CHAPTER: 6 ANATOMY OF FLOWERING PLANTS

Tissues - a group of similar cells performing same function.

Types of plant tissues - meristematic tissues and permanent tissues.

Meristematic tissues

- Have power of cell division

Characteristics features

- Cells are thin walled
- No intercellular places
- Abundant cytoplasm
- Retains power of cell division

Classification based on position. Three types

1. Apical meristem
2. Lateral meristem
3. Intercalary meristem

Based on the origin – three types

1. Promeristem- embryo/ seedlings
2. Primary meristem
3. Secondary meristem

Permanent tissues:

I.Simple permanent tissues

1. Parenchyma(storage)-living
2. Collenchymas (support) below epidermis, living
3. Sclerenchyma – sclereids and fibres- dead

II.Compound permanent tissues

- Xylem- xylem vessels, xylem tracheids, xylem parenchyma, xylem fibres
- Phloem – sieve tubes, sieve cells, companion cells, phloem parenchyma

Tissue system in plants :

1. Epidermal tissues
2. Vascular tissues
3. Ground /fundamental tissues

Meristematic tissues:

- Growth in plants is largely restricted to specialized regions of active cell division called meristem.
- Apical meristems are the meristems which occur at the tips of roots and shoots and produce primary tissues
- Intercalary meristem are the ones which occur between mature tissues
- Lateral meristem occurs in mature regions of roots and shoots and appear later than primary meristem

Permanent tissues/ mature:

- The newly formed cells from primary and secondary meristems which become structurally and functionally specalised and lose the ability to divide are permanent tissues

I.Simple tissues. (made up of only one type of cells)

1. ***Parenchyma*** -
    - major component within organs
    - Isodiametric,spherical, oval,round, polygonal,elongated in shape.
    - Thin cell walls made of cellulose.
    - Closely packed or have intercellular spaces
    - Function. Photosynthesis, storage, secretion.
2. ***Collenchymas*** –
    - occurs in layers below epidermis, either in homogeneous layer or in patches
    - Thickened at the corners due to pectin, cellulose, oval, spherical, polygonal
    - Assimilate food when chloroplasts is present
    - Intercellular spaces absent- function. Mechanical support
3. ***Sclerenchyma*** -
    - long narrow cells, lignified walls, with pits
    - Dead- fibers-thick walled, elongated, pointed
    - Sclereids- spherical, dead, narrow cavity-lumen
    - Found in – guava, pear, sapota
    - Function. Mechanical support

II. Complex tissues (more than one type of cells)

1. ***Xylem***. Conducting tissue for water and minerals
    - *Tracheids*. Elongated or tube like cells, dead, main water transporting element
    - *Vessels*. Long cylindrical, lignin in cell walls, large central cavity, devoid of protoplasm.
    - *Xylem fibres*- lumens present, septate/aseptate
    - *Xylem parenchyma*- living thin- walled, cell walls, cellulose, store food as starch or fat, tannins

2. **Phloem** - (transports food material)
    - *Sieve tubes*- long, tube like, perforated, forms sieve plates
    - *Companion cells* – pit is present , helps in maintenance of pressure gradient in the sieve tubes
    - *Phloem parenchyma* – elongated, tapering, dense cytoplasm, cell wall, cellulose, pits
    - *Phloem fibres* - unbranched, pointed, quite thick.

Tissue system :

1. ***Epidermal tissue system***
    - Cuticle present- contains stomata (guard cells, subsidiary cells, stomatal apparatus)
    - Trichomes – (on stem) multicellular, secrete oils. Root hairs- single celled.

