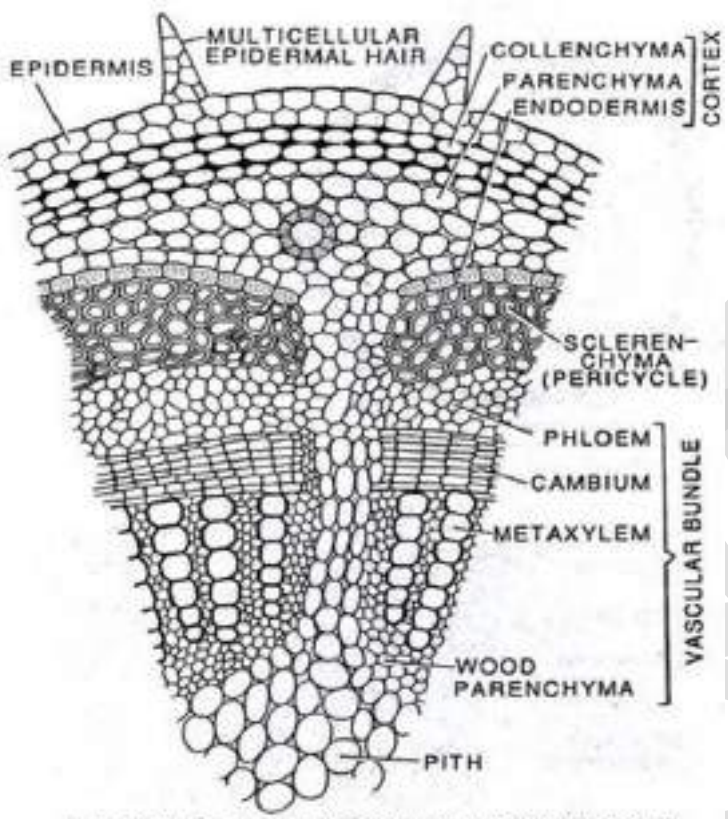


Fig. 40.12. T.S. of a dicotyledonous stem (*Helianthus annuus*).

16. <u>Describe the internal structure of Monocot stem with the help of neat labelled diagram.</u>

Transverse section of Monocot stem shows following Anatomical features:-

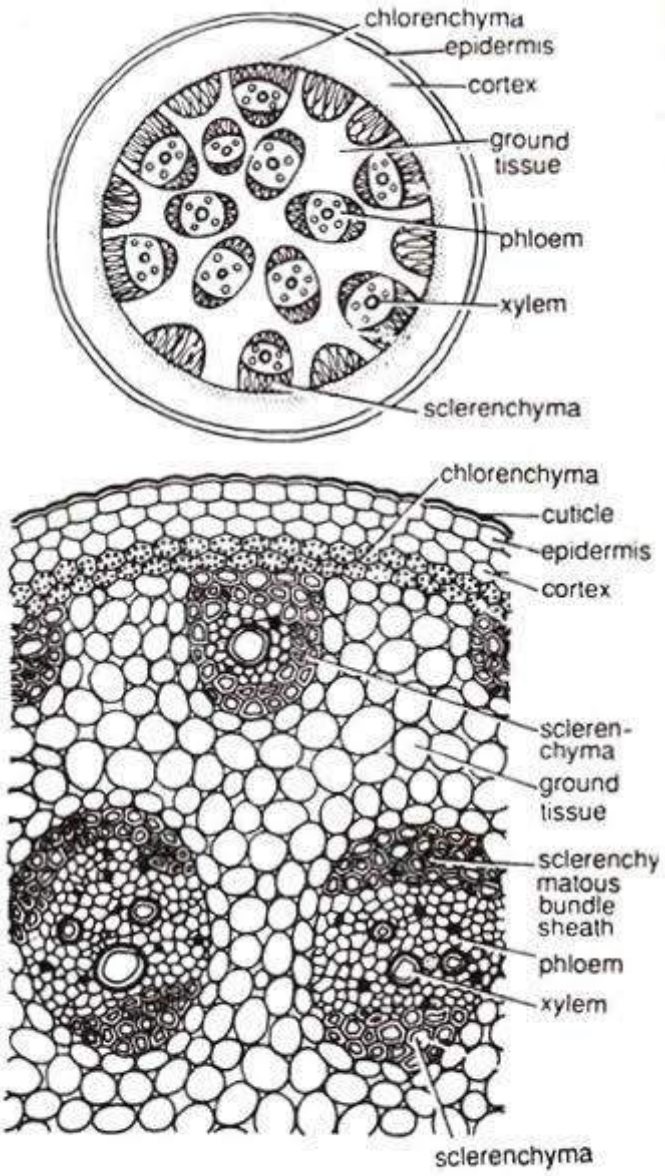


Fig. 109. *Canna* : **Upper** – T. S. stem (diagrammatic); **Lower** – T. S. stem (A part cellular)

Epidermis: - Epidermis is the outermost, single layer of compactly arranged, tubular cells with cuticle on their outer walls. Epidermal hairs are absent, and Few Stomata are present.

Ground tisssue: - Ground tissue is present internal to Epidermis. Just below epidermis few layers of Sclerenchyma cells are called **"Hypodermis".** Rest of the ground tissue is Parenchymatous in which vascular bundles are scattered (Atactostele).Endodermis; Pericycle, Medullary rays and Pith are absent.

Vascular bundle:-Vascular bundles are many scattered in the ground tissue. (Atactostele).Peripheral vascular bundles are small closely arranged; Central bundles are larger, less crowded.

Each Vascular Bundle is **Conjoint, Collateral, and Closed with endarch xylem**. (**Conjoin**t-Xylem and Phloem are in a compact bundle, **Collateral-**Xylem and Phloem lie in same radius**, Closed** – Cambium is absent between Xylem and Phloem, **Endarch-** Protoxylem towards center and Meta xylem towards Periphery,) Phloem is outer and Xylem is inner in position. (Xylem contains irregularly arranged Tracheids, four distinct Vessels arranged in the form of letter 'Y'. 2 smaller vessels towards centre constitute Proto xylem and two bigger vessels present laterally constitute Meta xylem. Cavity formed due to breaking of proto xylem forms '**Water containing cavity**". Phloem consists of Sieve tubes and companinion cells. There is no Phloem parenchyma.

17. Differentiate between anatomical features of Dicot stem with that of Monocot stem.

Differences between Monocot and Dicot Stem

Sl. no	Dicot Stem	Monocot Stem
1	Multicellular Epidermis are more common	Multicellular Epidermis are not common
2	Hypodermis is Collenchymatous	Hypodermis is Sclernchymatous
3	Ground tissue is differentiated into Cortex and Endodermis.	Ground tissue is Undifferentiated.
4	Endodermis and Pericycleand Pith are present	Endodermis and Pericycleand Pith areabsent
5	Cambium is Present in Vascular bundle, Hence said to be Open type.	Cambium is absent in Vascular bundle, Hence said to be Closed type.
6	Vascular bundles are arranged in a ring (Eustele)	Vascular bundles are scattered in the ground tissue (Atactostele).
7	Phloem parenchyma is present	Phloem parenchyma is absent
8	Vascular bundles are wedge shaped	Vascular bundles are Oval shaped
9	Lysogenous cavity is absent	Lysogenous cavity is present in Vascular bundle

18. Explain the internal structure of Dicot leaf.

Anatomy of Dorsiventral leaf:-Transverse section of Dicot leaf shows following anatomical features;-

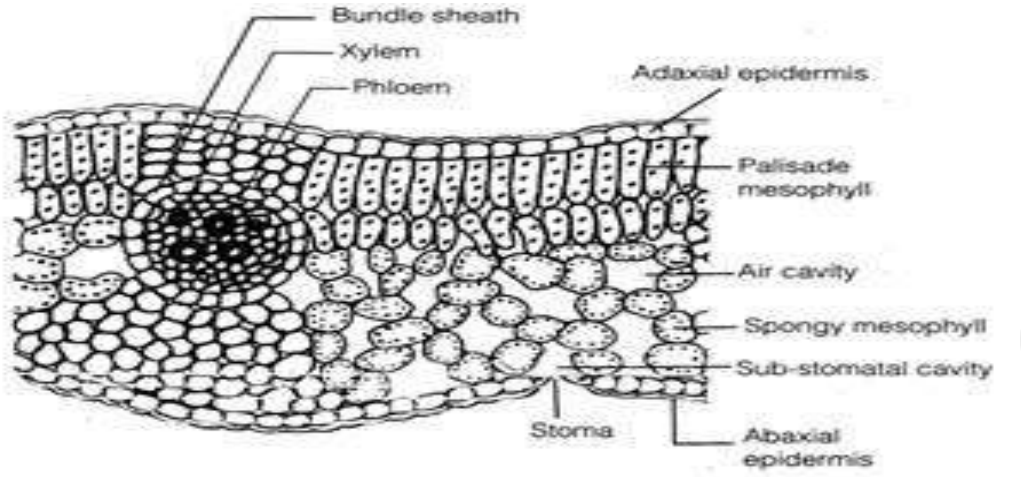
Upper Epidermis:-It consists of single layer of continuous and compactly arranged rectangular cells with thick Cuticle. Multicellular hairs are present. It is protective in function.

Lower Epidermis: - It consists of single layer of discontinuous and compactly arranged rectangular cells with thick Cuticle. Few stomata are and multicellular hairs are present.

Mesophyll;-Parenchyma tissue present in between Epidermal layers in leaf is called **"Mesophyll". It is** differentiated into **a) Palisade Parenchyma: -** It consists of 2 to 3 layers of cylindrical, elongated compactly arranged Parenchyma cells with plenty of chloroplasts. It is placed at right angles to epidermis**. b) Spongy Parenchyma: -** It is

composed of loosely arranged, isodiametric parenchyma cells with less number of chloroplasts. It is present between palisade parenchyma and Lower Epidermis**.**

Vascular bundles: - Mid and veins in Lamina are the regions of Vascular bundles. Phloem is present towards Lower epidermis and Xylem towards Upper Epidermis. Each Vascular bundle is surrounded by Sclerenchymatous Bundle sheath.



T.S of dicot leaf

19. With neat labelled diagram explain the internal structure of Iso bi lateral leaf.

Isobilateral leaf. Ex: Monocot leaf. In Monocot plants grows parallel to stem, so they are equally illuminated on both the surfaces. Hence they do not show differences between upper and lower surfaces. Hence they are called "Iso bi lateral Leaves".

Anatomy of Iso bi lateral leaf:-Transverse section of Monocot leaf shows following anatomical features;-

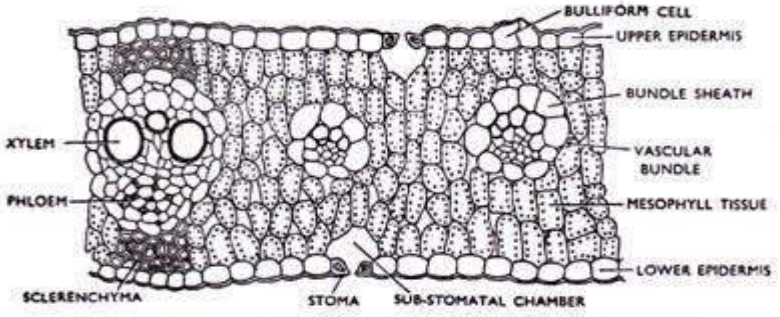


FIG. 619. A portion of leaf of *Zea* (maize) in transverse section.

Upper Epidermis:-It consists of single layer of compactly arranged, thick walled, rectangular cells with Cuticle. It contains Stomata and Bulliform cells. Each Stoma consists of 2 dumb-bell shaped guard cells and 2 triangular subsidiary cells. '**Bulliform cells' are also called as 'Motor cells'**. It consists of groups of thick walled cells which occur in longitudinal rows. In dry atmosphere, these loose water and bring bout longitudinal rolling of lamina. Thus reduce rate of transpiration. It is protective in function.

Lower Epidermis: - It consists of single layer of discontinuous and compactly arranged rectangular cells with thick Cuticle. Few stomata are present.

Mesophyll;-Parenchyma tissue present in between Epidermal layers in leaf is called "Mesophyll". It is not differentiated into Palisade Parenchyma Spongy parenchyma. It consists of uniform, compactly arranged isodiametric cells containing chloroplasts.

Vascular bundles: - Lamina shows parallel venation; hence many larger smaller vascular bundles are seen in a section. In each vascular bundle Phloem is present towards Lower epidermis and Xylem towards Upper Epidermis. Each Vascular bundle is surrounded by parenchymatous Bundle sheath. Bundle sheath extension is Sclerenchymatous.

20. Differentiate the anatomical features of Dorsi ventral and Iso bi lateral leaf.

Sl. no	Dicot Leaf	Monocot Leaf
1	Dicot leaf is Dorsiventral	Monocot leaf is Isobilateral
2	Venation is Reticulate	Venation is Parallel
3	Upper Epidermis is continuous	Upper Epidermis is Discontinuous
4	Stomata are present in Lower epidermis only (Hypostomatic)	Stomata are present in both upper and lower epidermis -Amphistomatic
5	Motor or Bulliform cells are absent in upper epidermis.	Motor or Bulliform cells are present in upper epidermis.
6	Mesophyll is differentiated into Palisade Parenchyma and spongy parenchyma	Mesophyll is uniform. It is not differentiated into Palisade Parenchyma and spongy parenchyma
7	Stomata consist of small pore guarded by 2 kidney shaped Guard cells.	Stomata consist of small pore guarded by 2 Dumb-bell shaped Guard cells.
8	Bundle sheath is Sclerenchymatous	Bundle sheath is Parenchymatous

21. What is meant by Anamolous secondary growth? List the causes.

anamolous secondary growth takes place in following conditions: -

In Dicots Vascular bundles are Conjoint, collateral, open and arranged in a ring. Formation of secondary tissues takes place by Fascicular cambium in stele and Cork cambium in cortex.

In Monocots Vascular bundles are conjoint, collateral, closed and are scattered in the ground tissue. Secondary growth is absent.

Any deviation in the above pattern of development in Primary and secondary structure is called "Anamolous secondary growth".

Anamolous prmary structures are as follows:-

1. Scattered vascular bundles in Dicots.
2. Arrangement of Vascular bundles in a ring in Monocots.
3. Medullary or cortical vascular bundles.
4. Presence of intraxylary Phloem or separate Phloem bundles.

Anomalous Secondary structures are as follows:-

1. Abnormal behavior of Fascicular cambium.
2. Origin of Cambium in monocots.

3. Replacement of normal cambium by abnormal accessory cambium.
4. Abnormal behavior of abnormal cambium.

22. Describe the anamolous secondary growth in Boerhavvia stem.
anomalous secondary growth in boerhaavia stem shows following features.

Boerhaavia diffusa is a Dicot plant belonging to Family Nyctaginaceae. It grows few inches off the ground. **It shows following primary structures in the stem:-**

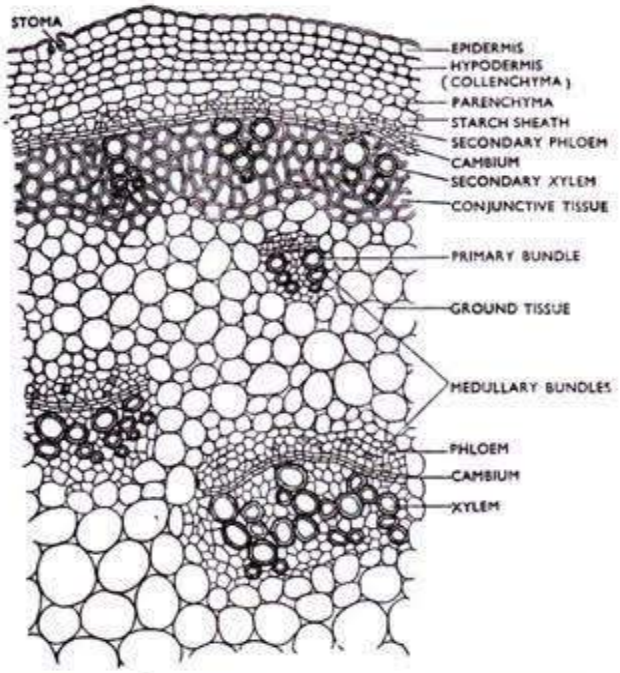


FIG. 653. A portion of stem of *Boerhaavia* in transverse section.

- Epidermis with thick Cuticle and stomata.
- Collenchymatous Hypodermis with below Epidermis.
- It is followed by Chlorenchymatous cortex. Endodermis is clearly defined.
- Pericycle sometimes contains strands of Sclerenchyma. It encloses vascular bundles and pith.
- There are two large Vascular bundles on the sides of the pith. It is surrounded by number if small bundles (6-14) in second or middle ring.
- Bigger vascular bundles shows limited amount of growth in thickness by Fascicular cambium.

In Boerhaavia Secondary growth begins by cambium that arises secondarily from the cells of the Pericycle. Or cells outside primary bundles. Intra Fascicular cambium form ring of vascular bundles with Xylem on the inner side and Phloem on the outer side. Interfascicular cambium produces thick walled lignified conjunctive tissue towards inside and Parenchyma towards outside. The cambium ring ceases it activity.

A New cambial ring gets differentiated outside by cells of pericycle and Parenchyma cells. It forms another ring of Vascular bundle in the same manner. Soon this ceases its activity. One

more cambium gets differentiated and functions in the same manner. Thus several concentric rings of Vascular bundles are formed. Cork and Lenticels develops outside the Hypodermis

23. <u>Describe the anamolous secondary growth in Dracaena stem.</u>
<u>anamolous secondary growth in dracaena stem following features:</u>

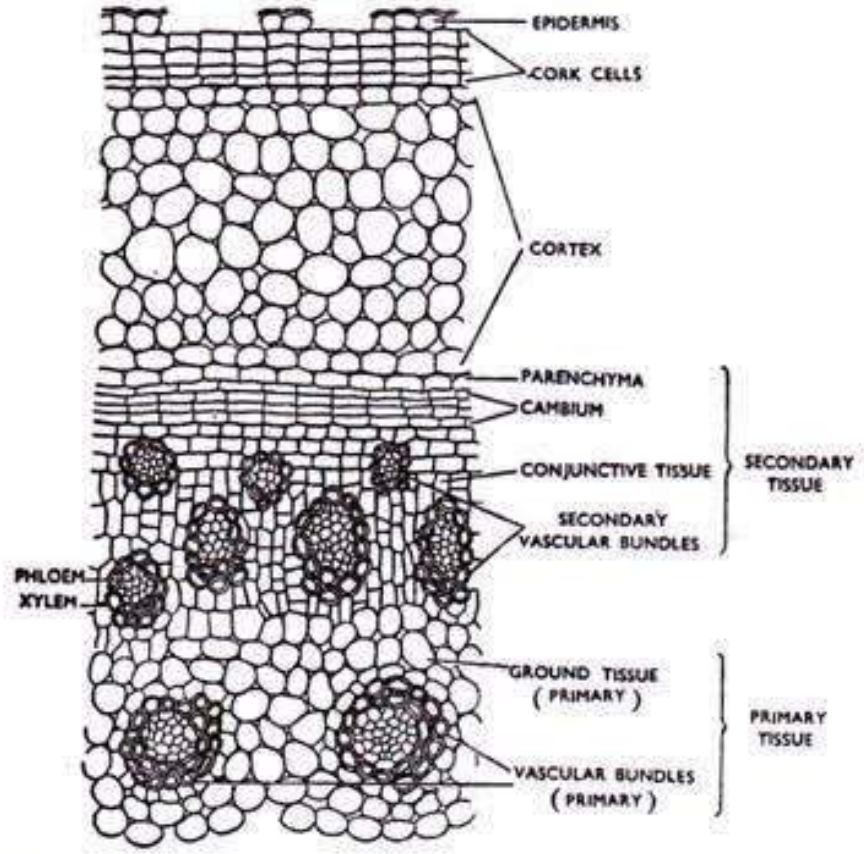


FIG. 643. A portion of *Dracaena* stem in t.s. showing special type of secondary growth.

In Monocotyledons Vascular bundle is closed (Cambium is absent). Hence Secondary growth is absent. But rarely seen in woody monocots like Dracaena, Yucca, Aloe, Agave etc.
Dracaena belongs to the Family Liliaceae. Here secondary growth results in large amount of thickness. In Canary Isles, Dracaena draco is 6000yrs old, measures 14 meters in girth at the base. In 1868 it was destroyed by Strom.

In Dracaena Primary structure is typically Monocotyledonous with numerous closed, collateral or concentric (Amphivasal- Phloem at the centre surrounded by Xylem.)Vascular bundles lying scattered in the ground tissue.

- Secondary growth in Dracaena begins with the formation of secondary meristematic tissue- the cambium in the parenchyma outside the primary bundles. This parenchyma divides tangentially and forms and of cambium, a few layers in thickness.

- The cambium thus formed is more active on inner side, cuts off cells which differentiate into distinct vascular bundles (secondary) and thick walled, lignified parenchyma secondary). On outerside Cambium produces thin walled parenchyma.
- Primary bundles are scattered and Secondary bundles are radially seriated, surrounding secondary parenchyma.
- In transverse section Vascular bundle is oval and Amphivasal. In some species it may be collateral.
- After secondary growth to some extent, the peripheral parenchyma becomes meristematic and begins to divide tangentially and also cells derived from them until a few linear layers are formed. The cells then become suberised and differentiate into cork.
- Deeper lying parenchyma again begins to divide, form new layers of cells and again give rise to strip of cork. Thus cork in Dracaena appears in seriated bands without formation of Cork cambium (Phellogen). This is known as "Storied cork".

