BASUDEV GODABARI DEGREE COLLEGE , KESAIBAHAL

BLENDED LEARNING STUDY MATERIAL

UNIT-II

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DEPARTMENT OF BOTANY

3rd SEMESTER BOTANY Hons.

PAPER- V (ANATOMY OF ANGIOSPERMS)

SELF STUDY MODULE DETAILS

Class- 3rd Semester (2020-2021)
Subject-Botany
Paper Name- Anatomay of Angiosperm
Paper- V

Unit-II

(i) Stem: Organisation of shoot apex (Apical cell theory, Histogen theory, Tinic corpus theory, continuing meristomatic residue, cyto- histological zonation), Types of vascular bindles, Anatomy of dioot and monocot stem, vascular cambium. Structure, function and seasonal activity of cambium, secondary growth in stem (normal and anomalous). Root stem transition.

(ii) Leaf: Anatomy of dicot and monocot leaf, knonz anatomy.

Plan – Unit-II

No of period to be taken – 08

Date	Time	Period	Topic Covered	Signature
17.08.20	10.15am to 11.15am	1	Introduction to stem anatomy. Organization of shoot apex, Apical cell theory. Continuing meristomatic residue cyto-historical zonation.	
27.08.20	10.15am to 11.15am	1	Types of Vascular bundles, Anatomy of dicot and monocot stem.	
05.09.20	10.15am to 11.15am	1	Doubt clearing class, question discussion.	
08.09.20	10.15am to 11.15am	1	Vascular cambium structure and function and seasonal activity of cambium. Secondary growth in stem.	
15.09.20	10.15am to 11.15am	1	Normal and anomalous secondary growth in stem. Root stem transition.	
19.09.20	10.15am to 11.15am	1	Doubt clearing class.	
08.10.20	10.15am to 11.15am	1	Anatomy of leaf dicot and monocot. Kranz Anatomy.	
21.10.20	10.15am to 11.15am	1	Doubt clearing class.	21-10-20

Learning Objectives:-

After learning this you should be able to

1. Various theories on Organisation of shoot apices in Angiosperm.
2. Various cytohistorical zonation concepts of shoot apices in plants.
3. Various vascular tissues in plants.
4. Origin and types of Vascular bundles in plant.
5. Anatomy of monocot stem and how it differs from that of a dicot stem.
6. A brief account on vascular cambium.
7. Secondary growth in stems.
8. Vascular Cambium.
9. An account of the anatomy of leaves in angiosperms.
10. Anatomy of dorsiventral leaf and how it is different from that of on isobilateral leaf.
11. What is kraz anatomy and its significance.

You can use the following video link to :-

https://youtu.be/soFhzHSIking - Theories of shoot apical meristem.
https://youtu.be/IVMA32ztyZSQ- Vascular bundles # types of vascular bundles.
https://youtu.be/DCIRVHnGSM - Anatomy of dicot and monocot stem.
https://youtu.be/zGM3qBhj9J4 - Types of cambium, structure function ans seasonal activity of cambium.
https://youtu.be/BeKL-5Uwq7E - Secondary growth in dicot stem.
https://youtu.be/84bjNn5bDj4 - Leaf anatomy, dorsiventral and isobilateral leaf.
https://youtu.be/a83lsnvUnEY - Kranz Anotamy.

And you can also used the following books

1- Anatomy of Angiosperm – By Bijay Kumar Mishra and nirupama das- Kalyani
2- Anatomy of Angiosperm – By Singh, Pande and jain Rostogi publ-
3- Notes

Unit-2 SEM-1
1st chapter

SHOOT APICS

→ The aerial part of seedling is generally known as the shoot system.

→ The main axis of the shoot is the stem which bears leaves & at matured stage in its antogeny to the stem also bear flower and fruit.

→ stem is terminated by cell perpting population of small isodermic repetly deviding cell known as shoot apical meristem.

→ It is the part of the shoot and give rise to leaf premordia and produce the tissue that contribute to the increase in length of the stem.

→ The apical meristem has one of the out standing char is that as a center of most embryonic development.

→ It function as a organizes. It determinate the fats of its own derivative and in this process to continous to produce leats and floral meristem through out the life of the plant thus the shoot apical meristem is capable of interemidiate growth.