2. ***Ground tissues***
    - Tissues except epidermal and vascular tissues.
    - Mesophyll. (collenchymas, sclerenchyma, parenchyma)

3. ***Vascular tissue system***
    - Cambium. (lateral meristem)
    - Radial vascular bundle – in roots
    - Conjoint open vascular bundle - in dicot stem and leaves
    - Conjoint closed vascular bundle – in monocot stem and leaves

Anatomy of dicotyledonous and monocotyledonous plants:

1. ***Dicotyledonous root***

    Epidermis – root hair – cortex (Parenchyma) endodermis – suberin layer as casparian strips
    Pericycle (lateral roots) pith is small – conjuctive tissues (between xylem and phloem)
    Cambium ring (2-4 xylem and phloem)
    Stele (endodermis, pericycle, vascular bundle and pith)

2. ***Monocotyledonous root***

    No cambium in the vascular bundles. (6 vascular bundles and are scattered) called polyarch - pith is large – since no cambium, and no secondary growth

3. ***Dicotyledonous stem***
    - Epidermis, cuticle, trichomes, hypodermis (collenchymas)
    - Cortical layer (parenchyma) endodermis(starch sheath)
    - Pericycle - vacular bundles – medullary rays
    - Vascular bundles are in a ring
    - Conjoint, open, and endarch protoxylem
    - Pith is larger (parenchyma)

4. ***Monocotyledonous stem***
    - Epidermis – hypodermis (sclerenchyma) scattered vascular bundles, sclerenchyma.
    - Bundle sheath – vascular bundles are conjoint, closed, no cambium
    - Peripheral vascular bundle are smaller than central
    - No secondary growth- no trichomes
    - Water containing cavities are present- no distinct pith

Stem :

1. Trichomes present / absent
2. Vascular bundle scattered/ rings
3. Vascular bundles closed/ open – cambium
4. Pith present /absent

Leaves :

1. **Dorsiventral leaf /dicot leaf:**
    - Epidermis are adaxial epidermis (upper) and abaxial epidermis (lower)
    - Cuticle – stomata is more on lower epidermis
    - Mesophyll – it has two types of cells , palisade parenchyma and spongy parenchyma
    - Vascular system vascular bundle are present in vein and midrib
    - Reticulate venation –vascular bundle are surrounded by bundle sheath

2. **Isobilateral / monocot leaf:**
    - Same anatomy – but no spongy parenchyma and stomata on both side
    - Bulliform cells – parallel venation

Secondary growth:

- Primary growth- apical meristem (grows length wise)
- Secondary growth –increase in girth
- It involves lateral meristem vascular cambium and cork cambium
- Vascular cambium

Formation of cambial ring

- Intrafacicular cambium
- Interfascicular cambium
- Activity of cambial ring
- Formation of secondary xylem secondary phloem
- More active on the inner side so more xylem
- ***Spring early wood*** –more active and light coloured
- ***Autumn late wood*** – less active and dark coloured
- The two kinds of wood that appear as alternate concentric rings, constitute an annual ring
- ***Heart wood*** – dead, elements, highly lignified provides mechanical support
- ***Sap wood*** – peripheral region , secondary xylem, light in colour, conduction of water and minerals

Cork cambium:

- Cortical and epidermis layer get broken
- Replaced to provide new protective cell layers
- ***Cork cambium/ phellogen*** –develop in cortex region and produce new cells towards both sides
- ***Outer cells form cork / phellum***
- ***Inner cells form secondary cortex / phelloderm***
- Bark - soft early bark – formed early in the season
- Late / hard bark – formed late in the season
- *Lenticels*. Lens shaped openings helps in exchange of gases.

Secondary growth in roots:

- Wavy ring – later becomes circular
- Secondary growth occurs in gymnosperms too (except in monocots) as monocot do not have cambium.

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CHAPTER 7 : STRUCTURAL ORGANISATION IN ANIMALS

Tissues – a group of similar cells which perform same function together.

Types of tissues are – Epithelial tissue, Connective tissues, Muscular tissues and Nervous tissues.