24. Explain Annual ring.

Annular ring:-Concentric ring of secondary wood in Dicot stem formed during secondary growth is called "Annular ring" or 'Growth rings'. Each annular ring is composed of 'spring wood '(Early wood) and 'Autumn wood' (Late wood).By counting the number of annular rings in the secondary wood of stem, approximate age of the tree can be determined. Wood science that deals with the determination of approximate age of the tree by counting the number of Annual rings is called '**Dendrochronology'.**

Spring wood: - spring wood is formed from 'Vascular cambium in DIcot stem during secondary growth in spring season of the year. It is composed of Xylem vessels with broader cavities. **Autumn wood: - Autumn wood is formed from Vascular cambium** Vascular cambium in Dicot stem during secondary growth in Autumn season of the year. It is composed of Xylem vessels with narrow cavity. One such Spring wood ring and Autumn wood ring will be produced once in a year. These two types of wood together constitute an **'Annual ring'.**

25. Explain Heart wood and Sap wood.

Heart wood and Sap wood:- Secondary Xylem of Dicot Stem is called 'Wood'. In Dicot stem wood is differentiated into Heart wood and Sap wood**.**

Heart wood (Duramen):- In secondary Dicot stem, the central dark colored, hard wood is called **'Heart wood' or 'Duramen'.** It is composed of dead elements of Xylem. It gives mechanical support to the plant. Xylem elements are filled with Tannins, Gums, and Resins etc. Hence it is dark coloured and hard. Heart wood vessels are clogged with Tyloses, hence it cannot perform conduction.

Sap wood (Alburman): - In secondary Dicot stem, the peripheral zone of wood is soft, light colored called '**Sap wood' or 'Alburman'.** It is composed of both living and dead elements. It has less Tyloses (Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses). It gives mechanical support and also takes part in conduction.

26. Explain Tyloses,

Tyloses:-Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses. It is formed due to enlargement of pit membrane and protrusion of Xylem parenchyma cell into the cavity of Xylem vessel. Tyloses formed contain Cytoplasm, Nucleus, some amount of reserves like Starch, Resin etc. These are frequently formed in Heart wood in Dicots.

Tyloses by blocking the cavity of Vessel obstruct the conduction of water and minerals through vessels. Sometimes it is advantageous as infectious agents like bacteria; fungi which move along with the fluids can not enter vessel and helps in longevity and durability of wood.

In Gymnosperms Epithellial cells that surround the Rsin ductsenlarge and protrude into the cavity in the from of balloon. These are called 'Tylosoids. (False tyloses). They never protrude into the Vessel through pit.

27. Give an account of Porous and Non porous wood.

The secondary growth product of an Angiosperm in Dicot and Gymnosperm is called Wood. There are 2 types of wood. Namely 1) Porous wood and 2) Non- porous wood.

Porous wood: - In this type **t**he wood contains Xylem vessels which appear as circular pores in transverse section, it is called 'Porous wood'. Ex: Secondary wood of Dicot stem. The porous wood is divided into 2 types. they are :-

- **Ring porous wood:-**In Ring porous wood, pores are arranged in concentric rings of spring wood and autumn wood. There is clear distinction between rings. Ex: Ulmus, Betula wood.
- **Diffuse porous wood:-**In Diffuse porous wood, pores are scattered in the ring. As there is gradual increase in size of the pore from Autumn wood to Spring wood, there is no clear demarcation between Spring wood and Autumn wood. Ex: Juglans.

Non- porous wood: - In this type the wood contains only Tracheids. There will be no circular pores in transverse section. Ex: Gymnosperm wood. Presence or absence of pores, arrangement of pores helps in identification of type of wood.

28. Give an account of Secretory tissues.

The non utilizable by product of metabolism which is isolated from the living protoplast or removed from the plant body are "Secretions". Ex: Gums, Resins, Latex, Essential oils, Nectar. The tissues concerned with non utilisable byproduct of metabolism such as Gums, Resins, and Latex are called **"Secretary Tissues".** These are widely distributed in the plant body.Secretary tissues are grouped into 2 types. They are **Glandular tissue and Laticiferous tissue.**

GLANDULAR TISSUE: The glandular tissue consists of special structures; the Glands which contain some secretary or Excretory products. A Gland may consist of isolated cells or small group of cells with or without central cavity. They are of various types. They may

be internal or external. It can be classified into 2 types. They are a) Secretary cells b) Glands.

Secretory cells :(**Internal Glands):-**

- Secretary cells are found in members of Umbelliferae, Rutaceae. These cells contain inconspicuous cytoplasm and cell is filled with secretion which does not exude.
- Oil gland secreting essential oils, as in Fruits, leaves of Orange, Lemon Eucalyptus etc.
- Mucilage secreting glands, as in the Betel leaf.
- Special water secreting glands at the tip of the Veins.
- Some secretary cells contain granular cytoplasm with prominent Nucleus. These exude the secretion such as Gum. These are called **"Excretory cells'.**

Glands :-(External Glands):-

29. External glands are commonly short hairs tipped by glands.

- In Plants Gland is defined as a Plant structure located on or near the plant surface or externally which secretes one or more products.Ex: Glandular hairs, Nectaries.
- Glandular hairs secreting Gum like Substances as in Tobacco, Plumbago etc.
- Hydathodes are Water secreting Gland. (Water contains Salts, Sugars and organic substances).
- Glandular hairs secreting irritating, Poisonous substances as in Nettles (Utrica dioica-Utricaceae, stinging perennial herb.
- Honey secreting glands called" Nectaries" (Sugary fluid derived from phloem). As in Euphorbia.
- Fragrance emitting glands called "Osmophores" as in members of Araceae and Asclepiadaceae. Or produced from volatile oil distributed through out Epidermis of Petals.

10 ARKS QUESTIONS

1. Describe theories of MERISTEM

Several theories are proposed to explain the origin of Apical meristem. They are as follows: 1.Apical cell theory 2. Histogen theory 3. Tunica – corpus theory

Apical cell theory

- Nageli 1858 coined the term 'Meristem' and put forward this theory.
- According to this theory Apical meristem consists of a single, large, inverted pyramid like apical cell called 'Apical initial' which is structural and functional unit of Apical meristem.
- Sequence of cell division in apical cell is responsible for the formation of different members of the body.
- **Criticism:** - Apical cell theory is true for Thallophytes and Vascular cryptogams. In higher plants (Phanerogams) different parts of a plant body have independent origin. Hence it is proved to be wrong.

Histogen theory

In 1868 Hanstein formulated "Histogen Theory". According to this theory the tissues of a plant body originate from a mass of meristem which is divisible into 3 zones. Namely Outer Dermatogen, Middle Periblem and Inner Plerome.

Dermatogen: - (In greek Derma means 'Skin') It is the single, outermost layer of meristem.The cells divide by radial walls only.i,e. at right angles to the surface of the stem and increase in circumference , thus keeping pace with the increasing growth of the underlying tissues. It gives rise to Epidermis of Root and stem.

In Root, apex is covered over and protected by many layered tissue called Root cap. Apical meristem lies behind the root cap. Promeristem differentiates into Dermatogen, periblem and plerome. Dermatogen is single layered.it cuts off many new cells outside called "Calyptrogen". By repeated division it gives rise to root cap. Periblem gives rise to cortex and plerome gives rise to Vascular bundle.

Periblem: - (In Greek 'Peri' means around,'blema' means 'Clothing' or'covering'). It occurs internal to dermatogens but peripheral to Plerome. It is single layered at apex and multilayered towards lower down. It gives rise to Cortex of root and shoot and inner tissues of leaves.

Plerome: - (In Greek it means' Fills) It is composed of irregular cells. It is the central core of stem covered by Periblem and Dermatogen. It gives rise to Procambium which ultimately differentiates into vascular cylinder (Xylem and Phloem elements, Pericycle, medullary rays, pith) of root, Stem.

Tunica – corpus theory

Schmidt in 1924 proposed Tunica corpus theory. According to this theory there are two zones of Apical meristem. Tunica and Corpus.

Tunica: - Tunica is the outer zone consisting of one or more peripheral layers of small uniform cells normally divide anticlinally (Perpendicular to the Surface).In Dicots it is 1to 5 layered, in Monocots it is 1 to 4 layered. It is responsible for the surface growth in the apex as a sheet but not in thickness. To increase in thickness it has to divide periclinally. Normally it does not occur except at the point of origin of leaf primordium and axillary bud.

Cytological 2 zones are recognized in Tunica. The first one is central apical zone and second is occurs between Central apical zone and leaf primardium.

Corpus:- Corpus is the inner zone of shoot apex composed of undifferentiated mass of larger cells enclosed by Tunica. It divides in all palnes to increase volume of shoot apex. It gives rise to cortex and Vascular tissue. It consists of several zones such as:

- Central mother cells: - It is the uppermost zone of Corpus.
- Pith rib meristem: - Occurs below the Central mother cell zone.
- Flank meristem: - It surrounds both Central mother zone and pith rib meristem.

Merits of Tunica corpus theory.

- It deals with planes of cell division, description of meristem becomes precise.
- It explains growth pattern clearly in shoot apex of Angiosperms.
- It enables to understand development of leaves as they arise close to apex.

- Specific variation of number of Tunica layer may be of Taxonomic importance as in Grass.
- It has topographical value in the study of development of different tissue system in plants.
- The destiny of derivatives of corpus is not predetermined.

MORPHOLOGY OF ANGIOSPERMS

1) What is an angiosperm? Give examples.

Angiosperms are highly evolved flowering plants in which seeds are enclosed with in Fruit. They represent major community in the plant kingdom Ex: Monocot , Dicot.

2) List characteristics of Angiosperms.

General features of angiosperms are as follows:-

1. The plant body is Sporophyte differentiated into Root, Stem and Leaves.
2. They produce highly specialised organ "Flower' for sexual reproduction.
3. Flower develops male reproductive organ Androecium and female reproductive organ Gynoecium.
4. Androecium is Collection of Stamens and they produce Pollen grains or Microspores that contain male gametes.
5. Gynoecium consists of carpels. Each carpel has basal Bulbous ovary, middle elongated style and an apical Stigma. Ovary encloses ovules which produce megaspores
6. Double fertilization takes place in Angiosperms.(One male gamete fuse with Haploid Egg to form Diploid Zygote. Another haploid male gamete fuse with Diploid secondary nucleus to form triploid Primary endosperm Nucleus).
   Angiosperms include Monocotyledons and Dicotyledons.

3) Differentiate between Monocotyledons and Dicoyledons.

Differences between monocotyledons and dicotyledons are as follows:-

Sl. no	character	Monocots	Dicots
1	Seed/ Embryo	One cotyledon	Two cotyledons
2	**Root**	**Fibrous root**	**Tap root**
3	**Stem**	**unbranched**	**Branched**
4	**Leaves**	**Isobilateral with sheathing leaf base**	**Dorsiventral without sheathing leaf base**
5	**Venation**	**Parallel**	**Reticulate**
6	**Flower**	**Trimerous**	**Tetra/ pents merous**
7	**Secondary growth**	**Absent**	**Present.**

4) <u>What is meant by Phytography?</u>

The branch of taxonomy dealing with the description of plant parts is called 'Phytography'.

5) **What is herb? Give an example.**
A small plant with Green, soft stem. Ex:- Leucas, Vinca rosea.

6) **What is shrub? Give an example.**
A bushy or woody plant with profuse branching.Ex:-Guava, Sapota, Hibiscus.

7) **Define Perennial and Epimeral**.
A plant that survives and grows for many years is called **Perennial**. A plant which is very short lived is called **Epimeral.**

ROOT SYSTEM

8) **Mention characteristics of Root and Shoot.**

A typical Angiosperm is distinguished into 2 parts. They are 1) Root system 2) Shoot system **Root system** is an underground, non green descending organ of the plant developed from Radicle part of an embryo. It is positively geotropic, positively hydrotropic. **Shoot system** is an aerial, green, ascending organ of the plant developed from Plumule part of an embryo. It is Positively Phototropic in nature. It consists of stem, leaves and Flowers.

9) Write characteristics and Functions of Root system.

Characters of Root system are as follows:-

1. Root is Descending, vegetative axis of the plant developed from Radicle part of an Embryo.
2. It is positively geotropic, positively hydrotropic and positively phototropic.
3. Root consists of Primary Root and Lateral secondary and Tertiary root. Each root is protected by a small root cap.
4. Lateral roots produce unicellular root hair. These take part in absorption of water and mineral nutrients.

Functions of Root system:-

1. Root fixes the Plant body firmly to the soil. (Fixation).
2. It absorbs water and minerals from the soil (Absorption).
3. It conducts water and minerals to shoot system. (Conduction).
4.

10) **Explain types of Root system.**

There are 2 types of Root system. Namely 1) Tap root system 2) Fibrous root system.

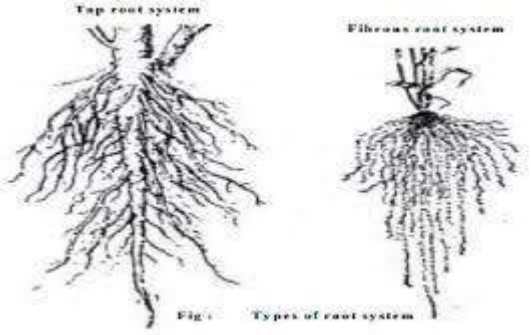


Fig : Types of root system

1. Tap root system: - Ex: - Dicot plants

In Tap root system Radicle develops into single, central main root called 'Primary root'. It develops lateral secondary roots which in turn branches to form tertiary and quaternary roots. Lateral roots bear unicellular root hairs which take part in absorption of water and mineral nutrients from soil. Tap root grows deep into the soil and persists throughout life of the plant.

2. Fibrous root system: - Ex: - Monocot plants.

In Fibrous root system Radicle develops into primary root. It is short lived and soon replaced by cluster of slender, fibre like root. They bear root hairs which help in absorption. Fibrous root does not grow deep into the soil (Surface feeders), and they are periodically renewed.

11) What is an adventitious root? Mention its functions.

The roots developed other than the radical are called 'Adventitious roots". They may be aerial or underground. It may develops from any part of the plant like branches, nodes etc. It performs various functions like providing mechanical support, storage of food, absorption etc. Ex: **Adventitious root system are present in Dicot and monocot plants.**

12) **What is modification of Root? Mention Adventitious root modified to give mechanical support.**

Any change in normal form and structure of Root, in response to the need of the plant is called 'Root modification'. Ex: Prop root, Stilt root, climbing root.

13) Explain Tap root modified for storage of food.

Tap root is modified for storage of food . Based on their shapes they can be classified as follows:-

a. Fusiform Root: - In this type primary root is broad in the middle, tapers at both the ends and become spindle shaped. Ex: - Radish (Raphanus sativa).

b. Conical Root: - In this type primary root is broad at the base and gradually tapers towards apex. It is conical in shape. Ex: Carrot. (Dacus carota)

c. Napiform Root:-In this type, the primary Root is almost spherical shaped above and abruptly tapers towards apex .EX; Beet root (Beta vulgaris).

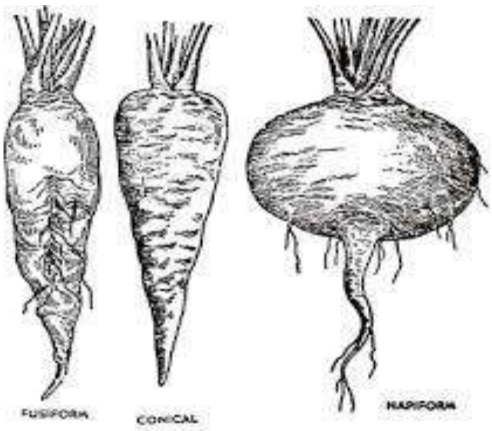
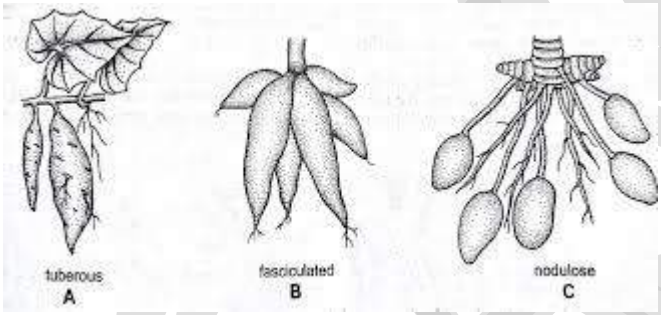


Fig. 36. Modifications of tap roots.

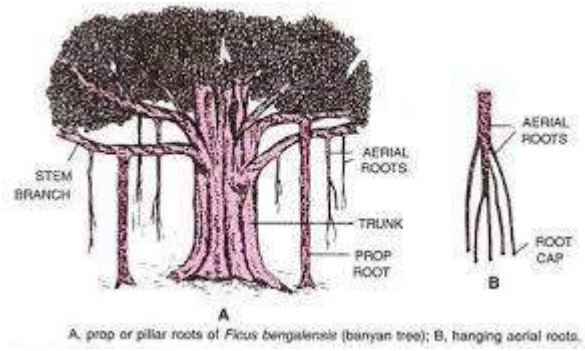


Adventitious roots modified for food storage

14) <u>Explain adventitious root modified for mechanical support.</u>

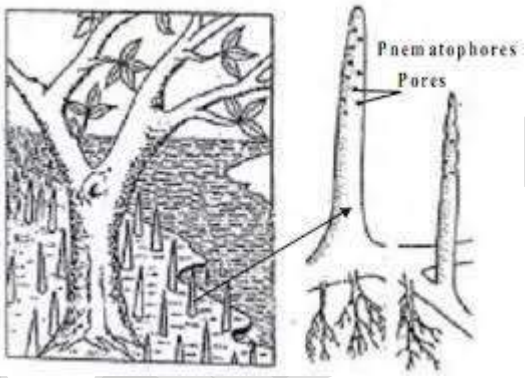
The roots developed other than the radical are called 'Adventitious roots". They may be aerial or underground, may develop from any part of the plant like branches, nodes etc. It performs various functions like providing mechanical support, storage of food, absorption. Adventitious root system are present in both Dicot and monocot plants. Adventitious root is modified to give mechanical support as follows:-

Adventitious roots growing from the aerial parts of the plants perform many functions like, to give mechanical support, to help in breathing, to suck food material and to absorb water. Adventitious root modified to give mechanical support.



A. prop or pillar roots of *Ficus bengalensis* (banyan tree); B, hanging aerial roots.

Still roots of Maize.



Respiratory roots

a. Prop Root: - Prop roots are an aerial adventitious root that develops from Horizontal branches of a tree. These grow downwards, reach the soil, Become thick, woody, acts like pillars and gives additional mechanical support.Ex: Banyan (Ficus benghalensis).

b. Stilt Roots:-Stilt roots are an aerial adventitious root that develops from lower nodes of the stem. These grow obliquely downwards into the soil and give additional mechanical support to the plant. Ex: Maize,(Zea mays), Sugar cane(Saccharum officinarum).

c.Climbing roots:- In Weak stemmed plants aerial adventitious roots develops from nodes . clasp the supporting object . Help the plant to climb. Ex: Betel. Pothas.

SHOOT SYSTEM

15) List characters of Shoot system.

Characters of Shoot system are as follows:-

1. Shoot system is an Aerial, Ascending organ of the plant body developed from Plumule of an embryo. It is Green in colour.
2. It is positively phototropic and negatively geotropic.
3. It consists of Central, cylindrical axis called ‘Stem’.
4. Stem consists of distinct nodes; region between nodes is called as ‘Internode’.
5. At each node develops Flat, Green, Lateral appendage called ‘Leaf’.
6. In the axil of the ‘Axillary bud’ is present. At the tip of the stem’ Terminal bud’ is present.

16**) Explain types of stem with examples.**

Stem are classified into 2 kinds. They are **1**) **Erect Stem. 2) Weak stem.**

1) **Errect Stem: -** The aerial stem which stands Errect without any support is called '**Errect stem'**. It includes following types:-
   a) **Herbs: -** The small plants with woody, soft, Sacculent, green, less branched stem are called '**Herbs'**. Ex: Sunflower, Paddy.
   b) **Shrubs:** - The medium sized plants with Hard, woody stem which is branched giving bushy appearance are called 'Shrubs'. Ex; Hibiscus, Custard apple.
   c) **Trees:** - The large, tall plants with very hard, woody stem which possess distinct trunk and profusely branched are called 'Trees'. Ex: Mango, Eucalyptus.

2). Weak stem:-The aerial stem which cannot stand erect is called 'Weak stem'. It includes following types:-

a) Creeper: - The weak stem which grows horizontally on the surface of the soil is called 'Creeper'. Ex: Sweet potato.

b) Decumbent: prostrate stem with top becoming vertical.

c) Climber: - The weak stem which climb upon other erect support with the help of special structures developed on them is called 'Climbers'. Ex: Betel, Pothas (Money plant).

17) Mention functions of stem.

Functions of stem are as follows:-

1. Stem gives support to branches, leaves, Flowers and Fruits.
2. It conducts water and minerals from root system to different parts of shoot system and food from leaves to the root system.
3. In some plants, stem perform Photosynthesis.

18) Classify stem modification . mention its significance.

Any change in normal form and structure of shoot or its parts, in response to the need of the plant is called 'stem modification'. It is classified into 3 types. They are

1**) Underground stem Modification**. In this type stem is modified with in soil and meant for vegetative propagation and perrenation. Ex- Ginger, potato, onion, yam

2) **Sub-aerial stem**:-In this type stem is just above or below the soil surface. It is meant for vegetative propagation. Ex: Oxalis, Mint, Eiichornia, Colocasia.