Organisation of shoot apex:-

→ The shoot apex or shoot apical meristem is a grove of meristematic cell prusent at the tip of meristematic cell prusent at tip of the stem.

→ It is the region of initiation of primary organizat. ion of the shoot where growth process occours.

→ The sc. wolf in 1759 through most like these important marey theory have good provided explain the organi- zation of shoot apex.

1. Apical cell theory
2. Histogen theory
3. Tunica corpus theory
4. Histogenetic layer theory
5. Annuaear initial & meristem detent theory
6. cytological zonation theory
7. Newmans theory

(1) Apical cell theory:-

→ Apical cell theory was the first theory to explain the apical organization in plant.

→ proposed by Nageli 1858

→ According to this theory. The single apical cell constitutes the growing point in most of the cryptogams. This single cell is called apical cell

→ Each single apical cell leads to the development of the complete plant body

→ Nageli proposed that the shoot apex of Gymnosperms and angiosperms also consisted of a single apical cell.

→ However later studieds rejected this apical cell theory beacause the single celled apical organization is limited only to cryptogams. such as algae, fungi, bryophytes & pteridophytes.

→ This theory is not applicable for gymnosperm and Angiosperms.

(2) Histogen theory

→ proposed by J. Hanstein in 1868 explained by sc. Derman in 1947.

→ Hanstein proposed the histogen theory based on two consideration

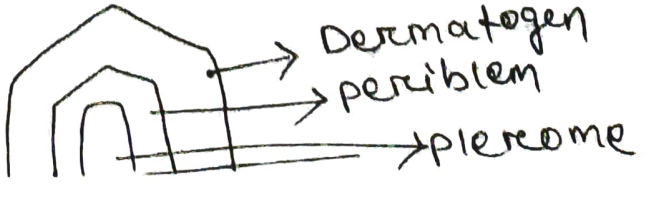
a) The plant body does not originate from a single supperficial cell but from a mass of meristematic cell.

→ This meristematic zone consist of 3 distinct zones called as Histogens. that contribute to the primary growth of the plant body.

① Dermatogen ② periblem ③ plerome

a) Dermatogen:-

- The outermost layer of apical meristem.
- This layer devide anticlinal division & give ruise to epidermis layer.



b) periblem:-
→ Located inner to the dermatogen, consist of a few layer of isodiametric cell.
→ Each cells are devided and give rise to cortex and ground tissue system.

c) plerome:-
→ Inner to the periblem plerome layer is present it is central zone of the shoot apex.
→ It give rise to vascular tissue, medullary ray & pith region
According to this theory each plant parts originated from a group of initials
→ The histogen theory is now rejected. This is because recent studies have shown that their is no strict zonal differentiation betn the histogens in the shoot apex meristem.
→ periblem & plerome from each other in apical region we can not differentiation.

③ Tunica corpus theory
→ proposed by schenidt in 1924. This theory is applicable only shoot apex and not to the root apex
→ According to this theory two distinct tissue zones occures in the apical region of the shoot.
ie Tunica & corpus

a) Tunica:-
→ consist of one or more peripheral layer of cell
- smaller then corpus
- show anticlinal division
- They assist in increasing surface area.
- If tunica is more then one layer the outer most layer form the epidermis. (outer layer)

Inner layer - cortex
pericycle
vascular tissue
pith
or central zone

b) Corpus:-

- The corpus is the core surrounded by the Tunica layer
- Largeer then tunica cell
- Devide in all plains
- They assist in increase volume (vascular tissue & pith)
- Tunica corpus theory is currently accepted theory of apical organization of shoot in plant.

Significance of Tunica corpus theory.

→ This theory serve well in the establisment of meristematic pattern shoot apex of seed plant.
→ the position, number & behebior of initiating cell in the seed plant.
→ stem & early stage in the development of primary body of the shoot.
→ This theory is of propographical value in studied of details development.

⇒ Types of vascular bundles:-

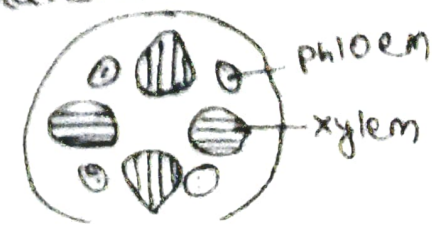
→ On the basis of orientation the (xylem & phloem) vascular bundles are classified as.