1.Epithelial tissues:

- Covers external surface and lines internal surface
- Three specialized junctions are tight junction, adhering junction and gap junction
- Non cellular basement membrane
- No blood vessels
- Receives nutrients from underlying connective tissues

Classification :

a)Simple epithelial (one layer) –

- Squamous epithelium
- Cuboidal epithelium
- Columnar epithelium
- Pseudo stratified epithelium

b)Compound epithelium (many strata) –

- Stratified compound epithelium (squamous, cuboidal, columnar)
- Transitional epithelium (urinary bladder)

2.Muscular tissues :

- Striated muscle / Striated muscle / Voluntary muscle
- Unstriated muscle / Smooth muscle / Involuntary muscle
- Cardiac muscle (heart)

3.Neural tissue – longest cell – neuron

Structure of neuron: Dentrite – Cyton – Axon with myelinated sheath with node of ranvier – axon ending

Organ and organ system:

Cockroach

Class: insect
Phylum: arthropoda

Morphology:

- 1/4 -3 inches
- nocturnal omnivorous
- body- head, thorax and abdomen
- body is covered with chitinous exoskeleton with hardened plates. Plates are called sclerites (tergites and sternites) connected by arthrodial membrane.
- Compound eyes. Antennae, bitting and chewing mouth parts.
- Mouth part consists of a labrum (upper lip), a pair of mandible, a pair of maxillae and a
- Labium (lower lip) and a tongue called hypopharynx.
- Throax consists of three parts- prothorax, mesothorax, metathorax (each has a pair of legs)

Anatomy :

a)Digestive system. Mouth-oesophagus-crop-gizzard-hepatic caecae- midgut-hind gut- rectum-anus

b)Circulatory system. Open blood vascular system- blood (haemolymph) - Pumped in to space (haemo coel) blood (plasma + haemocytes) heart is elongated muscular tube in dorsal line, heart is opening called ostia (blood enters pumped anteroirly.

c)Respiratory system. Tracheary system. (net work of trachea) - External opening called spiracles – trachea – tracheoles – blood.

d)Excretory system. Malphigian tubules - Collect uric acid - Uricotelic – in addition fat bodies, nephrocytes and Urecose glands.

e)Nervous system. Ganglian - 3 pair in thorax and 6 pair in abdomen.

f)Sense organs. Antennae, compound eyes, maxillary palps, labial palps and anal cerci - Eye is compound, made of 2000 ommatidium (mosaic vision)

g)Reproductive system.

- Male. Testes. (4-6) vas deferens- seminal vesicle - ejaculatory duct.
- Female- ovaries (2-6) oviduct- vagina – genital chamber - fertilized egg – ootheae (9-10 oothecae) development is paurometabolous, devevelopmrnt Is through nymphal stage. It looks like adult grows of moulting 13 times.

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UNIT – II

CHAPTER 5: MORPHOLOGY OF FLOWERING PLANTS

Seed – Plumule – stem
Radical – root

Types of roots → Taproot, Fibrous root, Adventitious root.

Regions of root - Region of maturation
Region of elongation
Region of meristematic tissues.
Root cap

Modification of roots:

- Storage- carrot, turnip
- Prop root- banyan tree (support)
- Stilt root – maize, sugarcane
- Pneumatophores- rhizophora (mangroves)

The stem: Plumule have nodes and internodesbears with axillary /terminal buds

Modification of stems :

1. Storage - potato, ginger, tturmeric (perennation)
2. Tendrils – axillary buds –coils - support (watermelon)
3. Thorns - axillary buds – citrus (protection)
4. Flattened stem – opuntia (do photosynthesis)
5. Vegetative propagation (grass, jasmine, banana)

The leaf:

- Short apical meristem gives rise to leaves arranged in acropetal order
- Do photosynthesis
- Three main parts are leaf base, petiole and lamina (leaf blade)
- Have stipules
- Leguminous petioles have pulvinus. (midrib)
- Venation - arrangement of veins and veinlets on a leaf.

Types of venation :

- Parallel- monocot leaves
- Reticulate – dicot leaves

Types of leaves:

1. Simple leaves
2. Compound leaves - Pinnately compound (eg. Neem) and Palmately compound (eg. Silk cotton)

Phyllotaxy: Pattern of arrangement of leaves on the stem /branch.