3) **Aerial stem modification**. Ex:- In this type various parts of the stem is modified to perform functions like Photosynthesis, reduce transpiration, to help in vegetative propagation, to act as defensive organ.

19) **Explain underground stem modified for food storage**

"Underground stems modifications". Includes 4 types. They are: -

A] Rhizome] Tuber C] Corm D] Bulb

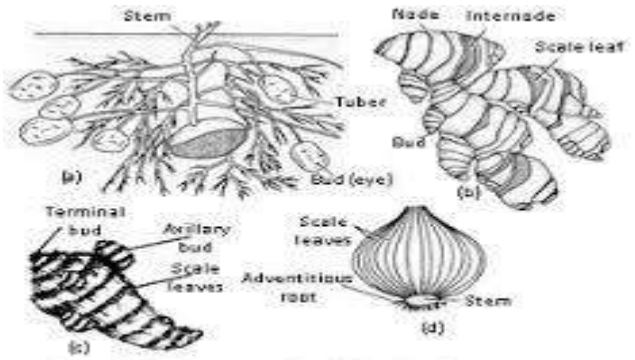


Fig: 5.1-7 Underground modification of stem
(a) Tuber of potato (b) Rhizome of ginger (c) Corm of colocasia (d) Bulb of onion

A] Rhizome: -Rhizome is a modified underground stem that grows horizontally below the soil surface. It consists of number of Nodes and Internodes. At nodes Scales are present. In the Axil of scale leaf Axillary bud and at the apex of Rhizome Terminal bud is present. Towards lower sides of the Nodes Adventitious roots are present.

The terminal bud develops into Leafy shoot and axillary bud develops into daughter Rhizome. These on separations from the mother plant, it develops into an independent plant. **Ex: Ginger, Turmeric**

B] Tuber:-Tuber is a bulged tip of lowermost branches of stem just below the soil surface. Tuber contains number of eyes that represent nodes. Each Eye consists of reduced scale leaf with axillary bud in its axil.

When Eyes of the Tuber separates from the mother Tuber and placed in moist soil, axillary develops into daughter plant. **Ex:Potato**

C] Corm: - Corm is an Underground stem. It is thick, Fleshy, Spherical shaped, grows vertically below the soil. It bears Scale leaves. In the axil of Scale leaves axillary buds are present. In its lower surface Adventitious roots are present. Single terminal bud develops into Leafy shoot. Axillary bud develops into daughter corm; this on separation from mother plant develops into independent plant**. Ex: Amorphophallus (Yam)**

D] Bulb: - Bulb is an underground modified stem meant for vegetative propagation and storage of food. In Bulb Stem is very much condensed into Disc like structure. From its lower surface number of adventitious roots develops and from its upper surface concentrically arranged fleshy scale leaves are present. In the axil of Scale leaf Axillary bud, at the central region terminal bud is present.Terminal bud develops into flowering shoot and axillary bud develops into daughter buds. This on separation from mother Bulb develops into in dependent plant. **Ex: Allium cepa (Onion).**

20) Describe sub-aerial stem modified for vegetative propagation.

In some plants stem grows horizontally just above or just below the soil. They are mainly meant for vegetative propagation. It includes 4 Types. They are:

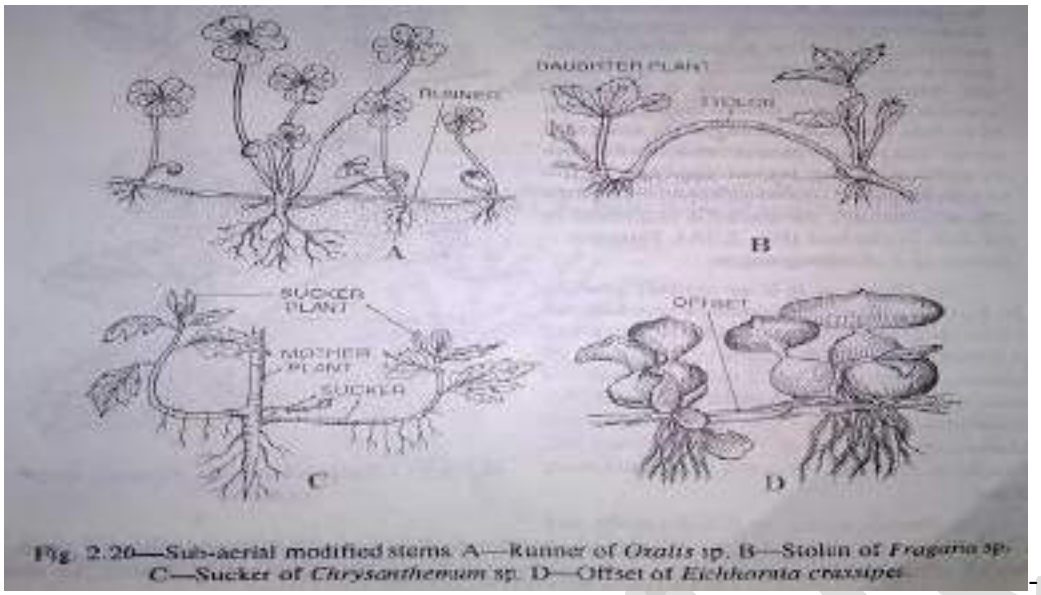


Fig. 2.20—Sub-aerial modified stems. A—Runner of *Oxalis* sp. B—Stolon of *Fragaria* sp. C—Sucker of *Chrysanthemum* sp. D—Offset of *Eichhornia crassipes*

A] Runner. Ex: Oxalis. Runner is sub aerial stem modified for Vegetative propagation. Stem is long, slender, branch that develops from axils of leaves and creeps on the surface of the soil. At each node it develops shoots above and adventitious roots below. These when separates from the mother plant develops into an independent plant.

B] Stolon .Ex: Colocasia, Metha (Pudina) Stolon is modified sub aerial stem modified for Vegetative propagation. It is an elongated structure grows upwards, bends down, touch the soil, and produce roots below and leaves above.
This on sepration from the mother plant develops into an independent plant.

C] Offset. Ex: Eichhornia , Pistia. Offset is a modified sub- aerial stem in Hydrophytes (Plants growing in water). Offsets are a short, stout, prostrate branch that grows in all directions from mother plant.This on separation from mother plant develops into independent plant.

D] Sucker. Ex:Chrysanthimum. Sucker is modified sub aerial stem .It is a Lateral branch that develops obliquely below the soil from underground stem. When it comes above the surface of the soil, develops into shoot.
When it separates from the mother plant, it develops into an independent plant. Different parts of the aerial shoot system are modified to perform different functions like protection, climbing, photosynthesis, vegetative propagation etc.

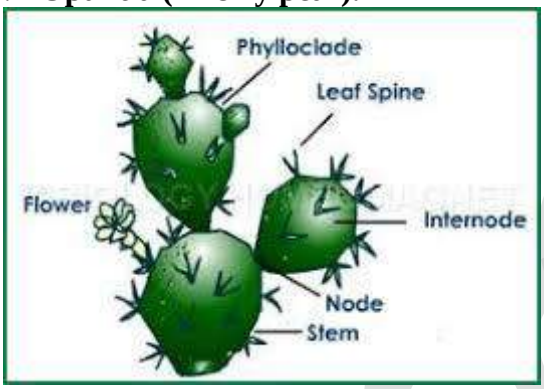
20) <u>What is Stem tendril? Mention its significance with example.</u>

Tendrils are long, slender, coiled modified structures which are sensitive to contact. They help the plants in climbing. In **Vitis quadrangularis** terminal bud is modified into Tendril. In **Passion flower (Passiflora)** axillary bud is modified into Tendril.

21) <u>What is Stem Thorn? Mention its significance with example.</u>
Thorns are hard pointed structures modified to provide protection.Ex: **In Canthium** axillary bud, **In Carrisa** Terminal bud is modified into thorn.

22) What is meant by Phylloclade? Mention its significance.

Phylloclade is Green, Fleshy, Cylindrical or Flattened or Spherical structures meant for photosynthesis. Here Leaves at nodes are modified into spines or Scales to avoid Transpiration.Ex: - **Opuntia (Prickly pear).**



23) What is Cladode? Give an example.

Cladode is a small, green, flat, leaf like modified lateral branch with only one or two internodes meant for photosynthesis. Leaves are reduced to small scales.Ex: **Asparagus.**

24) What is Bul-bil? Give example and significance.

Bul-bils are bulged vegetative or floral buds meant for Vegetative propagation.
Ex: **In Agave** Florl buds**. In Dioscoria** Vegetative buds are modified.

LEAF

25) What is Leaf? Mention its function.

Leaf is a Flat, green, lateral appendage developed at the nodal region on the stem. It is meant to perform Photosynthesis.

26) With neat labelled diagram explain the structure of Typical Dicot leaf .

Dicot leaf posses 3 parts. They are Leaf base, Petiole, Lamina**.**

1. **Leaf base:-The point of attachment of the Leaf to the stem is called "Leaf base".**
2. **Petiole"-The narrow cylindrical, stalk of the leaf is called "Petiole".** The leaf with Petiole is called **Petiolate;** the leaf without Petiole is called **'Sessile.**
3. **Stipule:-**At the base of the Petiole arise a pair of lateral small, green outgrowths called **'Stipules'**. The Leaf with stipule is called:" **Stipulate'**. Leaf without stipule is called " **Ex stipulate".**
4. **Lamina:-**The flat, Green, expanded part of the Lamina is called **"Lamina "or "Leaf blade".** The tip of the lamina is called **"Leaf apex",** The Edge of the lamina is called **"Leaf margin".** It may be smooth or entire or serrate or undulate or dentate or Spiny. The shape and size of Lamina shows variations.
5. **Mid-rib:-** The main that extends from Petiole to apex in the middle of Lamina is called **"Mid rib",** it is the main Vasculature. It gives rise to variously distributed "**Veins".** These are secondary vasculature (Transport water, dissolved salts and Organic food).It gives rise to delicately branched **"Vein lets".**

27) **Mention types of leaf margin**.

Margin of Lamina is called 'Leaf margin'. It is of following types;-

1. **Entire-** Margin is smooth. Ex: Mango
2. **Undulate or wavy:** Margin is wavy. Ex: Polyathia.
3. **Serrate-**margin is saw like teeth. Ex: Rose, Hibiscus.
4. **Dentate-**Margin is toothed. Ex: Water lilly.
5. **Spiny-** Margin is spiny. Ex: Datura.

28) Mention Shapes of leaf with examples.

Leaf Shapes are of various types . they are as follows:-

1. Linear:-Uniformly long, narrow and flat .Ex: grass.
2. Lanceolate: - Apical portion is tapering and shaped like lance .Ex: Nerium.
3. Oblong:-Base and apex are rounded uniformly long. Ex: Banana.
4. Elliptical:-Longer than broad and breadth is uniform. Ex: guava.
5. Ovate: Egg shaped, Broad at base tapering at apex. Ex: China rose.
6. Cordate: - Heart shaped. Ex: Betel.

29) Differentiate between Glabrous and Glaucus keaf surface.

Leaf surface may be hairy, smooth etc. If surface is smooth it is called **Glabrous**. Ex: Mango. If **Surface** covered with waxy coat it is called **Glaucus:** .Ex: Calotropis.

30) What is meant by Coriaceous leaf? Give an example.

If Lamina is firm, dry, and leathery it is called **Coriaceous** . Ex: Sapota

31) What is meant by Venation? Mention the types.

The rib –like, linear structures present in the leaf blade that arise from mid-rib constitutes Veins. It gives rise to lateral Vein lets**. Distribution and arrangement of Veins and Vein lets with in Lamina of leaf is called" Venation** Based on arrangement of veins and vein lets In Lamina, Venation is classified into 2 major types. **They are 1) Reticulate venation 2) Parallel venation.**

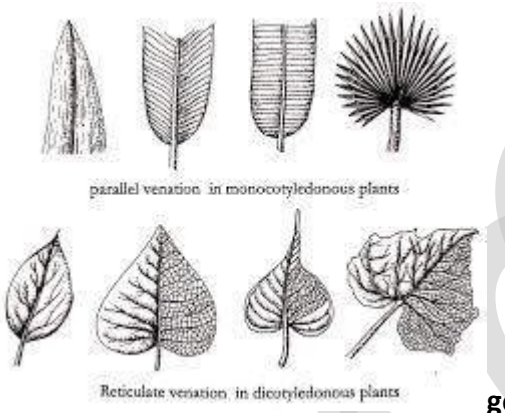
32) Explain Types of Venation.

The rib –like, linear structures present in the leaf blade that arise from mid-rib constitutes Veins. It gives rise to lateral Vein lets**. Distribution and arrangement of Veins and Vein lets with in Lamina of leaf is called" Venation. It is of 2 types , namely Reticulate , Parallel 1.Reticulate Venation:** - In Reticulate Venation Veins and Veinlets are repeatedly branched to form network or Reticulum**. Ex: Dicot leaf.** It is further grouped as follows:-

- **Unicostate(Pinnate type):-**In this type single midrib gives out lateral veins on either side like plumes of feathe**r.** Ex: Peepal.

- **Multicostate(Palmate type):-**In this type, two or more veins are given out from base of Lamina. It may be Convergent or Divergent.

a) **Multicostate Convergent type:** - In This type 2 or more major veins arising from leaf base converge towards leaf apex**.** Ex :ZIzipus .



b) Multicostate Diver gent:-In this type 2 or more major veins arise from leaf base and diverge towards the leaf margin. Ex:-Castor**.**

2.Parallel Venation:-In Parallel Venation all major veins run parallel to one another either from midrib to margin or from base to apex of the leaf. Ex: Monocot leaf. It is further grouped as follows:-

- **Parallel Unicostate**: - In this type single mid rib and veins run parallel to one another.Ex: canna.
- **Parallel multicostate**:-In this type two or more major veins arise from base pass through lamina and converge towards apex called' **Multicostate convergent'** as bamboo. Or diverge towards margin called '**Multicostate Divergent'** as in palm.

33) What is Stipule? Mention its types.

Stipule is a small leafy appendage present at the base of the leaf. It protects leaf in bud condition. The Leaf with stipule is called" **Stipulate"**. Leaf without stipule is called "**Ex stipulate".** They are of various types such as Free lateral, Adnate, Interpetiolar,Foliaceous, Ochreate.

33) Describe types of Stipules.

Stipule is a small leafy appendage present at the base of the leaf. It protects leaf in bud condition. The Leaf with stipule is called" **Stipulate"**. Leaf without stipule is called "**Ex stipulate".**

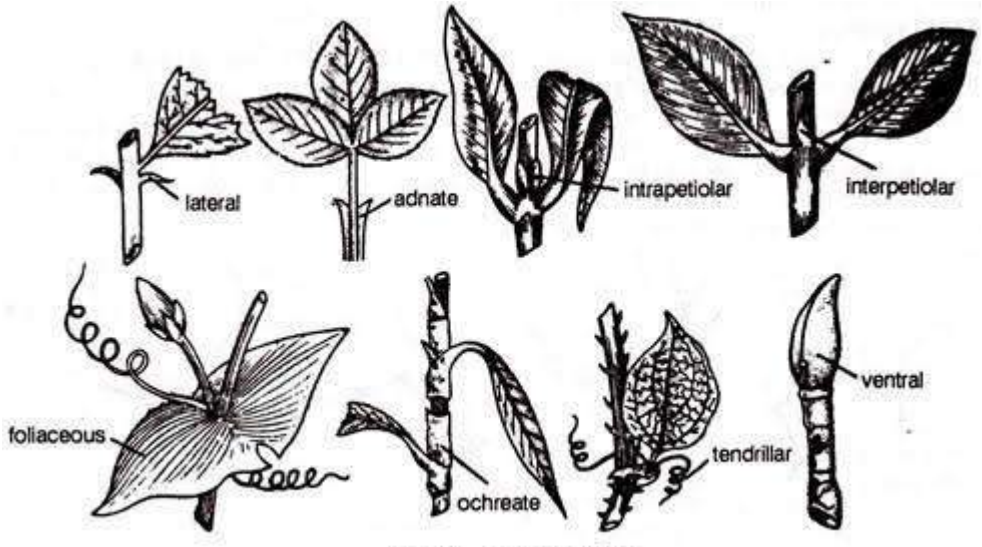


Fig. 74. Kinds of stipules.

1. **Free Lateral: -** Small greenish outgrowths one on either side of the leaf base is called" Free lateral". It is the simplest type of stipule. **Ex: Hibiscus, Gossypium.**
2. **Adnate(Adherent):-** Two lateral stipules fused with the petiole for some distance forming wing like structure .**Ex: Rose**.
3. **Interpetiolar**: In this type Stipules are present in between the petioles of opposite leaves.**Ex: Hamelia. Coffee.**
4. **Foliaceous:**-In this type Stipules are large, green and leaf like in structure. **Ex: Pea.**
5. **Ochreate**: In this type stipules fuse to from a tubular structure covering the stem above the node up to a certain height. **Ex: Polygonum.**

34) What is meant by phyllotaxy? Mention its types with significance.

The pattern of arrangement of leaves on Nodes of the stem at its branches is called "Phyllotaxy". Phyllotaxy can be classified into Alternate, Opposite and Whorled. It is meant to expose all the leaves to receive uniform sunlight.

35) **Explain types of Phyllotaxy with neat diagram**.

The pattern of arrangement of leaves on Nodes of the stem at its branches is called "Phyllotaxy". Phyllotaxy can be classified into Alternate, Opposite and Whorled. It is meant to expose all the leaves to receive uniform sunlight.

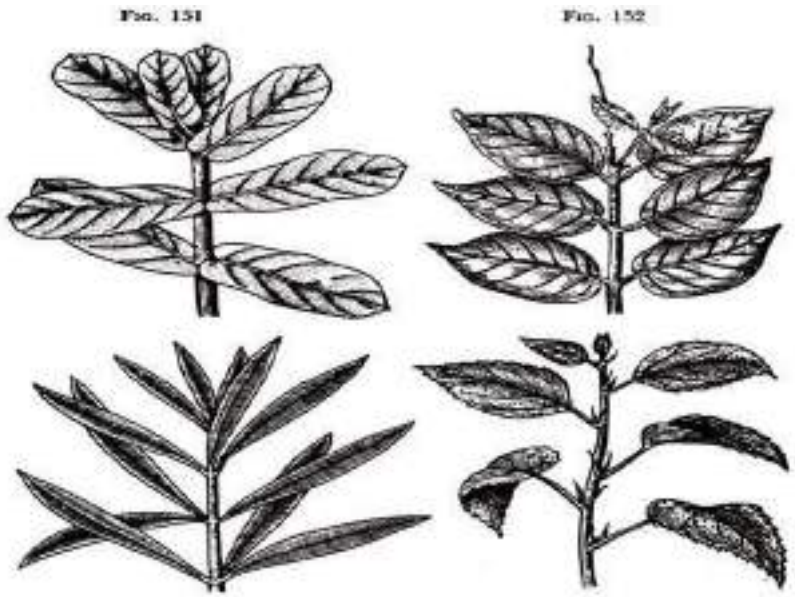


FIG. 151 FIG. 152

FIG. 153 FIG. 154

PHYLLOTAXY. FIG. 151. Opposite decussate in *Calceolaria*. FIG. 152. Opposite superposed in *Quisqualis*. FIG. 153. Verticillate (whorls of three) in *Nerium oleander*. FIG. 154. Spiral (*pentastichous*) in china-rose.

- **Alternate (Spiral):-In Alternate type** Single leaf at each node alternately. Or in a spiral manner around the stem. Ex: Hibiscus.
- **Opposite: -In Opposite type** two leaves at each node opposite to each other.
  In **Opposite Decussate, a** pair of leaves arise alternating planes at each node, at right angles to each other. Ex: Calotropis, Ixora.
  In Opposite **Superposed, A pair of leaves arise in same plane at** successive nodes are on the same plane. Ex: Guava.
- **Whorled:** - In Whorls Phyllotaxy three or more leaves arise in whorls at every node. Ex: Nerium.

36) Explain types of compound leaves.

Leaf is a Flat, green, lateral appendage developed at the nodal region on the stem. It is meant to perform Photosynthesis.Based on the number of leaf blades per petiole Leaves are classified into 2 types. They are Simple leaves and Compound leaves.

Leaf with many leaflets arranged on Rachis is called "Compound leaf". (Lamina is divided into many small separate units called' Leaf lets'. Rachis is Petiole of the compound leaf). Based on the arrangement of leaf lets compound leaf is classified into 2 I] Pinnately compound leaf, II] Palmately compound leaf.