① Radial Bundle
② concentric Bundle
③ conjoint Bundle

→ if the bundle contain cambium called as open ex- vascular bundle of dicot stem.
→ if the bundle's cambium is absent they are said to be closed ex- vascular bundle of monocot stem.

① Radial Bundle

→ in this type xylem and phloem patches are located separate group.
→ Radial vascular bundle are characteristics of root.



Anatomy of Dicot stem:-

Internal str of a typical dicot stem sunflower

a) Epidermis-

→ It is the outermost layer of stem. composed thin walled parenchymatous cell arrcranged in compectly.
→ On the outer side it is covered by cuticle. The epidermis exhibits several unbranched multicellular hair present in surface of cuticle.
→ stomata are also present.

b) cortex-

→ present immediatly beneath the epidermis.
→ It is differentiated in to hypodermis, general cortex and endodermis.

(i) Hypodermis:-

→ In dicot stem Hypodermis is composed of few layer of living collenchymatous cell.
→ Chloroplast are also present so perform the function of photosynthesis.
→ provide mechanical support to the young stem

(ii) General cortex:-

→ It is present betn the hypodermis (outer) & (inner) endodermis.
→ composed of loosely arranged parenchymatous cell. with intracellular space.
→ The cells are isodiamatric in shape and known as chlorenchyma or assemelatory parenchyma.
→ In aquatic plant the cortex region developed aerenchyma with large intra cellular space. which provide bouncy to the plant.
→ Rosin duct (oil duct) or reserver of waste product are usually found in cortex region
→ The function is storage of food material also known as food storage region
→ It helps to photosynthesis process with provide mechanical support to the tissue of the stem

② Conjoint bundle:-

→ This vascular bundle in which xylem & phloem are present on the same radius and close to each other is known as conjoint bundle

It can be 2 types

① Collateral & ② Bicollateral

a- Collateral bundle

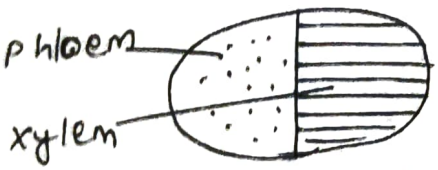
- In dicot stem (leave) vascular bundle are collateral and open while in monocot collateral and closed type.
- (xylem & phloem occurs at the same radius of the stem)

b- Bicollateral bundle

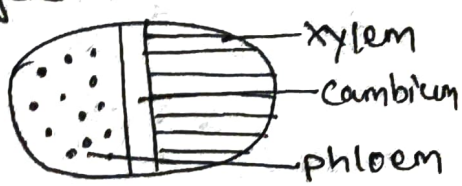
→ phloem is located at both side of the xylem. The cambium layer occurs betⁿ the xylem and phloem.

ex- stem of some ferns & member of cucurbitaceae family

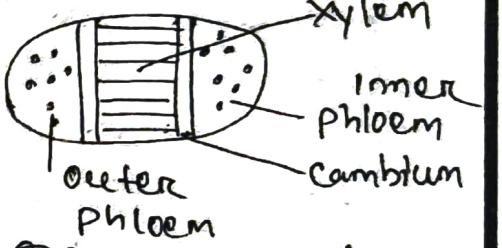
- Thus outer phloem, outer cambium, xylem, inner cambium & inner phloem layer are seen in such vascular bundle.



ⓒ conjoint closed



ⓑ conjoint open



ⓒ Bicollateral

③ Concentric bundle:-

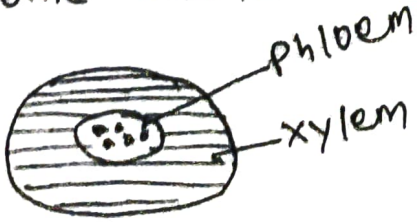
→ when the either (any one) one of the vascular tissue surrounds the other the bundle is called concentric.

a) when the phloem surrounds the xylem this type of bundle is known as amphicribal / hadrocentric.