1. Alternate- china rose
2 Opposite- guava
3. Whorled- alstonia

Modification of leaves:

1. Tendrils - pea (support)
2. Spines - cacti (protection, water ioss)
3. Storage - onion/ garlic
4. Petiole leaves – acacia
5. Pitcher leaves – insectivorous plant (venus fly trap)

The inflorescence: Arrangement of flowers on the floral axis

Types of inflorescence: Depending on whether the apex gets converted in to a flower/continues to grow there are two major types;

1. Racemose. Main axis continues to grow laterally (in an acropetal succession)
2. Cymose. Main axis terminates in a flower so limited growth (basipetal order)

The flower:

- Four whorls. Sepal, petal, gynoecium, and androecium
- Thalamus/receptacle
- Trimerous/tetramerous/pentamerous/polymerous
- Bracteates/ebracteate/bract. (Protective sheet around the flower)
- Bisexual/unisexual
- Actinomorphic (mustard) zygomorphic (pea) asymmetric (canna)

Based on the position of ovary:

1. Hypogynous ovary (mustard) superior
2. Perigynous ovary (rose) half inferior
3. Epigynous ovary (guava, cucumber) inferior

Parts of flower:

1. ***Calyx***. Made of sepals. Can be gamosepalous/polysepalous
2. ***Corolla***. Made of oetals. Gamopetalous/ polypetalous
    - ***Aestivation***: Arrangement of sepals/ petals in floral bud
    - Main types are valvate (petunia alba , calotropis) twisted(china rose), imbricate(gulmohur) vexillary (pea, bean)
3. ***Androecium***.
    - Staminode- sterile stamen
    - Epipetalous. Attached to the petal
    - Epiphyllous- attached to the perianth

- Polyadelphous- Free stamens
- Monoadelphous- united as one bunch (china rose)
- Diadelphous – united two bundles (pea)
- Polyadelphous – many bundles (citrus)

4. ***Gynoecium***- one/ more carpels
    - Ovules attached on the wall of ovary called placenta.
    - Apocarpous - Free carpels (lotus, rose)
    - Syncarpous - Carpels are fused (mustard, tomato)
    - After fertilization ovules devopls into seed.
    - Ovary develops into fruit
    - ***Placentation:*** Arrangement of ovules within the ovary.
    - Different types are marginal (pea), axile (china rose, lemon, tomato), Parietal (mustard), freecentral (primrose) and basal (sunflower)

The fruit:

- ***Parthenocarpic fruit***: Formation of fruits without fertilization of ovary. Ex. Seedless grapes, seedless orange.
- Two parts of a fruit are pericarp and seeds.
- Pericarp has epicarp, mesocarp and endocarp
- Both mango and coconut are known as drupe fruits (fruits formed from single ovary /carpel)
- ***Perianth***: Fused petals and sepals.

The seed:

- Fertilized ovules.
- Made up of seed coat and an embryo
- Embryo with radical and plumule with one cotyledon or two cotyledon

Structure of a dicot seed:

- Seed coat, Testa and tegmen
- Hilum - small pore (place where it is attached to fruit)
- Micropyle. (water enters)
- Endosperm, cotyledons, embryonal axis (plumule and radicle)
- Mature seeds in dicot do not have endosperm called non-endospermic seeds. (stored food is utilized by embryo)

Structure of monocotyledonous seed:

- Mostely endosperm except orchids
- Endosperm is bulky and store food
- Aleurone layer (produce enzymes to hydrolise proteins for embryo)
- Cotyledon is scutellum
- Protective coats- coleoptiles (piumule), coleorhizae (radical)

Semi – technical description of a typical flowering plant:

- Scientific language
- Floral diagram and floral formula (check text book)

Floral formula by symbols:

Br - Bracteate
K - Calyx
C - Corolla
P - Perianth
A - Androecium
G - Gynoecium
$\underline{G}$ Superior Ovary

$\underline{\underline{G}}$ - Inferior ovary

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