I**] Pinnately compound leaf:-In this type** leaves leaflets arise along rachis. It is of following types:-

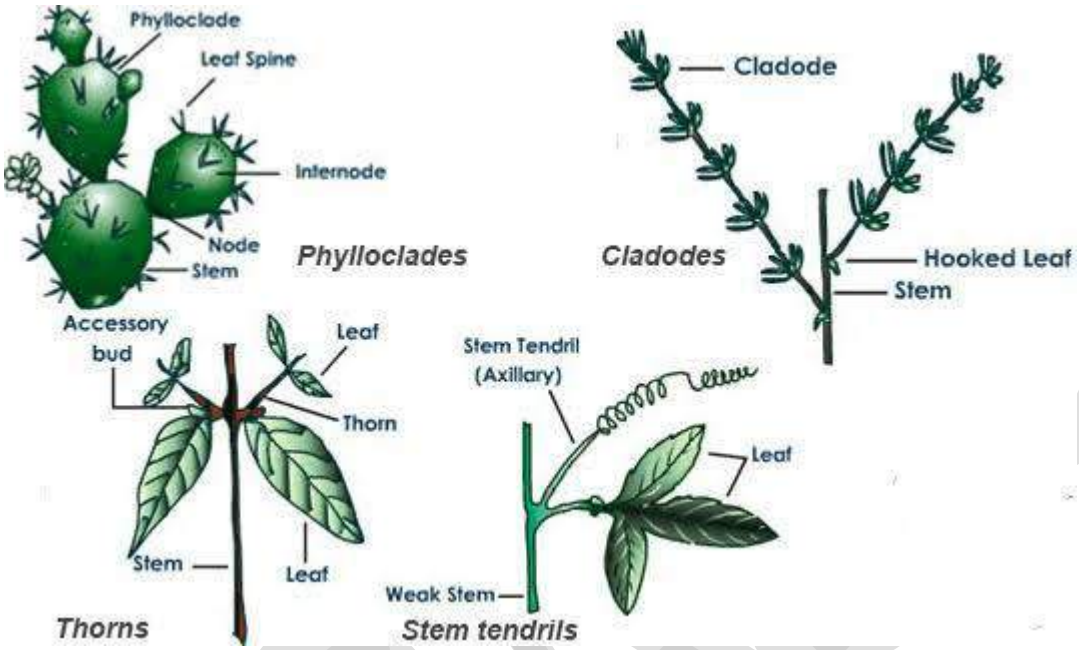
- **Unipinnate**: In this type, leaflets are developed on Primary rachis. If Rachis terminates in a pair of Leaflets it is called **"Paripinnate leaf**" .Ex: Tamarind. If Rachis terminates in single Leaflet, it is called as "**Immaparipinnate leaf"**. Ex: Rose.
- **Bipinnate:** -In this type, Leaf lets are developed on secondary rachis. Ex: Mimosa pudica.
- **Tripinnate:-**In this type Leaf lets developed on tertiary rachis. Ex: Moringa (Drum stick).
- **Decompound:** Rachis branched many times, with leaf lets on ultimate branches.

II] Palmately compound leaf:- In this type leaflets arise from single point at the tip of the petiole. Based on the number of leaf lets present It is of following types:-

- **Unifoliate**: - In this type single leaf let is attached to the winged petiole. Ex: Citrus.
- **Bifoliate**: - In this type two leaf lets are developed from tip of petiole. Ex: Hardwickia.
- **Trifoliate:** - In this type three leaf let's are developed from tip of the petiole. Ex: Aegle marmelosus (Bilva patrae).
- **Quadrifoliate**: - In this type Four leaf let's are developed from tip of the petiole. Ex: Marselia.
- **Multifoliate**: - In this type more than Four leaf lets are developed from tip of petiole. Ex: Silk cotton.

37) Explain modification of Leaf .

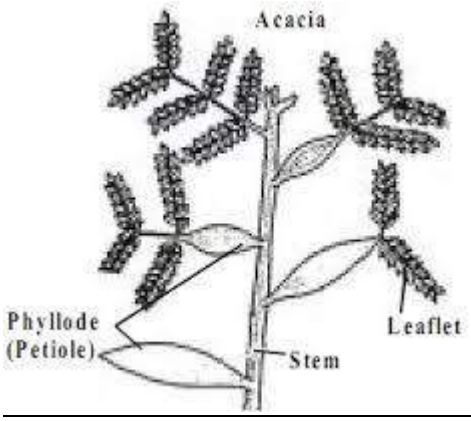
Leaf is a Flat, green, lateral appendage developed at the nodal region on the stem. Any change in normal form and structure of leaf or its parts, in response to the need of the plant is called **'Leaf modification'.** According to the nature of Special functions, the following leaf modifications are recognised:-



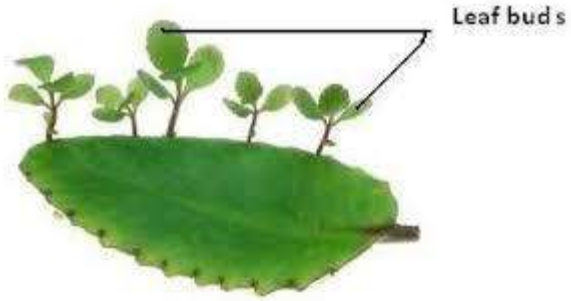
1. **Leaf tendrils: -** Tendrils are long, slender, coiled structures which are sensitive to contact and may develop from any part of the plant, meant for climbing. Such plants are called 'Tendril climbers'. Ex: In Garden Pea terminal leaf let is modified into Tendril, In Gloriosa Leaf tip, In Smilax Stipules are modified into Tendril.

Fig. 34.48. Leaf tendrils and spines. A, leaf spines of *Hakea*; B, leaflet tendril of *Pisum sativum*; C, leaf tendril of *Lathyrus aphaca*. Note the leaf like stipules; D, petiolar tendrils of *Clematis*; E, tendrillar leaf tip of *Gloriosa superba*; F, stipular tendrils of *Smilax*.

2. **Phyllode:-** Green , flattened leaf like modified petiole or Rachis meant for photosynthesis structures when the Lamina is poorly developed is called **' Phyllode". Ex:** In Acacia melanoxylon (Australian acacia) secondary Rachis and leaf lets are shed during early growth and Petiole is modified into Phyllode. In Parkinsonia Secondary rachii of a bicompound leaf is modified into a phyllodes and primary Rachis is modified into a spine.



3. **Leaf Buds:** - Leaf buds are adventitious Buds produced from the surface of the leaf , meant for Vegetative reproduction . They are also known as Epiphyllous buds. Ex: In Bryophyllum, Leaf buds are developed along the margin. They develop roots below and leaves above. This can be developed into an independent plant.



4. **Leaf Spines:-**Hard, pointed structure developed from leaf is called **'Leaf spine'.** It is meant for protection and to check transpiration.Ex: In Acacia stipules are modified into spines. In Date palm, Agave Tip of the leaf is spiny.

38) What is Insectivorous plants? Give examples.

In some plants the leaves are modified for capturing Insects to full fill their Nitrogen fulfilment are called **"Insectivorous plants**" Or **"Carnivorous Plants"**. EX: Drosera, Nepenthes, Utricularia.

39) Describe Insectivorous plants with examples.

Drosera

Nepenthes **Venus fly trap**

In some plants the leaves are modified for capturing Insects to full fill their Nitrogen fulfilment are called **"Insectivorous plants**" Or **"Carnivorous Plants"**. EX: Drosera, Nepenthes, Utricularia.

Ex:1)In **Drosera** Lamina is spoon shaped, covered with sticky hairs called Tentacles, which shine like dew in sunlight. Insect confuse it for Nector and alights on it to suck. Sensitive tentacles bends over insects entrap and digest it by its secretions of tentacles.

2) In **Nepenthes (Pitcher)** entire Leaf is modified into brightly coloured Pitcher, with a lid to trap the Insects**.** Inner wall of Pitcher bears hairs to prevent insect escape and secrete digestive enzymes to digest its protein. The edge of Pitcher is slippery. When an insect alight on pithcher, slips into it and get digested.

3) **Utricularia (Bladder wort)** a submerged Hydrophyte, has submerged leaves and Floating leaves. Floating leaf is modified into a Bladder with Trap door. It allows small aquatic insects to enter, trap door closes and imprison the insect and digest it to full fill Nitrogen requirement.

INFLORESCENCE

40) What is an inflorescence? Mention its types

"Cluster of Flowers produced by a plant, borne on a special reproductive axis is termed as an "Inflorescence". The Inflorescence are classified into 2 main types .They are 1) Racemose or Indefinite type 2) Cymose or Definite.

41) Differentiate between Racemose and Cymose Inflorescence.

"Cluster of Flowers produced by a plant, borne on a special reproductive axis is termed as an "Inflorescence". The Inflorescence are classified into 2 main types .They are 1) Racemose or Indefinite type 2) Cymose or Definite

Sl.no	Racemose inflorescence	Cymose Inflorescence
1	Peduncle shows **continued growth**; hence it is also called "indefinite growth'	Peduncle shows **limited growth**; hence it is also called "**Definite Type'.**
2	Peduncle **never terminates in a Flower**.	Peduncle **terminates in a Flower**.

3	Flowers are arranged in **Acropetal manner** .i.e., The Older flowers are towards the base and Younger flowers are towards the tip.	Flowers are arranged in **Basipetal manner** .i.e., The Older flower is present in terminal region and Younger flowers are towards the base.
4	The order of opening of Flowers is **'Centripetal'** i.e, Lower (Marginal) flowers in the inflorescence are older and open earlier, while the central flowers are younger and open later.	The order of opening of Flowers is **'Centrifugal'** i.e., the central older flowers in the inflorescence open first and the younger peripheral ones open later, while the central flowers are younger and open later.

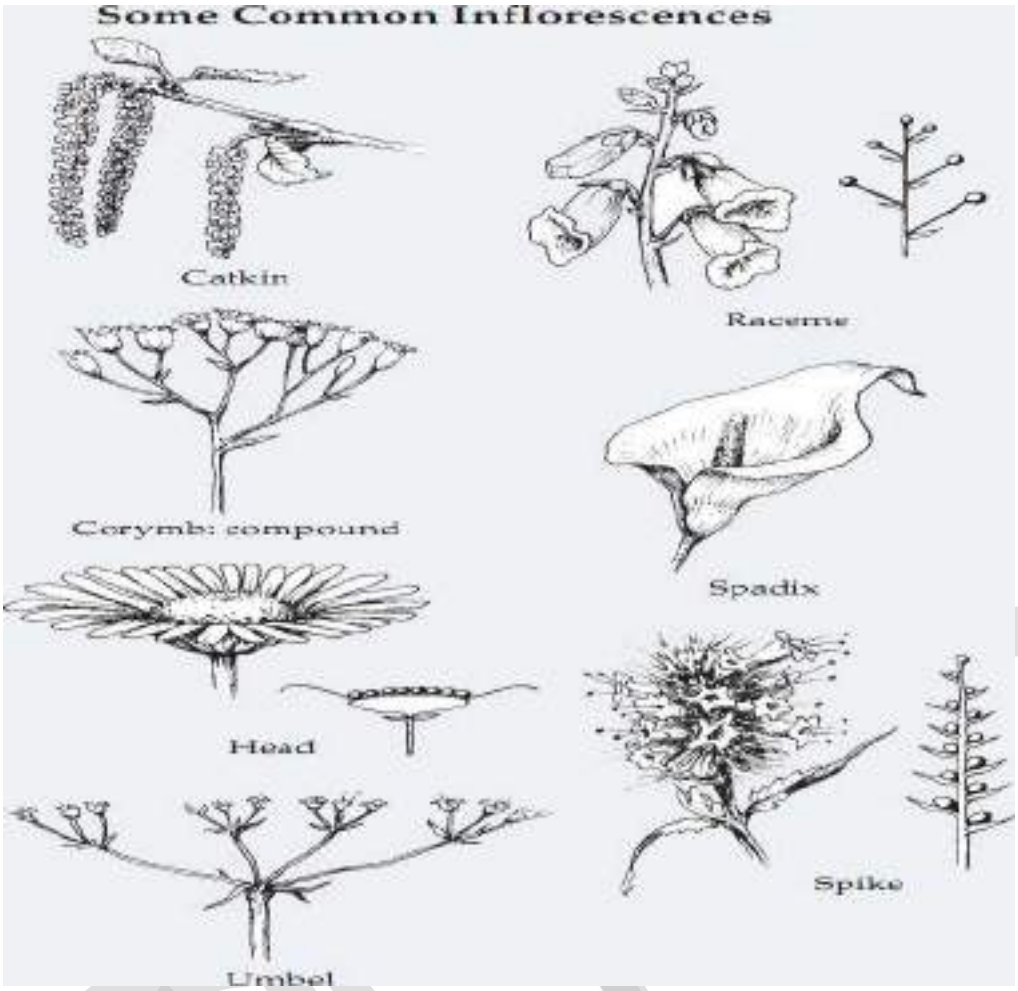
42) Differentiate between Raceme and Spike.(2 marks)

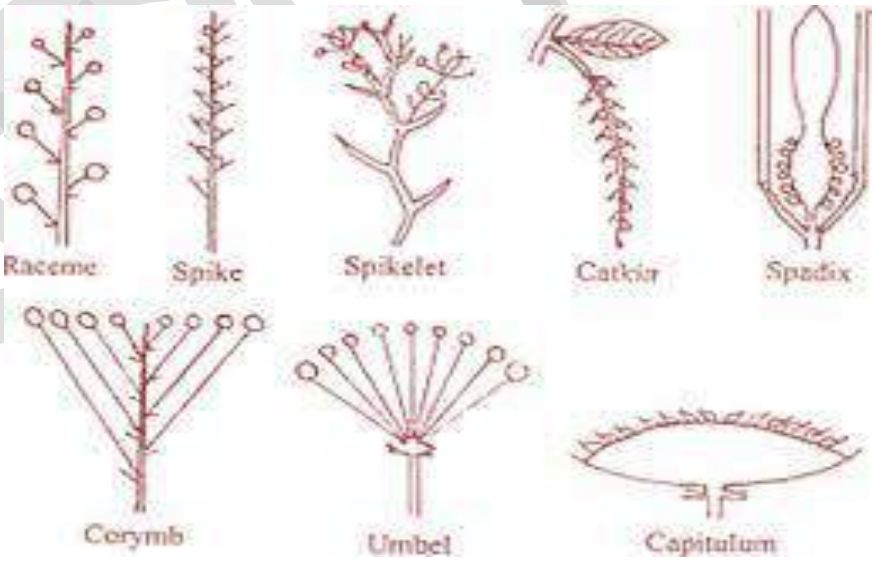
1. **Simple Raceme:-**In this type **elongated Peduncle bears Pedicillate flowers in acropetal manner**.Ex Cassia. If Peduncle is branched and each branch bears pedicillate flowers in acropetal manner it is called 'Compound **Raceme" or "Panicle**". Ex: Mango
2. **Spike**:- In this type **elongated peduncle bears sessile flowers in Acropetal manner.** Ex: Acyranthus.

43) Describe any types Racemose inflorescence. (10 Marks)

Cluster of Flowers produced by a plant, borne on a special reproductive axis is termed as an "Inflorescence". **Racemose Inflorescence** shows **continued growth.**Peduncle **never terminates in a Flower**.Flowers are arranged in **Acropetal manner** The order of opening of Flowers is **'Centripetal'**

Racemose inflorescence is further classified into following types. They are as follows:-





1. **Simple Raceme:-**In this type **elongated Peduncle bears Pedicillate flowers in acropetal manner**.Ex Cassia.
2. **Panicle:**If Peduncle is branched and each branch bears pedicillate flowers in acropetal manner it is called 'Compound **Raceme" or "Panicle**". Ex: Mango

3. **Spike**:- In this type **elongated peduncle bears sessile flowers in Acropetal manner.** Ex: Acyranthus.
4. **Spadix**:- In this type **Peduncle is thick, fleshy, bears sessile unisexual flowers. Entire inflorescence is enclosed by single, large, coloured bract called" Spathe'.** Ex: Colocasia. If Axis of Spadix is branched , each branch bears unisexual flowers & entire florescence is covered by large woody, boat shaped bract, it is called **"Compound Spadix".** Ex: Musa.
5. **Corymb:-**In this type **Peduncle is short and Pedicels of the lower flowers are much longer than upper flowers**, so that all flowers are more or less placed at the same level. Ex; Gold mohur.
6. **Umbel:-**In this type Peduncle is highly condensed, flowers have equal length pedicels arising from same point. Flowers are bracteate and bracts are arranged in a whorl at the base to form Involucre. Ex: Onion. If the main axis is branched and branches are of equal size, which bear flowers with pedicels like Umbel, it is called **"Compound Umbel".** Ex: Carrot, Coriander.
7. **Head or Capitullum:-**In this type Peduncle is flattened to form a circular disc called "Receptacle". On its lower surface it bears large number of green bracts forming an Involucre. The Flowers are arranged on the receptacle in a centripetal manner. I.e. The central flowers are younger and peripheral ones are older, and the sequence of blooming is from periphery towards the centre.

The sessile small flowers are called 'Florets'. There are 2 types of Florets, the peripheral Zygomorphic Ray florets and central, actinomorphic 'Disc florets'. Based on type of florets in an Inflorescence it can be grouped into 2 types, namely 1) **Homogamous head** – Head inflorescence with only one type of Floret. 2**) Heterogamous head**- Head inflorescence with both Ray floret and Disc floret.

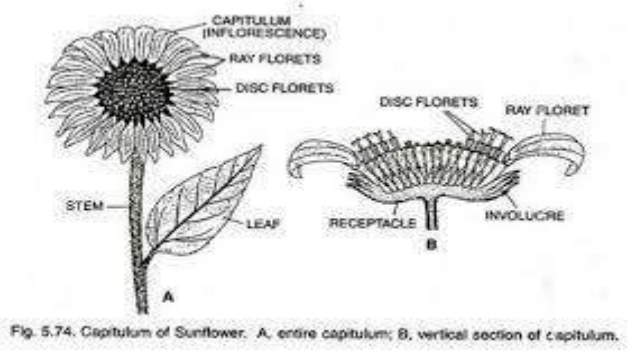


Fig. 5.74. Capitulum of Sunflower. A, entire capitulum; B, vertical section of capitulum.

44) List characteristics of Cymose Inflorescence.(2 marks)

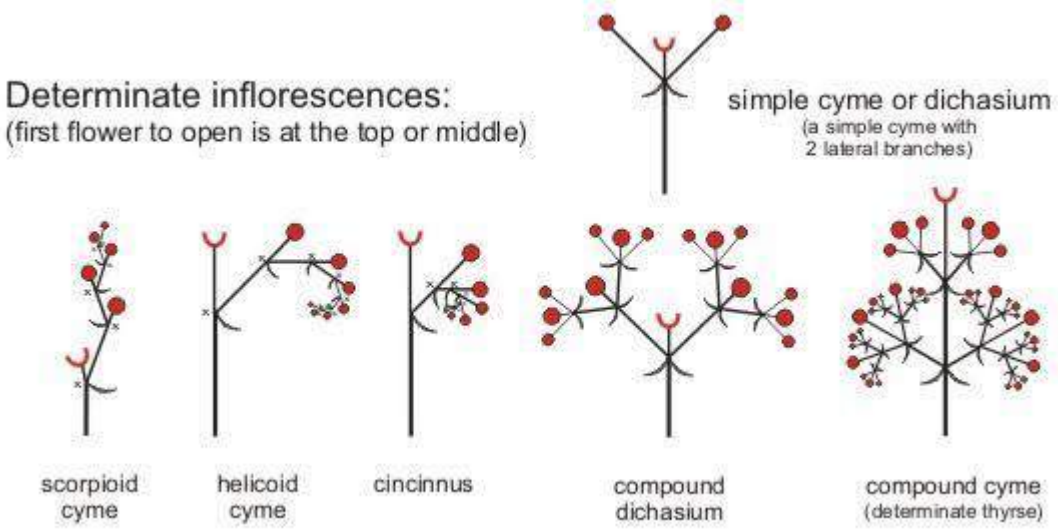
- Cymose Inflorescence shows following characters:-
  Peduncle shows **limited growth**; hence it is also called "**Definite Type'.**
- Peduncle **terminates in a Flower**.
- Flowers are arranged in **Basipetal manner** .i.e., The Older flower is present in terminal region and Younger flowers are towards the base.

- The order of opening of Flowers is **'Centrifugal'** i.e., the central older flowers in the inflorescence open first and the younger peripheral ones open later, while the central flowers are younger and open later.

45) Explain Cymose Inflorescence.(5 marks)

Cluster of Flowers produced by a plant, borne on a special reproductive axis is termed as an "Inflorescence". In Cymose Inflorescence Peduncle shows **limited growth**; It **terminates in a Flower**.Flowers are arranged in **Basipetal manner** .i.e., The Older flower is present in terminal region and Younger flowers are towards the base.The order of opening of Flowers is **'Centrifugal'** i.e., the central older flowers in the inflorescence open first and the younger peripheral ones open later, while the central flowers are younger and open later.

CYMOSE INFLORESCENCE is of following types :-



1. **Monochasial or Uniparous cyme**: -

In this type the main axis terminates in a flower. It then produces lateral branch in the axil of a bract, which also ends in a flower. On the basis of development of flowers two main forms are recognized. They are:- Helicoid cyme and Scorpoid cyme.

a) Helicoid cyme: - In this type successive branches are developed on the same side forming helix. Ex: Hamelia.

b) Scorpoid cyme:-In this type successive lateral branches are developed from bracts alternately on the opposite sides of the axes resulting in the Zigzag manner. Ex: Heliotropium.

2. **Dichasial Cyme:** - In this type main axis terminates in a flower, and then 2 flowers develop from axils of oppositely placed bracts behind it. Ex; Jasmine. From this various compound Dichasium are developed as in Clerodendron, Ixora.
3. **Polychasial Cyme**:-In this type main axis terminates in a flower, then more than 2 lateral branches are developed simultaneously, each of which behaves in a similar manner. Ex: Calotropois.