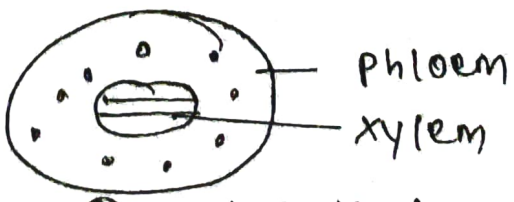
- found in some pteridophytes & also smaller bundle of some leaves, flower & fruit of dicots.

ⓑ when the xylem surrounds the phloem it is known as amphivasal / leptocentric.

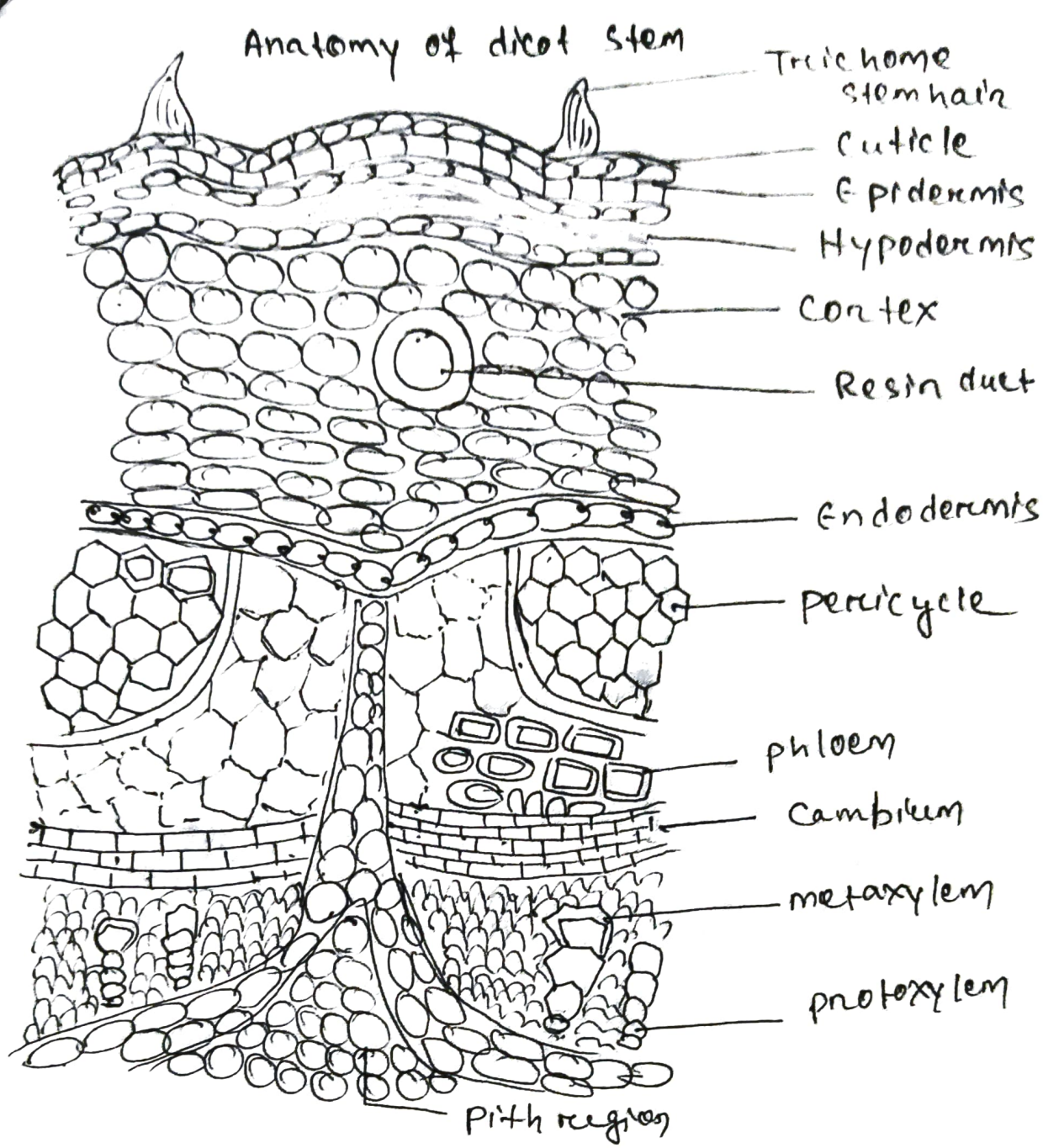
- found in some monocot stem and also medullary bundle of some dicots.



ⓐ Amphivasal or leptocentric



ⓑ Amphicribal or hadrocentric



⇒ Anatomy of Monocot stem

A transverse section of monocot stem ie maize stem is differentiated into

1. Epidermis
2. Hypodermis
3. Vascular bundle

① Epidermis

→ Single outermost layer, composed of rectangular cell The outer wall of the cell forming a thick wall. cutiele

→ Absent of epidermal hair Trichomes

(B) Endodermis –

→ It is the innermost layer of cortex which separates the stele from cortical cell.
→ It is uniseriate wavy layer composed of barrel shaped elongated cell in vertically.
→ starch grain are found in this layer & hence it is called as starch seath.

(C) Pericycle :-

→ This layer is occures inner to the endodermis composed of both sclerenchymatous & parenchymatous cell present in alternate patches.
→ sclerenchyma patches are found just outer to the vascular bundle also provides mechanical support
→ The parenchymatous cell are act as storage of food.

(D) Vascular System :-

→ A number of vascular bundles arranged in ring The vascular bundle are may be various type such as conjoint, collateral & open (amphicribal) type with endarch protoxylem.

(E) Primary medulary rays :-

→ The ground tissue found in between vascular bundle is known as medulary rays
→ composed of thin wall parenchymatous cell connect the pith with pericycle.
→ The medulary ray are involved in radial conduction of food & water.

(F) Pith or medulla :-

→ pith is present at the centre is larege & composed of parenchymatous cells.
→ present intracellular space.
→ filled with starch grains & other food materials.

② Hypodermis:-

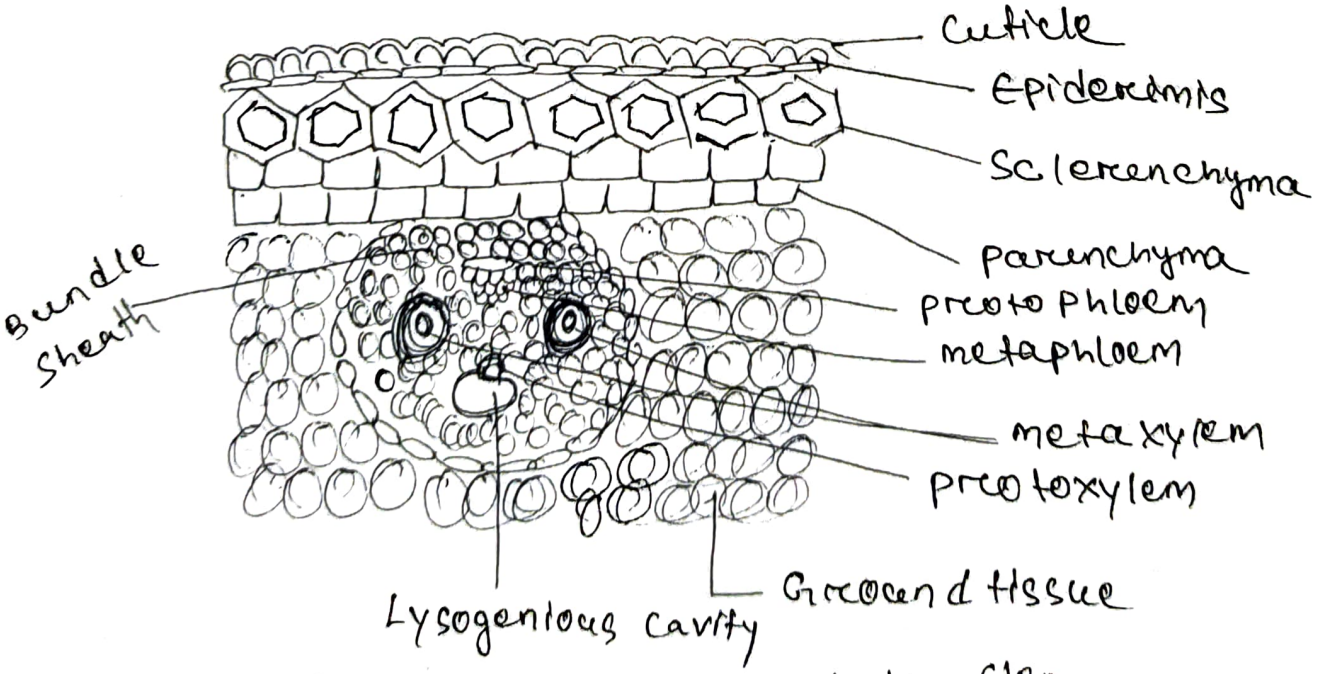
→ present below the epidermis layer
→ composed of 2-3 layered of sclerenchymatous cell.