46) What is meant by mixed Inflorescence? Give Examples.(2 marks)

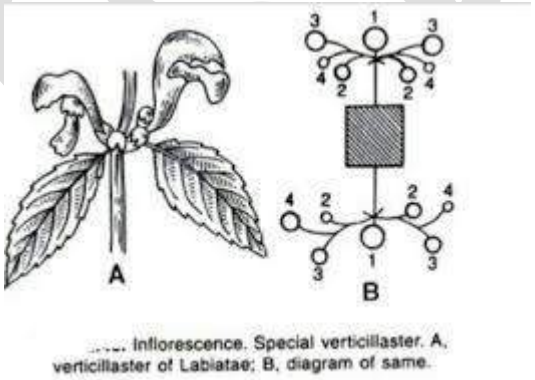
An Inflorescence which shows characters of both Racemose and cymose inflorescence is called 'Mixed type'. It includes one type. Namely **Thyrsus.** In Thyrsus the Peduncle grows idefinaltly as in Raceme, and it bears flowers in cymose cluster in an acropetal manner**.**Ex: Ocimum sanctum (Tulsi-Basil).

47) What is meant by Special Inflorescence? Give Examples.(2 marks)

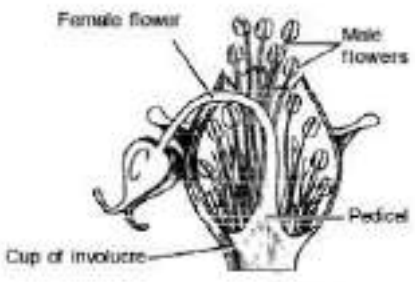
Special Inflorescence may show characters of racemose or Cymose along with its own special characters. It includes 3 types, they are **1. cyathium, 2.hypanthodium, 3.verticillaster**

48) Explain Special Inflorescence with examples.(10 marks)

Special Inflorescence may show characters of racemose or Cymose along with its own special characters. It includes 3 types, they are **1. cyathium, 2.hypanthodium, 3.verticillaster**



...rescence. Special verticillaster. A, verticillaster of Labiatae; B, diagram of same.



Cyathium

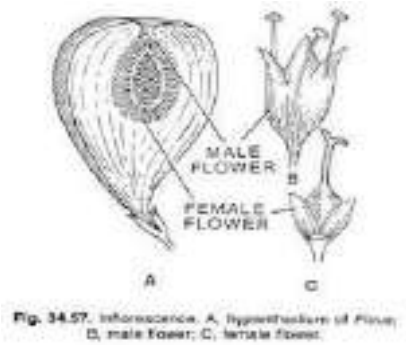


Fig. 34.57. Inflorescence. A, hypanthodium of Ficus; B, male flower; C, female flower.

1. CYATHIUM: -Cyathium is a specialized cymose inflorescence. It has cup like structure formed by fusion of bracts. It encloses disc like axis with Single centrally placed pistillate flower (Female flower) with long pedicel which brings out of the cup. It is surrounded by many staminate flowers (Male flowers) arranged in Zig-Zag manner. Honey secreting disc called Nector gland is present towards one side of the cup. Ex: Euphorbia.

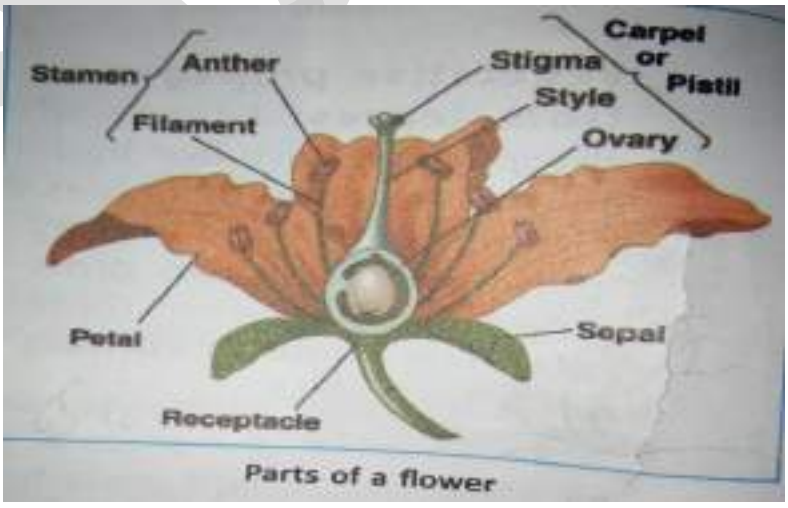
2.HYPANTHODIUM:-In Hypanthodium Peduncle condenses to form fleshy, cup shaped receptacle with an opening called 'Ostiole". Receptacle encloses hallow cavity which bears unisexual flowers. Male flowers are present towards ostiole and female flowers towards base. Between these two are sterile Goll flowers. Ex: Figs.

3. VERTICILLASTER: - Verticellaster is the characteristic inflorescence of the Family 'Lamiaceae'. In this type in the axil of opposite leaves Biparous cyme develops, Lateral branches of it produces Uniparous Scorpoid cyme. The flowers are sessile and form a false whorl (Verticel) around the stem.

FLOWER

47) Describe Typical Flower with an example.(5 marks)

Flower is a modified shoot meant for Sexual reproduction. A Typical Flower consists of following parts:-



1. **Pedicel: -** Stalk of the Flower is called "Pedicel". Flower with stalk is called 'Pedicillate' and flower without Stalk is called 'Sessile'. It arises from the axil of a leaf like structure called 'Bract'.If it is present it is said to be Bracteate , absent as ebracteate flower.
2. **Thalamus:-** Thalamus is the bulged tip of the Pedicel on which flower whorls like Calyx, Corolla, Androecium and Gynoecium are present.
3. **Calyx (K):-** Calyx is the outermost and protective whorl. It consists of small green Sepals. If sepals are free it is said to be **Polysepalous. If** sepals are fused **Gamosepalous.** Whorl of bracteoles below the calyx is called **Epicalyx.**
4. **Corolla(C)**:-

Corolla is the second whorl of the Flower. It **is colored &often scented.** Unit of Corolla l is called Petal. If petals are free it is said to be **Polypetalous.**

5. Androecium (A):-

Androecium is the third and male reproductive whorl of a Flower. It consists of many Stamens. Each Stamen has long Filaments with 2 Anther lobes bearing pollen grains attached by connective. If Filaments of all the stamens are fused and anthers free, filaments are fused to form one bundle it is called **Monadephous**.

6. **Gynoecium(G)**: -

Gynoecium is the innermost and female reproductive whorl. It consists of Basal Bulbous Ovary, Middle Style and terminal Stigma. Ovary with many carpels **Multicarpellory. If** Carpels fused **Syncarpous ,Multilocular** with ovules on axile placentation.

48) What is meant by Hypogynous flower? Give an example.(2 marks)

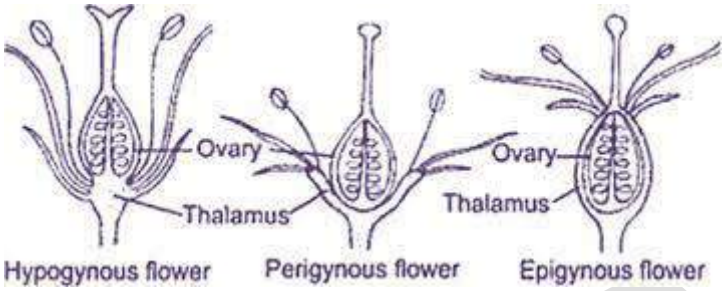
The Flower in which Thalamus is dome shaped and floral parts Calyx, Corolla, Androecium and Gynoecium are developed below the Gynoecium is called "**Hypogynous flower". The position of the ovary is said to be superior.Ex: Hibiscus, Coconut.**

49) Mention position of ovary in Hypogymous flower and Epigynous with examples.(2 Marks).

In Hypogynous Flower the Position of Ovary is Superior Ex: Hibiscus and In Epigynous Flower is Inferior Ex: Sunflower.

50) With diagrams describe types of Flower . (5/ 10 marks)

Flower is a modified shoot meant for Sexual reproduction. A Typical Flower consists of **icel: -** Stalk "PedicelThalamus is the bulged tip of the Pedicel on which flower whorls like Calyx, Corolla, Androecium and Gynoecium are present. Based on position of the Ovary with respect to the other floral whorls .Flower can be classified into 3 types as follows:-



1. **Hypogynous:-**The Flower in which Thalamus is dome shaped and floral parts Calyx, Corolla, Androecium and Gynoecium are developed below the Gynoecium is called "**Hypogynous flower". The position of the ovary is said to be superior.Ex: Hibiscus, Coconut.**
2. **Perigynous:-** The Flower in which Thalamus is Cup shaped, Gynoecium is centrally placed, Calyx, Corolla, Androecium are developed from the rim of cup is called **"Perigynos flower'.** The position of the Ovary is said to be **'Semi superior' or 'Semi inferior'. Ex: Rose,**
3. **Epigynous**:-The Flower in which Thalamus is cup shaped and completely united with the ovary and Calyx, Corolla, Androecium are developed above the Ovary is called **" Epigynous".** The position of the Ovary is said to be **'Inferior'.Ex: Guava.**

51) Differentiate between Pedicillate and Sessileflower.(2 marks)

Pedicillate: Flower with stalk.**Sessile:**- Flower without stalk.

52) Differentiate between Bracteate and ebracteate flower .(2 marks)

Tiny, leaf like structure from the axil of which flower develops is called **Bract. Bracteate is** Flower with Bract. **Ebracteate is** Flower without bract.

53) **) Differentiate between Bracteateolate and ebracteateolate flower .**(2 marks) Small, scale like structure developed in pairs on pedicel is called **Bracteole**. **Bracteolate is** Flower with bracteole. **Ebracteolate is** Flower without Bracteole.

54) What is an Involucre? Give an example.

Tiny, leaf like structure from the axil of which flower develops is called **Bract. Bracteate is** Flower with Bract. Small, scale like structure developed in pairs on pedicel is called **Bracteole**. **Bracteolate is** Flower without bracteole. When Bracts and Bracteoles occur in whorls it is called **Involucre**. Ex: head inflorescence.

55) Define complete and incomplete flower.

Complete is Flower possessing all the 4 whorls namely K, C, A, G. **Incomplete is** Flower lacking any one or more whorls.

56) Define Dichlamydeous and Monochlamydeous flower.

Dichlamydeous (Heterochlamydeous) is a Flower with calyx and corolla.
Monochlamydeous (Homochlamydeous) is a Flower with perianth.

57) What is Pistillate and Staminate flower?

Achlamydeousis a flower with either Androecium or Gynoecium, but without Calyx and Corolla. **Pistillate is an** Achlamydeous flower with only Pistil**. Staminate is an** Achlamydeous flower with only Stamens.

58) Define Unisexual and Bisexual flower.

Unisexual is a Flower with only one of the reproductive organ either Androecium or gynoecium. **Bisexual is a** flower with both reproductive organs Androecium and Gynoecium**.**

59) What is Pentamerous , tetramerous and Trimerous flower?

Pentamerous is a flower with 5 sepals and 5 Petals in each whorl. **Tetramerous is** a floral organ in four or multiple of four. **Trimerous a** Flower organs with multiples of 3.

60) What is an Actinomorphic Flower? Give an example.

Flower is said to be Actinomorphic When flower is cut through the axis in any plane.Ex: Hibiscus.

61) What is meant by Zygomorphic Flower? Give an example.

A Flower is said to be **ZYgomorphic(Irregular)** When flower is cut through the axis , if it gives 2 symmetrical parts along one plane. EX: Leucas.(Tumbae).

62) Differentiate Glume and Lemma.

Glume is a sterile bracts found in grass. **Lemma is a fertile** bract found in grass.

63) Differentiate Staminode and Pistillode.

Sterile stamen is called Staminode. Sterile Pistil is called Pistillode.

64) What is meant by Epipetalous stamens? Give an example.

When Stamens are attached to petals, it is called Epipetalous. Ex: Vinca rosea.

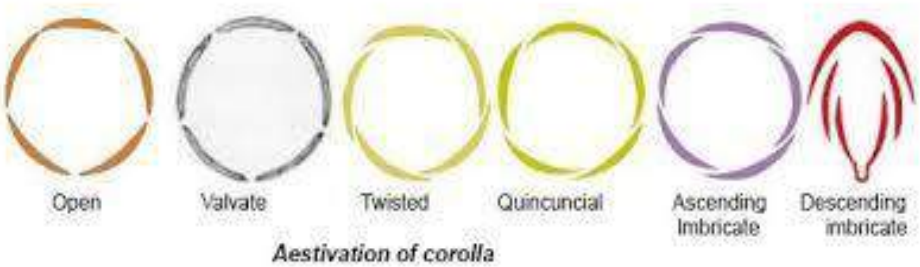
65) What is meant by Aestivation? Mention its types.

The mode of Arrangement of petals and sepals in bud is called "Aestivation". Aestivation is of following types:-Valvate, Twisted, Imbricate,Quincontial.

66) Describe Aestivation with neat diagrams.

The mode of Arrangement of petals and sepals in bud is called "Aestivation". Aestivation is of following types:-Valvate, Twisted, Imbricate,Quincontial.

1. **Valvate**: Arrangement of sepals and petals without overlapping is called 'Valvate'.ex: Mustard, Annona, Mimosa.



Aestivation of corolla

2. **Twisted (Contorted):** In Twisted aestivation all Sepal and Petal show one margin in and one margin out. (Margin of one sepal or petal overlaps the margin of the next). Ex: Hibiscus, Cotton.

3. Imbricate: Arrangement of petals and sepals are in such a way that one petal or sepal shows both margins in, one petal or sepal shows both margins out, rest shows one margin in & other margin out.Two variations are seen in imbricate aestivation.

- **In ascendingly imbricate** aestivation overlapping starts from anterior side, so that posterior petal is internal Ex: Cassia, Caesalpinia.
- **In Descendingly imbricate** aestivation the overlapping starts from posterior side, so that anterior petal is innermost. This is also referred as '**Vexillary aestivation'**. Ex: Pea, Ban, Crotalaria.

4. Quincontial: Two petal or sepal shows both **margins in**, **two** petals or sepal shows both **margins out**, other shows one margin in & other margin out.

67) What is Persistant calyx? Give an example.

If sepals remain after fertilization and present in the fruit , it is called **" Persistant calyx'.**
Ex: Tomato, Brinzal .

68) What is pappus ? Give an example.

Hair like calyx is called Pappus. Ex: Members of Asteraceae**.**

69) Differentiate between Caducous and Deciduous.

If sepals are shed as soon as flower opens it is called '**Caducous'**. If sepals persists as long the Petals it is called 'Deciduous',

70) What is Corolla? Mention its function.

Corolla is the second accessory whorl of a flower composed of Petals. It is brightly colored, fragrant and attractive whorl. If petals are fee it is called Polypetalous.Ex: Hibiscus. If Petals are fused, it is said to be Gamopetalous. Jasmine. Corolla protects essential whorl of a flower and It attracts Insects for Cross Pollination.

71) Define Cruciform corolla? Give an example.

In Cruciform type, Corolla is composed of 4 free clawed petals arranged in the form of cross. Ex: Mustard, Radish.

72) What is meant by papilionaceous Corolla? Give an example.

Papilionaceous: - (Papilion- Butterfly). This is the characteristics of the Family Papilionatae. In this type corolla consists of 5 un equal petals. of these posterior one petal is large called 'Standard petal", two lateral 'Wing petal'or 'Alae', ans anterior 2 petals are united to along one margin forming boat shaped structures called' Keel petal' or 'Carina'. It encloses Essential whorls.

73) Describe different forms of Corolla.

Based on shape and fusion of Petals Corolla exhibits various forms. Some of them are as follows**:-**

- **Cruciform:** In Cruciform type, Corolla is composed of 4 free clawed petals arranged in the form of cross. Ex: Mustard, Radish.
- **Papilionaceous:** - (Papilion- Butterfly). This is the characteristics of the Family Papilionatae. In this type corolla consists of 5 un equal petals. of these posterior one petal is large called 'Standard petal", two lateral 'Wing petal'or 'Alae', ans anterior 2 petals are united to along one margin forming boat shaped structures called' Keel petal' or 'Carina'. It encloses Essential whorls.
- **Companulate**: Bell shaped.
- **Tubular**: In this type united petals form complete tube. Ex: Florets of Asteraceae.
- **Bilabiate**: Corolla fused to form two lips like structures. Ex: Leucas (Tumbae).
- **Infundibulum**: - The corolla produces funnel like structure with terminal parts of the petals gradually spreading out. Ex Datura, Ipomoea.

74) What is meant by Adelphous? Explain its types.

Sometimes stamens in a flower are united by filaments or Anthers or both Anther and filaments. Accordingly they are named as follows:-

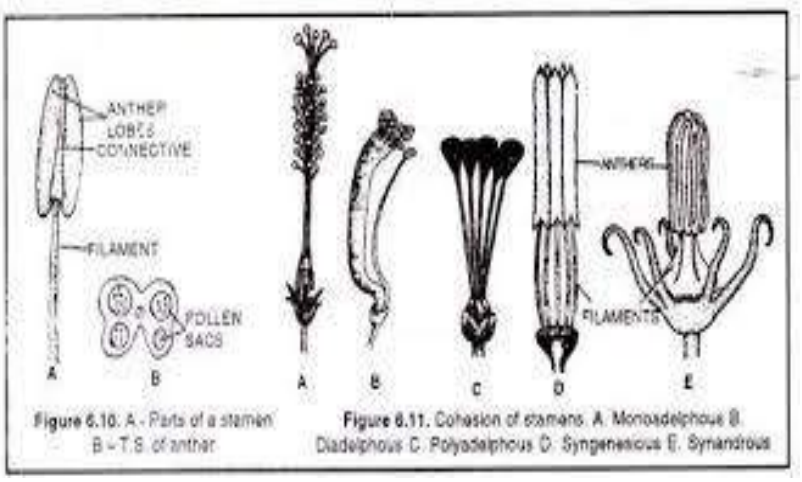


Figure 6.10. A - Parts of a stamen B - T.S. of anther

Figure 6.11. Cohesion of stamens. A. Monoadelphous B. Diadelphous C. Polyadelphous D. Syngenesious E. Synandrous

1. Adelphous:-In a flower if filaments of all the stamens are United and and anthers are free, such condition is called as**" Adelphous". It is of following types:-**

a) Monadelphous: - In this type Filaments of all the stamens are united to form single bundle. Ex: Members of family Malvaceae(Hibiscus, Cotton).
b) Diadelphous:-Filaments in a flower are united to form 2 bundles.Ex: Bean, Pea.
c) Polyadelphous:- Filaments are united to from many bundles of stamens .Ex: Lemon.

2. Syngenesious:- In a flower if Anthers of all the stamens are united and Filaments are free, such condition is called as"**Syngenesious".** Ex: Members of the family Asteraceae.(Sun flower).

3. Synandrous Stamens:- In a flower if filaments of all the stamens and Filaments are united and such condition is called as **"Synandrous Stamens". Ex: Members of the family Cucurbitaceae. (Cucumis).**

75) Differentiate between Didynamous and Tetradynamous stamens.

Stamens often attain different lengths and give rise to following conditions:-
Didynamous means In a Flower if there are 4 Stamens out of which 2 are long and 2 are short Ex: Oscimum, Leucas. **Tetrandynamous** means In a Flower if there are 6 Stamens out of which out of which 4 are long and two are short .Ex: Mustard, Radish.

76) Define Gynostegium.

Style arising from the base of the ovary is called **Gynobasic**. A disc surrounding the base of the style is called **Stylopodium.**

77) Differentiate between Apocarpous and Syncarpous ovary with examples.

The Female reproductive organ of flower gynoecium , number of carpels in an ovary is variable. If it contains one carpel called monocarpellory, more than 5 carpels Polycarpellory ovary. If carpels are free from one another, they are called '**Apocarpus ovary'.** Ex: Michelia, If carpels are united, they are called '**Syncarpus ovary'**, Ex:Ladies finger.

78) What is Placentation? Mention its types.

Placenta is a soft tissue inside the ovary. Arrangement of ovules within the ovary is called '**Placentation'**.Placentation may be **Axile** with Ovules attached to central axis ex; Hibiscus, **Marginal** with ovules attached to ventral margin. Ex: Pea, **Basal** with ovules attached to base of the ovary Ex: Sunflower, **Parietal** with ovules attached to inner walls of the ovary Ex: Cucumis.

79) Define Gynophore, Gynandrophore and Gynostegium.

A stalk bearing gynoecium called **Gynophore**. A stalk bearing both Androecium and Gynoecium is called **Gynandrophore**. A sheath covering the gynoecium and anthers is called **Gynostegium.**

FRUITS

80) Differentiate between True Fruit and False fruit.

The Fertilized, ripened Ovary is called" Fruit". The fruit developed from Ovary is called '**True fruit**. Fruit developed from other floral parts in addition to ovary is called '**False fruit'. Or 'Pseudo carp'.**

81) What is Pericarp? Mention its parts.

The fruit wall is called**" Pericarp**". It is differentiated into Outer Epicarp, Middle Mesocarp and Inner Endocarp.

82) Define Parthenocarpicfruit with an example.

'Fruit developed without fertilization is called **'Parthenocarpic fruit'. Ex: Bannana.**

83) What is Simple fruit? Classify them.

Simple fruits are a Fruit developed from syncarpus ovary of a single flower. **Simple Fruits are classified into 2 types. They are: - Fleshy fruits and Dry fruits.**

84)Differentiate between Aggregate and Multiple fruit.

Aggregate fruits are a Fruit developed from Apocarpus ovary of a single flower. **Multiple fruits is a** Fruit developed from entire Inflorescence.

85) Explain Fleshy fruits. (5 marks).

Fruit developed from Monocarpellory or Polycarpellory syncarpus, ovary of a single flower is called **"Simple Fruit".**

Fleshy fruits are simple fruits in which Pericarp is thick, Fleshy and juicy at maturity. Pericarp is differentiated into outer Epicarp, Middle Mesocarp and Inner Endocarp. It includes 5 types. They are: - Drupe, Berry, Hesperidium, Pome and Pepo.

1. Drupe: - Drupe is a simple fleshy fruit developing from monocarpellary, syncarpous, superior or inferior ovary. Endocarp is hard enclosing seeds. Ex: Mango, Coconut.

In Mango- Epicarp forms the skin, mesocarp is fleshy, juicy and edible, and Endocarp is hard.

Coconut-Epcarp froms the skin, Mesocarp is fibrous, Endocarp is hard and Endosperm is edible.

2. Berry:- Berry is a simple fleshy fruit developing from Bi or multicarpellory, syncarpous ovary. Entire pericarp is fleshy, juicy and edible. Ex: Tomato, guava, Sapota.

3. Hesperidium:-Hesdperidium is a simple fleshy fruit developing from multicarpellory, syncarpus ovary with ovules on axile placenta. It is a characteristic fruit of the family Rutaceae.Epicarp and mesocarp unite to from thick rind, Endocarp is membranous, project

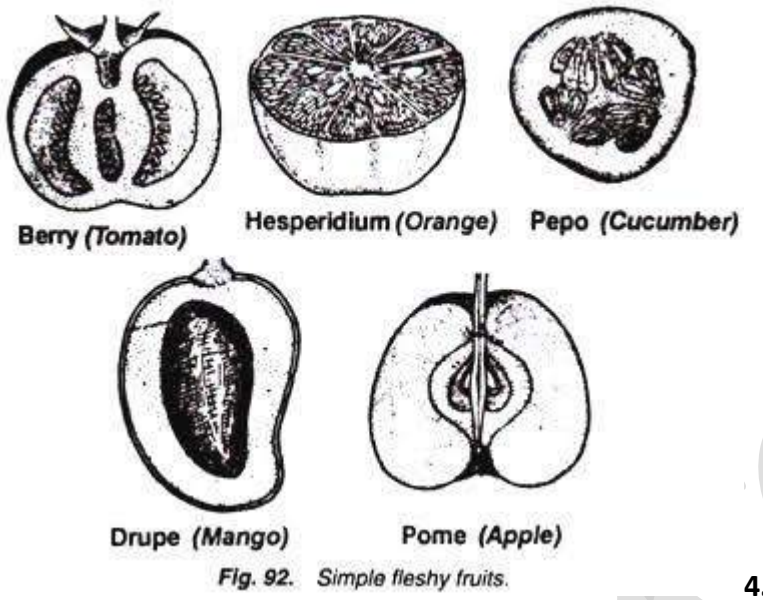


Fig. 92. Simple fleshy fruits.

4. Pome:-Pome is a simple, fleshy flase fruit developing from inferior, syncarpous ovary. Thalamus is fleshy, Juicy, edible part. It encloses Pericarp and seeds. Ex: Apple, Pear. **5. Pepo:-**Pepo is a simple, fleshy flase fruit developing from inferior, Tricarpellory, syncarpous ovary with Parietal placentation. It is characteristic fruit of Family Cucurbitaceae. Placental tissue is fleshy, and edible. Ex: Cucumis, Pumpkin.

86) What is Dry fruit ? Mention its types.

Simple fruits are a Fruit developed from syncarpus ovary of a single flower. Dry fruits are **Simple fruits in which Pericarp is thin, dry at maturity** without distinction into EPicarp, Mesocarp and Endocarp.

Based on the mode of dehiscence of fruit at maturity it is classified into 3 types. They are as follows:-**1. Dry dehiscent fruits: -P**ericarp split open to release seeds.**2. Dry Indehiscent fruits: -** Pericarp never split open to release seeds.**3. Dry schizocarpic fruits: -** Pericarp splits into individual units which never break open.

86) Describe Dry fruits with examples. (10 marks)

Simple fruits are a Fruit developed from syncarpus ovary of a single flower. Dry fruits are **Simple fruits in which Pericarp is thin, dry at maturity** without distinction into EPicarp, Mesocarp and Endocarp. Based on the mode of dehiscence of fruit at maturity it is classified into 3 types.Namely **1. Dry dehiscent fruits,2. Dry Indehiscent fruits3. Dry schizocarpic fruits.**

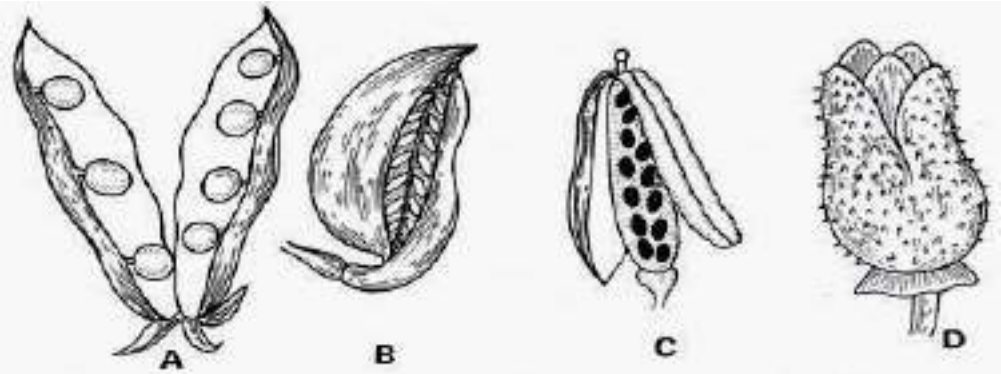


Fig. 34.68. Fruit. A, legume or pod of pea; B, follicle of *Calotropis*; C, siliqua of mustard; D, capsule of *Datura*.

1. Dry dehiscent fruits: - (Pericarp split open to release seeds).

In Simple Dry dehiscent fruits, at maturity Pericarp split open to release seeds. It includes following types:-

a) Legume (Pod): Legume is a dry dehiscent fruit that develops from superior, monocarpellory ovary with marginal placenta. It is a characteristic of Family Leguminosae. At maturity Pericarp dehisce along both the margins to release seeds. Ex; Pea, Bean.

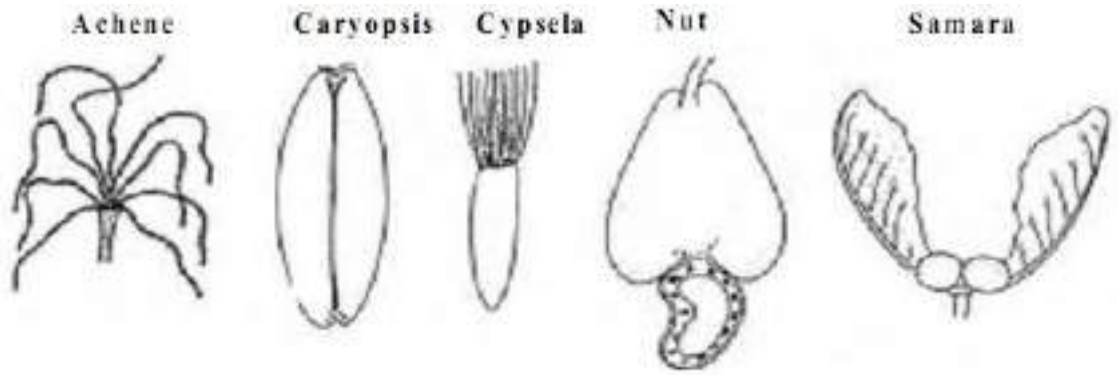
b) Follicle: - Follicle is a simple dry dehiscent fruit developing from superior, monocarpellory ovary. At maturity pericarp dehisce along only on ventral suture to release seeds. Ex: Calotropis.

c) Siliqua:- Siliqua is a dry dehiscent fruit that develops from superior, Bicarpellory, syncarpous ovary with parietal placentation. It is a characteristic fruit of the family Brassicaceae(cruciferae).At maturity pericarp splits along both the margins from base upwards. Seeds are attached to false septum called "Replum". Ex: Mustard.

d)Capsule:- Capsule is a Simple, dry dehiscent fruit developing from superior or inferior, multicarpellory , syncarpous ovary with ovules on axile placentation.

At maturity Pericarp may split along the middle of the locule called "**Loculicidal capsule**". Ex: Cotton, Lady's finger. OR Split along the septa called **"Septicidal capsule**"Ex: Datura.

2. Dry Indehiscent fruits (Pericarp never split open to release seeds).In Simple Dry indehiscent fruits at maturity pericarp never split open to release the seeds. The seeds are released only after the decay of the Pericarp. It includes following types.

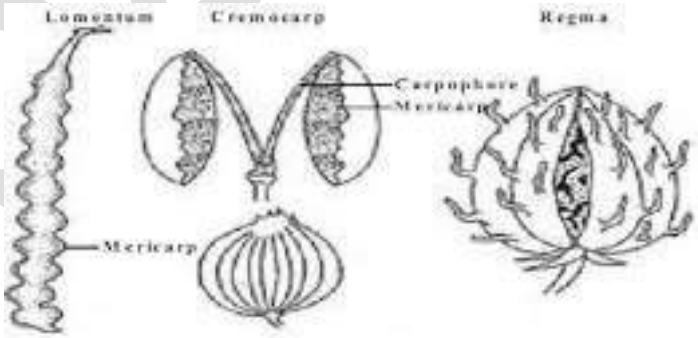


a**) Caryopsis:-**Caryopsis is a Simple Dry indehiscent fruit developing from superior, monocarpelory , unilocular ovary. It is a characteristic fruit of the Family 'Poaceae'.
It is one seeded fruit in which Pericarp is united with the seed coat of seed. At maturity Pericarp never split open to release seed. Ex: paddy, Maize, Whea**t.**

b) Cypsella:-Cysella is a Simple Dry indehiscent fruit developing from inferior, Bicarpelory , syncarpous, unilocular ovary with basal placenta. It is a characteristic fruit of the Family 'Asteraceae'.
It is one seeded fruit in which Pericarp is free from the seed coat of seed. Ex: Sun flower.

c) Nut:-Nut is a Simple Dry indehiscent fruit developing from superior, monocarpelory , unilocular or polycarpellory ovary. Here Pericarp is stony in nature. Ex: Cashew nut.
d) Samara:-Samara is a Simple Dry indehiscent fruit developing from superior, Bicarpelory or Tricarpellory ovary. Pericarp is flattened, wing like structure. Ex: Hiptage.
e) Utricle:-Utricle is a Simple Dry indehiscent fruit developing from superior, monocarpellary ovary. It is single seeded fruit.Ex: Amaranthus.

3. Dry schizocarpic fruits(Pericarp splits into individual units which never break open).In Simple dry schizocarpic fruit, at maturity fruit breaks into individual, indehiscent units called 'Mericarps". It includes following types:-



a**) Lomentum:-**Lomentum is a simple dry schizocarpic fruit developing from monocarpellory, unilocular, superior ovary with marginal placentation.

At maturity fruit splits transversly into single seeded units called 'Mericarp'. Ex: Acacia.

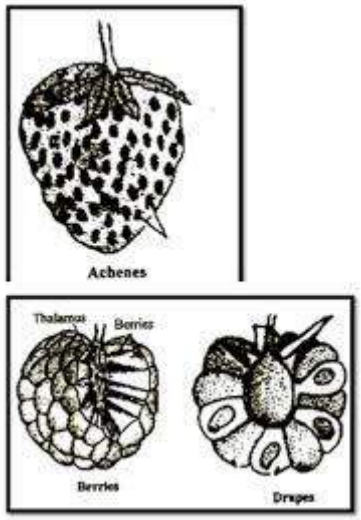
b) Cremocarp:-Cremocarp is a simple dry schizocarpic fruit developing from inferior, bicarpellory, syncarpous, inferior ovary. It is the characteristic fruit of family 'Umbelliferae'. At maturity fruit splits vertically into 2 mericarps held together by central stalk called 'Carpophore'.Ex: Coriander.

c) Regma:-Regma is a simple dry schizocarpic fruit developing from tricarpellory or multicarpellory, syncarpous, trilocular or multilocular, superior ovary.
At maturity fruit splits into many units as number of carpels. Each unit is called 'Coccus'.
Ex: Castor, Geranium.

d)Carcerule:-Carcerule is a simple dry schizocarpic fruit developing from superior, bicarpellory, syncarpous, tetralocular ovary. It is the characteristic fruit of family 'Lamiaceae'.Ex: Leucas.

87) Explain Aggregate fruits.(5 marks)

Aggregate fruits (Fruit developed from Apocarpus ovary of a single flower).An aggregate fruit develops from Multicarpellory, apocarpus ovary of flower. Each carpel develops into small fruitlet. Bunch of fruitlets are together called as 'Etaerio '. Based on the nature of fruitlets Aggregate fruits are classified into many types as follows:-



a) Etaerio of Follicle:-This Fruit develops from Multicarpellory, apocarpus ovary of flower. Each carpel develops into small fruitlet of Follicle ie, it opens along only ventral suture to release seeds, thus all fruitlets together gives rise to Bunch of Follicle. Ex: Calotropis.

b) Etaerio of Drupe:-This fruit develops from Multicarpellory, apocarpus ovary of flower. Each carpel develops into small fruitlet of drupe. Ie., endocarp is hard. Thus all fruit lets together gives rise to Bunch of Drupe. Ex: Rasberry.

c) Etaerio of Berry:-This fruit develops from Multicarpellory, apocarpus ovary of flower. Each carpel develops into small fruitlet of Berry. ie, Entire pericarp is fleshy, juicy and edible. Thus all fruitlets together give rise to Bunch of Berry. Ex: Custard apple.

88) Describe Multiple fruits.(5 marks).

3) Multiple fruits develops from entire Inflorescence. It is a False fruit. It includes 2 types. They are: - **a) Sorosis and b) Synconus:-**

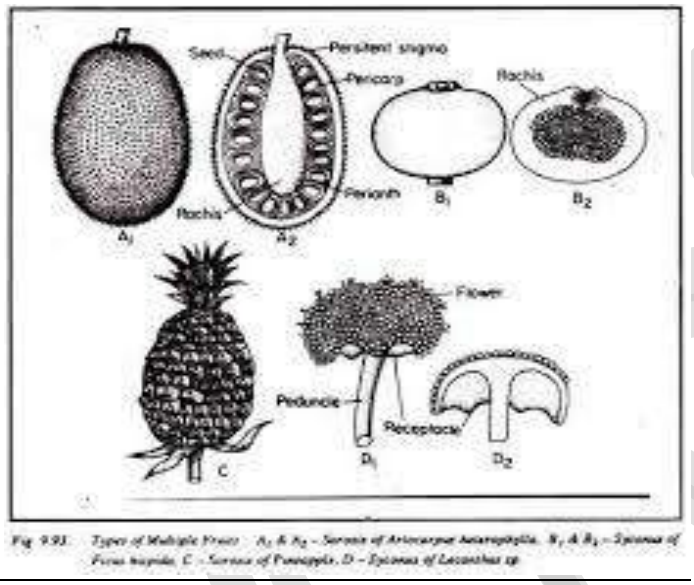


Fig. 9.93. Types of Multiple Fruits : A1 & A2 – Sorosis of Artocarpus heterophyllus, B1 & B2 – Synconus of Ficus hispida, C – Sorosis of Pineapple, D – Synconus of Lecanthus sp.

a) Sorosis:-Sorosis is a Multiple fruit that develops from Spadix or spike or Cat kin inflorescence. Ex: Jack fruit (Artocarpus heterophyllus-Moraceae), Pineapple (Annanus cosmosus - Bromeliaceae) Mulberry(Morus- Moraceae).

Jack fruit develops from Spadix inflorescence, central axis is peduncle. Fleshy; juicy, yellow and edible part is the perianth of flowers; inside the flake membranous bag containing seed represent pericarp. White, thin, less juicy chaffs are bracts. Spines on the rind are stigmas of the carpels.

Pine apple develops from Spike inflorescence, Fleshy; juicy, edible portion is Peduncle, bract and Perianth. Polygonal marks on the outer surface of the fruit correspond to each flower.

Mulberry develops from Female Cat kin inflorescence. Axis, bract and perianth become fleshy and edible.

b) Synconus:-Synconus is a Multiple fruit that develops from Hypanthodium inflorescence. Fleshy edible portion is the Receptacle.Ex: Figs.

89)What is meant by artificial methods of vegetative propagation? Mention its types.

Multiplication of plants by vegetative organs with the involvement of man is referred as “Artificial method of vegetative propagation”. This method is practiced to propagate

valuable ornamental and Horticultural plants for Commercial purpose. It is of 3 types. They are Cutting, Layering and Grafting.

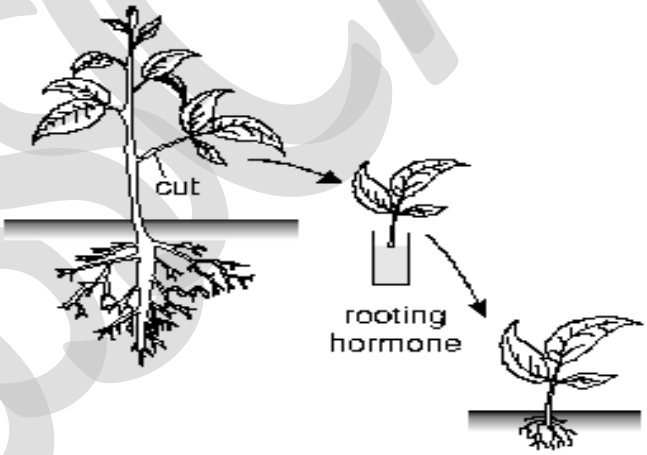
90) List advantages of artificial method of vegetative propagation.

Advantages of artificial propagation are as follows:-

1. New plants developed are exactly identical to the parent plant without alteration in genotype.
2. Many plants can be produced from a single plant in a short period.
3. Growth habit of the plant can be modified to environment.
4. Useful characters of 2 different individuals can be made to combine to obtain new variety.
5. It helps to produce more plants where seed output is less or plants do not produce seeds.

91) What is meant cutting? give example in which plant it is practiced.

Multiplication of plants by vegetative organs with the involvement of man is referred as "Artificial method of vegetative propagation". **cutting** is a method of artificial method of vegetative propagation. In this method healthy branch of a plant is selected, cut into several pieces of 8 to 10 inches length. They are placed into fertile moist soil. From the portion of cutting below the soil surface roots develops and portion above the soil surface buds develops that grow into leafy shoot. Thus each stem cutting develops into an independent plant.Ex: Hibiscus, Rose, Sugar cane, Grapes.



92) What is layering ? Mention its types.

It is a method of artificial method of vegetative propagation. The development of roots from a branch when it is intact with the stem is called as "Layering". It may be Simple layering, Compound Layering, Air Layering, Trench layering.

93) What is meant by Grafting? Mention its types.

Grafting is a method of artificial method of vegetative propagation. In this method 2 different plants named as **Stock and Scion** are made to unite covered with grafting clay and grown as a single plant.

The branch selected as **Scion is allowed to grow on the branch of rooted plant which serves as Stock.** It is physically strong, supplies water and nutrition for scion. It is of various types such as Wedge grafting, Cleft grafting, Crown grafting, Inarching .

Describe Artificial methods of Vegetative Propagation. (10 marks).

Multiplication of plants by vegetative organs with the involvement of man is referred as "Artificial method of vegetative propagation". This method is practiced to propagate valuable ornamental and Horticultural plants for Commercial purpose. It is of 3 types. They are Cutting, Layering and Grafting.