③ Ground tissue:-

→ composed of parenchymatous cell with thin walled present below the hypodermis to the centre
→ The cells are loosely arranged with intra-cellular space
→ The vascular bundles are embedded in this region it is not differentiated, cortex, endodermis, pericycle, pith.

④ Vascular system:-

→ The vascular bundle present scattered in the ground tissue They are numerous and present closer then in the centre
→ The vascular bundle are generally oval, covered by a sclerenchymatous seath
→ The bundle are conjoint collateral and closed due to absent of vascular cambium.
→ protoxylem is endarch & a lysigenous cavity (water containing cavity) is present just bellow the protoxylem
→ phloem parenchyma, and phloem fibres are absent in vascular bundle
→ Do not occures secondary growth

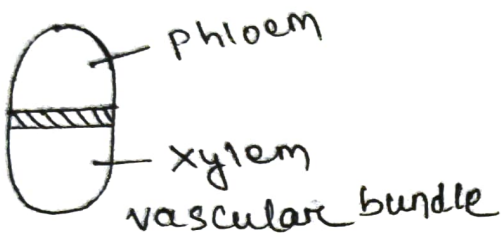


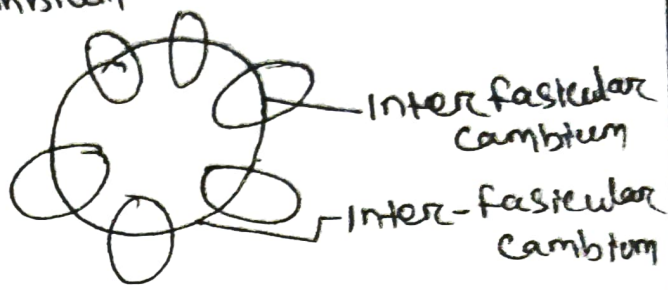
Anatomy of monocotyledon stem

⇒ Cambium

Helps in secondary growth mostly present in
① Dicot (Angiosperm
② Gymnosperm
But cambium is absent in monocot plant

Based on cambium position they are 2 types.
① Inter fasicular cambium
② Interfasicular cambium





- Intra-fasicular cambium:-
  present in betn xylem & phloem or under/inside the vascular bundle
- Inter-fasicular bundle:-
  present in between two vascular bundle form a ring str for secondary growth
- vascular cambium:-
  The vascular cambium is a lateral meristem that provides secondary vascular tissue.

origin:-
vascular cambium develop from procambium in the vascular bundle (region) the procambium tissue differentiate to form primary vascular tissue Then it undergoes division to form secondary vascular tissue.

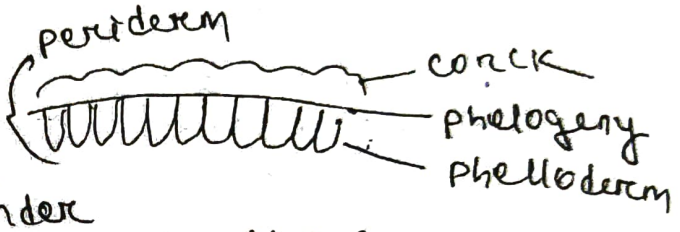
Cambium

→ Group of meristematic cell. They are parallel to one another & encircle the stem of a plant
→ cambium a cellular plant tissue from which phloem, xylem or cork grows by division resulting develop secondary growth of plants

Origin- Develop from procambium
There are several kind of cambium found in plants (stem and roots)

① Corck cambium (pallogen (pericambium) Bark
② Unifactal cambium
③ vascular cambium
(Bifactal / wood & main cambium)

① corck cambium :-
→ Responsible for the development of periderm
→ cells that grow inwards from there are termed phello-derm & cells that develop outwards are termed as Phellem or corck.