Artificial method of vegetative propagation can be basically classified into 3 types. They are as follows:-

1. Cutting
2. Layering
3. Grafting

1. CUTTING: -

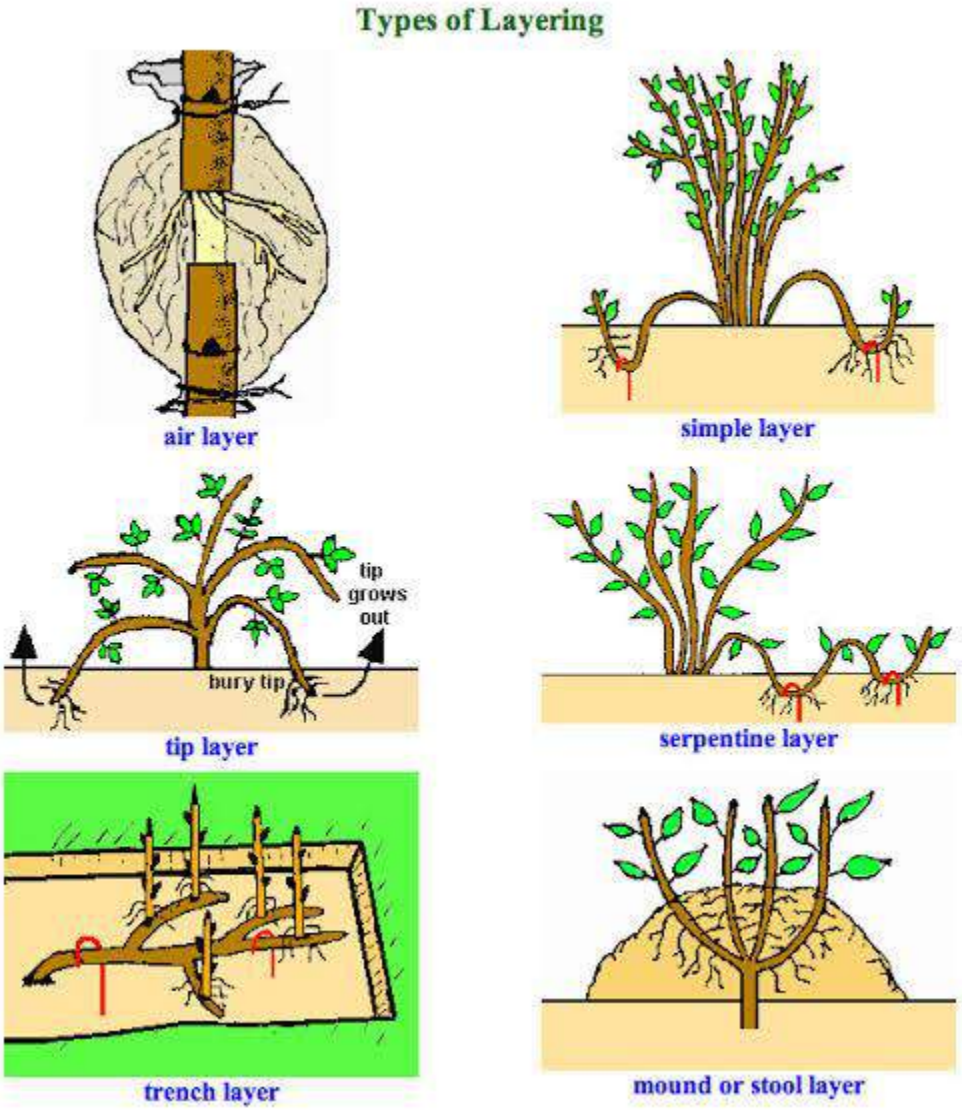
It is a method of artificial method of vegetative propagation. In this method healthy branch of a plant is selected, cut into several pieces of 8 to 10 inches length. They are placed into fertile moist soil. From the portion of cutting below the soil surface roots develops and portion above the soil surface buds develops that grow into leafy shoot. Thus each stem cutting develops into an independent plant.Ex: Hibiscus, Rose, Sugar cane, Grapes.

2. LAYERING: -

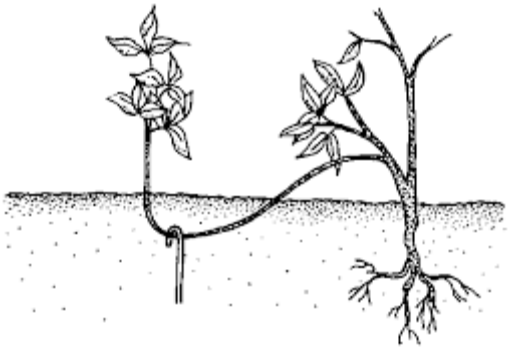
It is a method of artificial method of vegetative propagation. The development of roots from a branch when it is intact with the stem is called as "Layering". The branch which develops roots is called "Layer". The process of Layering involves following steps:-

- Select healthy branch of desired plant.
- Remove a ring of bark about 1 to 2 inches.
- Push this portion into moist soil keeping terminal portion of the branch free.
- Roots develop from the bark removed portion after 30 days.
- Cut off this from the main plant and it can be grown as an independent plant.

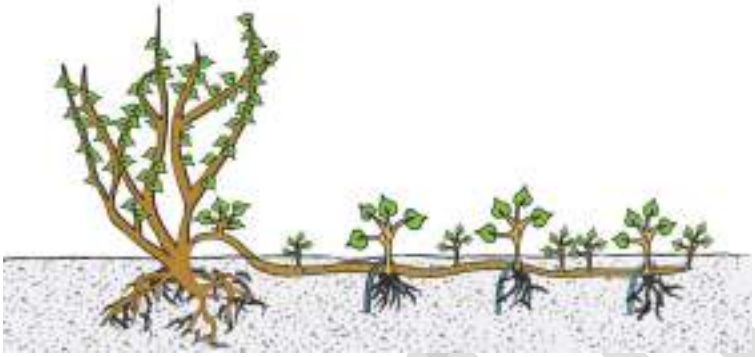
TYPES OF LAYERING: - Layering includes following types:-



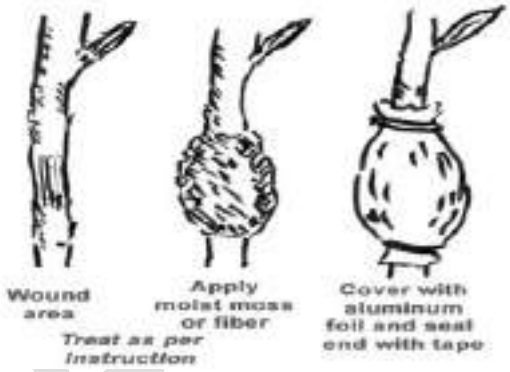
A) Simple layering:- In this method any healthy branch of a plant is selected, 1 to 2 inches bark is removed, pushed into the moist soil, weight is placed to keep branch in position. After 30 days roots develops in the layered portion. This is separated from mother plant and grown as an independent plant.



B) Compound layering: - in this method long, flexible branch is selected, ring of bark is removed at several points, covered with the soil and watered regularly. After several days' roots develops layered portion below and shoots in exposed region. Then branch is cut into pieces and grown into independent plants.



C) Air layering (Goo tee):- It is an ancient method of Layering practiced in woody fruit plants. In this method woody branch of desired plant is selected, ring of bark of 2 to 5 cms is removed , this portion is sprayed with growth promoting hormones, thick plaster of grafting clay is applied , wrapped with soil and tied using ploythene cover and regularly wetted. After 30 days roots develops in layered portion. Then separate it from mother plant by cutting it below the bandage and grown as an independent plant.



3. **GRAFTING-** It is a method of artificial method of vegetative propagation. In this method 2 different plants named as **Stock and Scion** are made to unite covered with grafting clay and grown as a single plant.
   The branch selected as **Scion is allowed to grow on the branch of rooted plant which serves as Stock.** It is physically strong, supplies water and nutrition for scion.

<u>TYPES OF GRAFTING</u>:-Grafting include following types:-

A) **Splice grafting:-**In this type slanting cut is made in Stock and Scion. Scion is inserted on stock, coated with grafting clay, allowed to grow for 30 days, it develops roots. Scion portion is separated from mother plant and grown as an independent plant.

B) **Wedge grafting: -** In this method **'V'** shaped cut is made in Stock and '**wedge shape'** in Scion. Fit these two, cover with grafting clay and allow it to grow for 30 days.

C) **Whip grafting:** - This method is practiced when stock and scion are of the same size. Inclined cut is made in both Scion and Stock. Scion is inserted into stock in such a way that cambial regions of both should come into contact. Exposed part is coated with grafting clay and allowed to grow.

D) **Inarching:-**In this method a ring of bark about 2 to 3 inches long is removed in both Stock and Scion. They are tied together at the sliced portion, coated with grafting clay, allowed to grow for 30 days. Later separate from mother plants and grow it independently.

E) <u>Approach grafting:</u>

1. The approach grafting is used if the base of the root stock plant is thicker than that of the scion plant.

2. A narrow cut of 7 to 10 cm long is made in the bark of the rootstock plant by making two parallel cuts and removing the strip of bark between, the cut should be exactly as wide as the scion to be inserted.

3. The stem of the scion plant should be cut long shallow along one side, of the same length as the cut in the rootstock plant and deep enough to go through the bark into the wood.

4.This cut surface of the scion branch should be laid into the slot cut in the rootstock plant and held thoroughly and covered with grafting wax.

5. After the union has healed, the rootstock can be cut off above the graft and the scion below the graft.

A)

THEORIES OF APICAL MERISTEM

Explain Apical cell theory.

Several theories are proposed to explain the origin of Apical meristem. They are as follows:-
1. Apical cell theory 2. Histogen theory 3. Tunica – corpus theory

1. Apical cell theory

- Nageli 1858 coined the term 'Meristem' and put forward this theory.
- According to this theory Apical meristem consists of a single, large, inverted pyramid like apical cell called 'Apical initial' which is structural and functional unit of Apical meristem.
- Sequence of cell division in apical cell is responsible for the formation of different members of the body.
- **Criticism:** - Apical cell theory is true for Thallophytes and Vascular cryptogams. In higher plants (Phanerogams) different parts of a plant body have independent origin. Hence it is proved to be wrong.

Describe Histogen theory.

In 1868 Hanstein formulated "Histogen Theory". According to this theory the tissues of a plant body originate from a mass of meristem which is divisible into 3 zones. Namely Outer Dermatogen, Middle Periblem and Inner Plerome.

- **Dermatogen:** - (In greek Derma means 'Skin') It is the single, outermost layer of meristem.The cells divide by radial walls only.i,e. at right angles to the surface of the stem and increase in circumference , thus keeping pace with the increasing growth of the underlying tissues. It gives rise to Epidermis of Root and stem.

- **In Root, apex** is covered over and protected by many layered tissue called Root cap. Apical meristem lies behind the root cap. Promeristem differentiates into Dermatogen, periblem and plerome. Dermatogen is single layered.it cuts off many new cells outside called "Calyptrogen". By repeated division it gives rise to root cap. Periblem gives rise to cortex and plerome gives rise to Vascular bundle.
- **Periblem:** - (In Greek 'Peri' means around,'blema' means 'Clothing' or'covering'). It occurs internal to dermatogens but peripheral to Plerome. It is single layered at apex and multilayered towards lower down. It gives rise to Cortex of root and shoot and inner tissues of leaves.
- **Plerome:** - (In Greek it means' Fills) It is composed of irregular cells. It is the central core of stem covered by Periblem and Dermatogen. It gives rise to Procambium which ultimately differentiates into vascular cylinder (Xylem and Phloem elements, Pericycle, medullary rays, pith) of root, Stem.

Describe Tunica – corpus theory

Schmidt in 1924 proposed Tunica corpus theory. According to this theory there are two zones of Apical meristem. Tunica and Corpus.

- **Tunica:** - Tunica is the outer zone consisting of one or more peripheral layers of small uniform cells normally divide anticlinally (Perpendicular to the Surface).In Dicots it is 1to 5 layered, in Monocots it is 1 to 4 layered. It is responsible for the surface growth in the apex as a sheet but not in thickness. To increase in thickness it has to divide periclinally. Normally it does not occur except at the point of origin of leaf primordium and axillary bud.

Cytological 2 zones are recognized in Tunica. The first one is central apical zone and second is occurs between Central apical zone and leaf primardium.

- **Corpus:-** Corpus is the inner zone of shoot apex composed of undifferentiated mass of larger cells enclosed by Tunica. It divides in all palnes to increase volume of shoot apex. It gives rise to cortex and Vascular tissue. It consists of several zones such as:

a) Central mother cells: - It is the uppermost zone of Corpus.
b) Pith rib meristem: - Occurs below the Central mother cell zone.
c) Flank meristem: - It surrounds both Central mother zone and pith rib meristem.

Merits of Tunica corpus theory.

1. It deals with planes of cell division, description of meristem becomes precise.
2. It explains growth pattern clearly in shoot apex of Angiosperms.
3. It enables to understand development of leaves as they arise close to apex.

4. Specific variation of number of Tunica layer may be of Taxonomic importance as in Grass.
5. It has topographical value in the study of development of different tissue system in plants.
6. The destiny of derivatives of corpus is not predetermined.

Explain Meristematic tissue.
Describe Parechyma/ Collenchy/ Sclerenchyma tissue.
Give an account of Complex tissue.(10 marks).
Explain elements of Xylem.
Explain Components of Phloem.
Differentiate between Spring wood and Autumn wood.

- **Spring wood: -** spring wood is formed from 'Vascular cambium in DIcot stem during secondary growth in spring season of the year. It is composed of Xylem vessels with broader cavities.
- **Autumn wood: - Autumn wood is formed from Vascular cambium** Vascular cambium in DIcot stem during secondary growth in Autumn season of the year. It is composed of Xylem vessels with narrow cavity.
  One such Spring wood ring and Autumn wood ring will be produced once in a year. These two types of wood together constitute an **'Annual ring'.**

What is an Annual ring?

Annular ring:-Concentric ring of secondary wood in Dicot stem formed during secondary growth is called "Annular ring" or 'Growth rings'. Each annular ring is composed of 'spring wood '(Early wood) and 'Autumn wood' (Late wood).By counting the number of annular rings in the secondary wood of stem, approximate age of the tree can be determined. Wood science that deals with the determination of approximate age of the tree by counting the number of Annual rings is called **'Dendrochronology'.**

Differentiate between Heart wood and Sap wood.
Heart wood and Sap wood:- Secondary Xylem of Dicot Stem is called 'Wood'. In Dicot stem wood is differentiated into Heart wood and Sap wood**.**

Heart wood (Duramen):- In secondary Dicot stem, the central dark colored, hard wood is called **'Heart wood' or 'Duramen'.** It is composed of dead elements of Xylem. It gives mechanical support to the plant. Xylem elements are filled with Tannins, Gums, and Resins etc. Hence it is dark coloured and hard. Heart wood vessels are clogged with Tyloses, hence it cannot perform conduction.

Sap wood (Alburman): - In secondary Dicot stem, the peripheral zone of wood is soft, light colored called '**Sap wood' or 'Alburman'.** It is composed of both living and dead elements. It has less Tyloses (Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses). It gives mechanical support and also takes part in conduction.

What are Tyloses? Mention its significance.

Tyloses are Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses. It is formed due to enlargement of pit membrane and protrusion of Xylem parenchyma cell into the cavity of Xylem vessel.

Tyloses by blocking the cavity of Vessel obstruct the conduction of water and minerals through vessels. Sometimes it is advantageous as infectious agents like bacteria; fungi which move along with the fluids can not enter vessel and helps in longevity and durability of wood.

What are Tylosoids? where are they found.

Epithellial cells that surround the Resin ducts enlarge and protrude into the cavity in the from of balloon. These are called 'Tylosoids. (False tyloses). They never protrude into the Vessel through pit. Ex: In Gymnosperms.

Differentiate between porous wood and non porous wood .

The secondary growth product of an Angiosperm in Dicot and Gymnosperm is called Wood. There are 2 types of wood. Namely 1) Porous wood and 2) Non- porous wood.

Porous wood: - In this type **t**he wood contains Xylem vessels which appear as circular pores in transverse section, it is called 'Porous wood'. Ex: Secondary wood of Dicot stem. The porous wood is divided into 2 types. they are :-

a) Ring porous wood:-In Ring porous wood, pores are arranged in concentric rings of spring wood and autumn wood. There is clear distinction between rings. Ex: Ulmus, Betula wood.

b) Diffuse porous wood:-In Diffuse porous wood, pores are scattered in the ring. As there is gradual increase in size of the pore from Autumn wood to Spring wood, there is no clear demarcation between Spring wood and Autumn wood. Ex: Juglans.

Non- porous wood: - In this type the wood contains only Tracheids. There will be no circular pores in transverse section. Ex: Gymnosperm wood. Presence or absence of pores, arrangement of pores helps in identification of type of wood.

SECRETORY TISSUES

What are secretory tissue. mention its types.

The non utilizable by product of metabolism which is isolated from the living protoplast or removed from the plant body are "Secretions**".** Ex: Gums, Resins, Latex, Essential oils, Nectar. The tissues concerned with non utilisable by product of metabolism such as Gums, Resins, and Latex are called **"Secretary Tissues".** These are widely distributed in the plant body.

Secretary tissues are grouped into 2 types. They are

A) Glandular tissue

B) Laticiferous tissue.

Explain Glndular tissue.

The glandular tissue consists of special structures; the Glands which contain some secretary or Excretory products. A Gland may consist of isolated cells or small group of cells with or without central cavity. They are of various types. They may be internal or external. It can be classified into 2 types. They are a) Secretary cells b) Glands.

1) Secretory cells :(**Internal Glands):-**

- Secretary cells are found in members of Umbelliferae, Rutaceae. These cells contain inconspicuous cytoplasm and cell is filled with secretion which does not exude.
- Oil gland secreting essential oils, as in Fruits, leaves of Orange, Lemon Eucalyptus etc.
- Mucilage secreting glands, as in the Betel leaf.
- Special water secreting glands at the tip of the Veins.
- Some secretary cells contain granular cytoplasm with prominent Nucleus. These exude the secretion such as Gum. These are called **"Excretory cells'.**

2) Glands :-(External Glands):-

- External glands are commonly short hairs tipped by glands.
- In Plants Gland is defined as a Plant structure located on or near the plant surface or externally which secretes one or more products.Ex: Glandular hairs, Nectaries.
- Glandular hairs secreting Gum like Substances as in Tobacco, Plumbago etc.
- Hydathodes are Water secreting Gland. (Water contains Salts, Sugars and organic substances).
- Glandular hairs secreting irritating, Poisonous substances as in Nettles (Utrica dioica-Utricaceae, stinging perennial herb.
- Honey secreting glands called" Nectaries" (Sugary fluid derived from phloem). As in Euphorbia.

- Fragrance emitting glands called "Osmophores" as in members of Araceae and Asclepiadaceae. Or produced from volatile oil distributed through out Epidermis of Petals.

B) **LATICEFEROUS TISSUE**

What are Laticiferous tissues? Mention its types.

Thin walled, greatly elongated, much branched ducts containing a milky or yellowish or watery fluid called "Latex" is called "Laticeferous tissue". These are irregularly distributed in the mass of parenchymatous cells. They contain numerous nuclei. They are of 2 types. Namely a) Latex cell or Non – articulate Latex ducts.b) Latex Vessels or Articulate latex.

Explain Laticiferous tissues.

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a) Latex cell or Non – articulate Latex ducts.

b) Latex Vessels or Articulate latex.

Laticiferous cells originate from Promeristem. The cell wall is thick, encloses many Nuclei. These are independent units which extend as branched structures for long distances in the plant body. They originate as minute structures, elongate quickly and by repeated branching ramify in all directions but do not fuse together.Ex: Vinca rosa, Calotropis. Euphorbia.

b) Latex Vessels or Articulate latex. Latex vessels originate from Meristem, grow more or less as parallel ducts which by branching and frequent anastomise to form a complex network. These are found in members of papavaraceae, Moraceae, Compositeae, Euphorbiaceae.etc.

Functions:-Laticiferous tissue may act as food storage organs or Reservoir of waste products.They may also act as translocatory tissue.

With neat labelled diagram explain internal structure of monocot root.

Transverse section of Cicer root shows following Anatomical features:-

1. **Epiblema:** Epiblema is the outermost layer of Root. It is consists of single layer of compactly arranged, rectangular, thin walled cells. Some of the cells develop into unicellular, tubular cells called **'Root hair'. It is meant fro absorption.**

2. Cortex: Cortex is composed of many layers of Parenchyma cells with intercellular spaces. **Endodermis** is innermost layer of the cortex. It consists of single layer of barrel shaped cells with casparian strips on their radial walls. Few endodermal cells opposite to ProtoXylem are thin walled called **'Passage cells".**

3. Stele: Stele is composed of Pericycle, Vascular bundle, Conjunctive tissue and Pith.

a) Pericycle: Pericycle is the outermost layer of stele present next to endodermis. It is made up of single layer of parenchyma cells.

b) Vascular bundle: - Vascular bundle is Radial, Tetrarch and Exarch.(Radial-Xylem and Phloem are present alternately at different radii**, Tetrarch-** There are 4 patches of Xylem alternating with 4 patches of Phloem**,Exarch-** Protoxylem is present towards pericycle and Meta Xylem towards Pith.)

c) Conjunctive tissue: - Parenchyma tissue present between Vascular bundle is called '**Conjunctive tissue'.**

d) Pith:-Central region of stele made up of parenchyma tissue is constitutes **'Pith'.** It is small.

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3. Stele: Stele is composed of Pericycle, Vascular bundle, Conjunctive tissue and Pith.

a) Pericycle: Pericycle is the outermost layer of stele present below endodermis. It is made up of single layer of parenchyma cells.

b) Vascular bundle: - Vascular bundle is Radial, Polyarch and Exarch.(Radial-Xylem and Phloem are present alternately at different radii**, Polyarch-** There are many patches of Xylem alternating with equal number of Phloem Patches **,Exarch-** Protoxylem is present towards pericycle and Meta Xylem towards Pith.)

c) Conjunctive tissue: - Parenchyma tissue present between Vascular bundle is called 'Conjunctive tissue'.**d) Pith**:-Central region of stele made up of parenchyma tissue is constitutes **'Pith'. It is very large.**

Differentiate the anatomical features of Monocot and Dicot root.

Differences between Monocot and Dicot root:-

Sl. no	**Dicot root**	**Monocot root**
1	Well defined Exodermis is absent	Well defined Exodermis is Present
2	Pericycle gives rise to Lateral roots and cambium	Pericycle gives rise to Lateral roots only

3	Vascular bundles vary from 2 to 6	Vascular bundles are numerous
4	Pith is absent or Very small	Pith is large

Describe the internal structure of Dicot stem with the help of neat labelled diagram.

Transverse section of Dicot stem shows following Anatomical features:-

1. Epidermis: - Epidermis is the outermost, single layer of compactly arranged, tubular cells with cuticle on their outer walls. It bears multicellular epidermal hairs.

2. Cortex: - Cortex is present internal to Epidermis. The outer zone of Cortex present below the epidermis consists of few layers of Collenchyma cells called "Hypodermis". Inner to Hypodermis is several layers of thin walled parenchyma cells. Its Outer cells contain chlorophyll. The innermost layer of the cortex is called Endodermis. It is made up of a single layer of barrel shaped cells with abundant starch and hence, called "Starch sheath".