② Unifactal cambium :-
→ Such cambium produces cell to the interior of its cylender
These cells differentiate into xylem tissue.

③ vascular cambium :-
→ It is a plant tissue located bet^n xylem & phloem in the stem & roots of vascular plants.
→ Give rise secondary vascular tissue.
→ It is the source of both secondary xylem growth inward the pith and (2ndary phloem) growth outwards to the bark
→ (# found in dicot & gymnosperm but not monocot
- Intra-facicular cambium - present bet^n xylem & phloem of vascular bundle
- Inter-fasicular cambium - present in bet^n vascular bundle

Structure

Vascular cambium is usually composed of 2 basic types of cell

(i) Ray initial (ii) fusiform initial

① Ray initial
→ It give rise to parenchymatous vascular ray. They are isodiametric & flattering structure These are not tapering end

(A) Fusiform initial:

→ cells are considerably long with tapering end and spindle shape.

→ Secondary xylem & phloem differentiate from this initial. Based on the arrangement of fusiform cells they are divide in to two types of vascular cambium.

1- Stratified

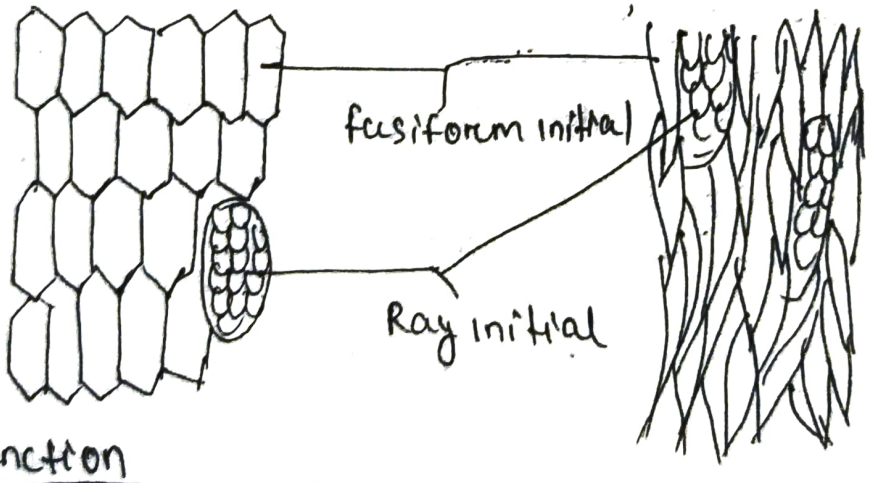
- Arranged in regular horizontal row in such away that their end & are approximately at the same level ex- found in Dalbergia sissue
  Grewia oppositifollia

2- Non-stratified vascular cambium

- Here the fusiform initial partially overlap to each other ex - Based on division cambium are of 2 types
  Steroid - Radial division
  Non steroid - obliquely radial (Pseudo transverse)

→ The cambial cells are highly vaculated & thin peripheral cytoplasm.

→ The wall of cambial cell have primary pits with plasmodesmata



Function

→ provides layers of xylem & phloem in a woody plant thereby growing the diameter of the stem.

→ In healing for injured plant life

→ The corck cambium is responsible for secondary growth that replace the epidermis in root & stem

Seasonal activity of cambium:-

→ Activity of cambium is under the influence of several environmental factor such as season.

→ Trees growing in the tropics show more or less uniformity in the size or dimension of their vessel elements.

→ These growing in temperate climets show clear morphological variation summber & winter wood.

- Summer - vessels are wider
- winter - vessels are narrow

according to wet mone R. Rier (1963)

- Low concentration of sugar - Xylem differentiation
- High concentration of sugar - phloem differentiation

⇒ Secondary growth of stem:-

→ The growth of the roots & stem in length with the help of apical meristem is primary growth.

→ Apart from primary growth the most dicotyledonous plant exhibit an increase in girth growth of lateral meristem) This increase is called secondary growth.

Secondary growth are of 2 types

① vascular cambium } Lateral meristem
② corck cambium }

→ occurs in all woody dicots, some herbaceous dicots & gymnosperm some monocot plant (Dracaena, Aloe and yucca etc.