3. Stele: - Stele is composed of Pericycle, Vascular bundle, Medullary rays and Pith.

a) Pericycle:-Pericycle is the outer layer of stele. It is sclerenchymatous in nature. There are more layers of Sclerenchyma opposite to Vascular bundles.

b) Vascular bundle:-Several Vascular bundles are arranged in a ring (Eustele). Each Vascular Bundle is Conjoint, Collateral , Open with Endarch xylem.(**Conjoin**t-Xylem and Phloem are in a compact bundle, **Collateral- xylem and Phloem lie in same radius, open** – Strip of Cambium is present between Xylem and Phloem ,**Endarch**- Protoxylem towards pith and Meta xylem towards Pericycle.,) Phloem is outer and Xylem is inner in position. (Xylem contains Vessels, Tracheids, Parenchyma and Fibers).

c) Pith (Medulla):- Centre of the stem is occupied by well developed parenchymatous Pith.

Describe the internal structure of Dicot stem with the help of neat labelled diagram.

Transverse section of Monocot stem shows following Anatomical features:-

1. Epidermis: - Epidermis is the outermost, single layer of compactly arranged, tubular cells with cuticle on their outer walls. Epidermal hairs are absent, and Few Stomata are present.

2. Ground tisssue: - Ground tissue is present internal to Epidermis. Just below epidermis few layers of Sclerenchyma cells are called **"Hypodermis".** Rest of the ground tissue is Parenchymatous in which vascular bundles are scattered (Atactostele).Endodermis; Pericycle, Medullary rays and Pith are absent.

b) Vascular bundle:-Vascular bundles are many scattered in the ground tissue. (Atactostele).Peripheral vascular bundles are small closely arranged; Central bundles are larger, less crowded.

Each Vascular Bundle is **Conjoint, Collateral, and Closed with endarch xylem**. (**Conjoin**t-Xylem and Phloem are in a compact bundle, **Collateral-**Xylem and Phloem lie in same radius**, CLosed** – Cambium is absent between Xylem and Phloem, **Endarch-** Protoxylem towards center and Meta xylem towards Periphery,) Phloem is outer and Xylem is inner in position. (Xylem contains irregularly arranged Tracheids, Four distinct Vessels arranged in the form of

letter 'Y'. 2 smaller vessels towards centre constitute Proto xylem and two bigger vessels present laterally constitute Meta xylem. Cavity formed due to breaking of proto xylem forms '**Water containing cavity**". Phloem consists of Sieve tubes and companinion cells. There is no Phloem parenchyma.

Differentiate between anatomical features of Dicot stem with that of Monocot stem.

Differences between Monocot and Dicot Stem

Sl. no	Dicot Stem	Monocot Stem
1	Multicellular Epidermis are more common	Multicellular Epidermis are not common
2	Hypodermis is Collenchymatous	Hypodermis is Sclernchymatous
3	Ground tissue is differentiated into Cortex and Endodermis.	Ground tissue is Undifferentiated.
4	Endodermis and Pericycleand Pith are present	Endodermis and Pericycleand Pith areabsent
5	Cambium is Present in Vascular bundle, Hence said to be Open type.	Cambium is absent in Vascular bundle, Hence said to be Closed type.
6	Vascular bundles are arranged in a ring (Eustele)	Vascular bundles are scattered in the ground tissue (Atactostele).
7	Phloem parenchyma is present	Phloem parenchyma is absent
8	Vascular bundles are wedge shaped	Vascular bundles are Oval shaped
9	Lysogenous cavity is absent	Lysogenous cavity is present in Vascular bundle

What is Dorsiventral leaf? Give example.

In Dicot plants Leaves grows Horizontal (at right angles) to stem, hence upper surface gets more light than lower surface. Due to this unequal illumination the leaves shoes differences between upper and lower (Dorasal and Ventral) surface both externally and internally. Hence it is called 'Dorsiventral leaf.'

What is meant by Iso bi lateral leaf? Give an example.

Isobilateral leaf. Ex: Monocot leaf. In Monocot plants grows parallel to stem, so they are equally illuminated on both the surfaces. Hence they do not show differences between upper and lower surfaces. Hence they are called "Iso bi lateral Leaves".

Explain the internal structure of Dicot leaf.

Anatomy of Dorsiventral leaf:-Transverse section of Dicot leaf shows following anatomical features;-

1**. Upper Epidermis:-**It consists of single layer of continuous and compactly arranged rectangular cells with thick Cuticle. Multicellular hairs are present. It is protective in function.

2. Lower Epidermis: - It consists of single layer of discontinuous and compactly arranged rectangular cells with thick Cuticle. Few stomata are and multicellular hairs are present.

3:-Mesophyll;-Parenchyma tissue present in between Epidermal layers in leaf is called **"Mesophyll". It is** differentiated into **a) Palisade Parenchyma: -** It consists of 2 to 3 layers of

cylindrical, elongated compactly arranged Parenchyma cells with plenty of chloroplasts. It is placed at right angles to epidermis**. b) Spongy Parenchyma: -** It is composed of loosely arranged, isodiametric parenchyma cells with less number of chloroplasts. It is present between palisade parenchyma and Lower Epidermis**.**

4. **Vascular bundles: -** Mid and veins in Lamina are the regions of Vascular bundles. Phloem is present towards Lower epidermis and Xylem towards Upper Epidermis. Each Vascular bundle is surrounded by Sclerenchymatous Bundle sheath.

With neat labelled diagram explain the internal structure of Iso bi lateral leaf.

Isobilateral leaf. Ex: Monocot leaf. In Monocot plants grows parallel to stem, so they are equally illuminated on both the surfaces. Hence they do not show differences between upper and lower surfaces. Hence they are called "Iso bi lateral Leaves".

Anatomy of Iso bi lateral leaf:-Transverse section of Monocot leaf shows following anatomical features;-

1**. Upper Epidermis:-**It consists of single layer of compactly arranged, thick walled, rectangular cells with Cuticle. It contains Stomata and Bulliform cells. Each Stoma consists of 2 dumb-bell shaped guard cells and 2 triangular subsidiary cells. '**Bulliform cells' are also called as'Motor cells'**. It consists of groups of thick walled cells which occur in longitudinal rows. In dry atmosphere, these loose water and bring bout longitudinal rolling of lamina. Thus reduce rate of transpiration. It is protective in function.

2. Lower Epidermis: - It consists of single layer of discontinuous and compactly arranged rectangular cells with thick Cuticle. Few stomata are present.

3:-Mesophyll;-Parenchyma tissue present in between Epidermal layers in leaf is called "Mesophyll". It is not differentiated into Palisade Parenchyma Spongy parenchyma. It consists of uniform, compactly arranged isodiametric cells containing chloroplasts.

4. Vascular bundles: - Lamina shows parallel venation; hence many larger smaller vascular bundles are seen in a section. In each vascular bundle Phloem is present towards Lower epidermis and Xylem towards Upper Epidermis. Each Vascular bundle is surrounded by parenchymatous Bundle sheath. Bundle sheath extension is Sclerenchymatous.

Differentiate the anatomical features of Dorsi ventral and Iso bi lateral leaf.

Differences between Monocot and Dicot Leaf:-

Sl. no	Dicot Leaf	Monocot Leaf
1	Dicot leaf is Dorsiventral	Monocot leaf is Isobilateral
2	Venation is Reticulate	Venation is Parallel
3	Upper Epidermis is continuous	Upper Epidermis is Discontinuous
4	Stomata are present in Lower epidermis only (Hypostomatic)	Stomata are present in both upper and lower epidermis -Amphistomatic
5	Motor or Bulliform cells are absent in upper	Motor or Bulliform cells are present

	epidermis.	in upper epidermis.
6	Mesophyll is differentiated into Palisade Parenchyma and spongy parenchyma	Mesophyll is uniform. It is not differentiated into Palisade Parenchyma and spongy parenchyma
7	Stomata consist of small pore guarded by 2 kidney shaped Guard cells.	Stomata consist of small pore guarded by 2 Dumb-bell shaped Guard cells.
8	Bundle sheath is Sclerenchymatous	Bundle sheath is Parenchymatous

What is meant by Anamolous secondary growth?List the causes.

anamolous secondary growth takes place in following conditions:-

- **In Dicots** Vascular bundles are Conjoint, collateral, open and arranged in a ring. Formation of secondary tissues takes place by Fascicular cambium in stele and Cork cambium in cortex.
- In Monocots Vascular bundles are conjoint, collateral, closed and are scattered in the ground tissue. Secondary growth is absent.
  Any deviation in the above pattern of development in Primary and secondary structure is called "Anamolous secondary growth".
  Anamolous prmary structures are as follows:-
  1. Scattered vascular bundles in Dicots.
  2. Arrangement of Vascular bundles in a ring in Monocots.
  3. Medullary or cortical vascular bundles.
  4. Presence of intraxylary Phloem or separate Phloem bundles.
  Anomalous Secondary structures are as follows:-
  1. Abnormal behavior of Fascicular cambium.
  2. Origin of Cambium in monocots.
  3. Replacement of normal cambium by abnormal accessory cambium.
  4. Abnormal behavior of abnormal cambium.

Describe the anamolous secondary growth in Boerhavvia stem.

anamolous secondary growth in boerhaavia stemshows following features.

Boerhaavia diffusa is a Dicot plant belonging to Family Nyctaginaceae. It grows few inches off the ground. **It shows following primary structures in the stem:-**

1. Epidermis with thick Cuticle and stomata.
2. Collenchymatous Hypodermis with below Epidermis.
3. It is followed by Chlorenchymatous cortex. Endodermis is clearly defined.
4. Pericycle sometimes contains strands of Sclerenchyma. It encloses vascular bundles and pith.

5. There are two large Vascular bundles on the sides of the pith. It is surrounded by number if small bundles (6-14) in second or middle ring.
6. Bigger vascular bundles shows limited amount of growth in thickness by Fascicular cambium.

In Boerhaavia Secondary growth begins by cambium that arises secondarily from the cells of the Pericycle. Or cells outside primary bundles. Intra Fascicular cambium form ring of vascular bundles with Xylem on the inner side and Phloem on the outer side. Interfascicular cambium produces thick walled lignified conjunctive tissue towards inside and Parenchyma towards outside. The cambium ring ceases it activity.

A New cambial ring gets differentiated outside by cells of pericycle and Parenchyma cells. It forms another ring of Vascular bundle in the same manner. Soon this ceases its activity. One more cambium gets differentiated and functions in the same manner. Thus several concentric rings of Vascular bundles are formed. Cork and Lenticels develops outside the Hypodermis.

Describe the anamolous secondary growth in Dracaena stem.

anamolous secondary growth in dracaena stem following features:=

In Monocotyledons Vascular bundle is closed (Cambium is absent). Hence Secondary growth is absent. But rarely seen in woody monocots like Dracaena, Yucca, Aloe, Agave etc.

Dracaena belongs to the Family Liliaceae. Here secondary growth results in large amount of thickness. In Canary Isles, Dracaena draco is 6000yrs old, measures 14 meters in girth at the base. In 1868 it was destroyed by Strom.

In Dracaena Primary structure is typically Monocotyledonous with numerous closed, collateral or concentric (Amphivasal- Phloem at the centre surrounded by Xylem.)Vascular bundles lying scattered in the ground tissue.

- Secondary growth in Dracaena begins with the formation of secondary meristematic tissue- the cambium in the parenchyma outside the primary bundles. This parenchyma divides tangentially and forms and of cambium, a few layers in thickness.
- The cambium thus formed is more active on inner side, cuts off cells which differentiate into distinct vascular bundles (secondary) and thick walled, lignified parenchyma secondary). On outerside Cambium produces thin walled parenchyma.
- Primary bundles are scattered and Secondary bundles are radially seriated, surrounding secondary parenchyma.
- In transverse section Vascular bundle is oval and Amphivasal. In some species it may be collateral.
- After secondary growth to some extent, the peripheral parenchyma becomes meristematic and begins to divide tangentially and also cells derived from them until

a few linear layers are formed. The cells then become suberised and differentiate into cork.

- Deeper lying parenchyma again begins to divide, form new layers of cells and again give rise to strip of cork. Thus cork in Dracaena appears in seriated bands without formation of Cork cambium (Phellogen). This is known as "Storied cork".

WOOD ANATOMY

What is meant by Ray and Fusiform initials.

Wood is the product of secondary growth in Dicots which takes place by, Vascular cambium in stelar region and Cork cambium in Cortex region.

Vascular cambium consists of 2 kinds of initials namely Fusiform and Ray initials. **Fusiform initials**: - These are elongated, spindle shaped with wedge ends. It gives rise to vertical system of wood that is composed of Vessels, Fibers and Parenchyma. **Ray initials: -** These are Isodiamatric cells. It gives rise to horizontal system wood that is composing of elongated Parenchyma cells.

Define cork cambium and its products.

Cork cambium (Phellogen):- In cortex parenchyma cells below epidermis become meristematic to form '**cork cambium or Phellogen'**. It divides tangentially to form '**Cork 'or 'Phellem' outside and' secondary cortex' or 'Phelloderm 'towards** inside.

Explain Annual ring.

Annular ring:-Concentric ring of secondary wood in Dicot stem formed during secondary growth is called "Annular ring" or 'Growth rings'. Each annular ring is composed of 'spring wood '(Early wood) and 'Autumn wood' (Late wood).By counting the number of annular rings in the secondary wood of stem, approximate age of the tree can be determined. Wood science that deals with the determination of approximate age of the tree by counting the number of Annual rings is called '**Dendrochronology'.**

Spring wood: - spring wood is formed from 'Vascular cambium in DIcot stem during secondary growth in spring season of the year. It is composed of Xylem vessels with broader cavities. **Autumn wood: - Autumn wood is formed from Vascular cambium** Vascular cambium in DIcot stem during secondary growth in Autumn season of the year. It is composed of Xylem vessels with narrow cavity. One such Spring wood ring and Autumn wood ring will be produced once in a year. These two types of wood together constitute an **'Annual ring'.**

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Sap wood (Alburman): - In secondary Dicot stem, the peripheral zone of wood is soft, light colored called '**Sap wood' or 'Alburman'.** It is composed of both living and dead elements. It has less Tyloses (Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses). It gives mechanical support and also takes part in conduction.

Explain Tyloses,

Tyloses:-Balloon like protrusions of Xylem parenchyma cells into the cavities of xylem vessels are called Tyloses. It is formed due to enlargement of pit membrane and protrusion of Xylem parenchyma cell into the cavity of Xylem vessel. Tyloses formed contain Cytoplasm, Nucleus, some amount of reserves like Starch, Resin etc. These are frequently formed in Heart wood in Dicots.

Tyloses by blocking the cavity of Vessel obstruct the conduction of water and minerals through vessels. Sometimes it is advantageous as infectious agents like bacteria; fungi which move along with the fluids can not enter vessel and helps in longevity and durability of wood.

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Porous wood: - In this type **t**he wood contains Xylem vessels which appear as circular pores in transverse section, it is called 'Porous wood'. Ex: Secondary wood of Dicot stem. The porous wood is divided into 2 types. they are :-

a) Ring porous wood:-In Ring porous wood, pores are arranged in concentric rings of spring wood and autumn wood. There is clear distinction between rings. Ex: Ulmus, Betula wood.

b) Diffuse porous wood:-In Diffuse porous wood, pores are scattered in the ring. As there is gradual increase in size of the pore from Autumn wood to Spring wood, there is no clear demarcation between Spring wood and Autumn wood. Ex: Juglans.

Non- porous wood: - In this type the wood contains only Tracheids. There will be no circular pores in transverse section. Ex: Gymnosperm wood. Presence or absence of pores, arrangement of pores helps in identification of type of wood.

Give an account of Secretory tissues.

The non utilizable by product of metabolism which is isolated from the living protoplast or removed from the plant body are "Secretions". Ex: Gums, Resins, Latex, Essential oils, Nectar. The tissues concerned with non utilisable byproduct of metabolism such as Gums, Resins, and Latex are called **"Secretary Tissues".** These are widely distributed in the plant body.Secretary tissues are grouped into 2 types. They are

A) Glandular tissue

B) Laticiferous tissue.

A) GLANDULAR TISSUE: -

The glandular tissue consists of special structures; the Glands which contain some secretary or Excretory products. A Gland may consist of isolated cells or small group of cells with or without central cavity. They are of various types. They may be internal or external. It can be classified into 2 types. They are a) Secretary cells b) Glands.

1) Secretory cells :(**Internal Glands):-**

- Secretary cells are found in members of Umbelliferae, Rutaceae. These cells contain inconspicuous cytoplasm and cell is filled with secretion which does not exude.
- Oil gland secreting essential oils, as in Fruits, leaves of Orange, Lemon Eucalyptus etc.
- Mucilage secreting glands, as in the Betel leaf.
- Special water secreting glands at the tip of the Veins.
- Some secretary cells contain granular cytoplasm with prominent Nucleus. These exude the secretion such as Gum. These are called **"Excretory cells'.**

2) Glands :-(External Glands):-

- External glands are commonly short hairs tipped by glands.
- In Plants Gland is defined as a Plant structure located on or near the plant surface or externally which secretes one or more products.Ex: Glandular hairs, Nectaries.
- Glandular hairs secreting Gum like Substances as in Tobacco, Plumbago etc.
- Hydathodes are Water secreting Gland. (Water contains Salts, Sugars and organic substances).
- Glandular hairs secreting irritating, Poisonous substances as in Nettles (Utrica dioica-Utricaceae, stinging perennial herb.
- Honey secreting glands called" Nectaries" (Sugary fluid derived from phloem). As in Euphorbia.

- Fragrance emitting glands called "Osmophores" as in members of Araceae and Asclepiadaceae. Or produced from volatile oil distributed through out Epidermis of Petals.

Describe theories of OF APICAL MERISTEM

Several theories are proposed to explain the origin of Apical meristem. They are as follows:-
1. Apical cell theory 2. Histogen theory 3. Tunica – corpus theory

1. Apical cell theory

- Nageli 1858 coined the term 'Meristem' and put forward this theory.
- According to this theory Apical meristem consists of a single, large, inverted pyramid like apical cell called 'Apical initial' which is structural and functional unit of Apical meristem.
- Sequence of cell division in apical cell is responsible for the formation of different members of the body.
- **Criticism:** - Apical cell theory is true for Thallophytes and Vascular cryptogams. In higher plants (Phanerogams) different parts of a plant body have independent origin. Hence it is proved to be wrong.

2. Histogen theory

In 1868 Hanstein formulated "Histogen Theory". According to this theory the tissues of a plant body originate from a mass of meristem which is divisible into 3 zones. Namely Outer Dermatogen, Middle Periblem and Inner Plerome.

- **Dermatogen:** - (In greek Derma means 'Skin') It is the single, outermost layer of meristem.The cells divide by radial walls only.i,e. at right angles to the surface of the stem and increase in circumference , thus keeping pace with the increasing growth of the underlying tissues. It gives rise to Epidermis of Root and stem.
- **In Root, apex** is covered over and protected by many layered tissue called Root cap. Apical meristem lies behind the root cap. Promeristem differentiates into Dermatogen, periblem and plerome. Dermatogen is single layered.it cuts off many new cells outside called "Calyptrogen". By repeated division it gives rise to root cap. Periblem gives rise to cortex and plerome gives rise to Vascular bundle.
- **Periblem:** - (In Greek 'Peri' means around,'blema' means 'Clothing' or'covering'). It occurs internal to dermatogens but peripheral to Plerome. It is single layered at apex and multilayered towards lower down. It gives rise to Cortex of root and shoot and inner tissues of leaves.

- **Plerome:** - (In Greek it means' Fills) It is composed of irregular cells. It is the central core of stem covered by Periblem and Dermatogen. It gives rise to Procambium which ultimately differentiates into vascular cylinder (Xylem and Phloem elements, Pericycle, medullary rays, pith) of root, Stem.

3. Tunica – corpus theory

Schmidt in 1924 proposed Tunica corpus theory. According to this theory there are two zones of Apical meristem. Tunica and Corpus.

- **Tunica:** - Tunica is the outer zone consisting of one or more peripheral layers of small uniform cells normally divide anticlinally (Perpendicular to the Surface).In Dicots it is 1to 5 layered, in Monocots it is 1 to 4 layered. It is responsible for the surface growth in the apex as a sheet but not in thickness. To increase in thickness it has to divide periclinally. Normally it does not occur except at the point of origin of leaf primordium and axillary bud.

Cytological 2 zones are recognized in Tunica. The first one is central apical zone and second is occurs between Central apical zone and leaf primardium.

- **Corpus:-** Corpus is the inner zone of shoot apex composed of undifferentiated mass of larger cells enclosed by Tunica. It divides in all palnes to increase volume of shoot apex. It gives rise to cortex and Vascular tissue. It consists of several zones such as:

a) Central mother cells: - It is the uppermost zone of Corpus.

b) Pith rib meristem: - Occurs below the Central mother cell zone.

c) Flank meristem: - It surrounds both Central mother zone and pith rib meristem.

Merits of Tunica corpus theory.

1. It deals with planes of cell division, description of meristem becomes precise.

2. It explains growth pattern clearly in shoot apex of Angiosperms.

3. It enables to understand development of leaves as they arise close to apex.

4. Specific variation of number of Tunica layer may be of Taxonomic importance as in Grass.

5. It has topographical value in the study of development of different tissue system in plants.

6. The destiny of derivatives of corpus is not predetermined.