⊙ Secondary growth in dicot stem:-

→ main secondary growth occurs in stelar region by the help of vascular cambium which is called stelar secondary growth

→ Extra stelar region - secondary growth occurs by the help of corck cambium which is called as extra-stelar secondary growth

→ This is lead to formation of periderm

Stelar secondary growth:-

- Formation of cambium Ring—

→ Intrafasicular cambium - present in betn xylem & phloem of the vascular bundle.

→ Interfassicular cambium - cambium develop in the parenchyma (medullary ray cell in betn the vascular bundle)

→ Fasicular & interafasicular cambium patches join end to end form a complete ring called cambium ring.

- Activity of Cambium Ring—

→ The cambium consist of elongated spindle-shaped cell called fusiform initial cell and small isodiametric cell are called ray initial.

→ fusiform initials towards the inner side differentiated in to secondary xylem. These cuts off towards outer side differentiate in to secondary phloem element

→ Ray initial produces parenchyma cell arranged in radially from secondary medulary rays which pass through secondary xylem & phloem.

→ Cambium ring is more active on the inner side (then the outer side) producing more amount of xylem & phloem.

→ Resulting a pressure is used pushing the cambium phloem & other surrounding tissue out wards

→ But the primary xylem remains intact. at the centre

→ Secondary growth, the main bulk of the plant body is formed by secondary xylem

- formation of annual ring

→ The cambium ring also shows seasonal variations in its activity. It become more active in spring producing more amount of xylem vessels & with wider lumen.

→ During winter cambium ring becomes less active large, thin & broad as compared to these formed during autmn which are small, narrow & thick

Spring - spring - spring wood or early wood

Autmn - autmn wood or late wood

→ Two types of wood appear in the form of distinct concentric circles called annual rings

SAP wood and Heart wood:-

→ Secondary xylem, present towards periphery. conduction of food storage

→ It is living and lighter in colour conduct water & mineral

→ The older wood of annual rings in the centre becomes stained due to deposition of aromatic substance, oil, gums, tannins etc (sap wood)

Heart wood or duramen:-

→ The cavity of Heart wood are often clogged with deposits of gummy materials and outgrowth of adjacent cell which enter through the pits called tyloses.

→ water conduction stop in heart wood & it helps mosly in mechanical support.

→ Heart wood is generally commercially more valuable then sap wood.

→ Heart wood is more resistant to micro-organism & insects then sap wood

Extra stelar secondary growth:-

Formation of cork cambium:-

→ Occurs outside the vascular bundle or stelar region is called extra stelar secondary growth

→ Such secondary growth leads to the formation of periderm

→ Extrastelar secondary growth encircle phellem or cork, phallogen or cork cambium & phelloderm. (secondary cortex)

- phellogen / cork cambium:-

→ present below the epidermis become secondary lateral meristem

- outer cell phellem / cork cells are rectangular, arranged in radial row

- phelloderm / secondary cortex present inner to the cork cambium

→ Lenticle develop on phellem. It formed due to over activity of cork cambium at this region

→ Resulting overlapping cells are pushed outwards and epidermis is raptured

→ The cells are arranged loosely thin wall parenchymatous intracellular space are called complementary cell.

→ They often project slightly above the outer surface of the stem.

→ Phellem, phellogen & phelloderm together constitute the periderm.

Anatomy of Angiosperm

No-1 1×10 = 10

1- Tunica corpous theory was proposed by _____.
2- The vascular bundles originate from _____.
3- Xylem and phloem are _____ tissue.
4- In root _____ type of vascular bundle are found.
5- The cambium is absent in vascular bundle, this type of vascular bundle are called _____
6- The Dicotyledon leaf is also called as _____,
7- The monocotyledon leaf is also called as _____
8- mesophyl tissue divisible in to _____ and _____ parenchyma
9- Epidermis layer of stem is developed from _____.
10- Vascular bundle is developd from _____ layer of cell/ short note.

No-2 3×5 = 15

1- Apical cell theory
2- What is Histogen
3- Periblem
4- Tunica corpus theory.
5- Inter-fasicular cambium

No-3 long question 2×5 = 10

1- Describe the str & distribution of vascular cambium.
2- Anatomy of Dicotyledon stem.
3- Anatomy of monocotyledon stem.
4- secondary growth in stem.
5- Kranz anatomy.