B.Sc. Second Year
SEMESTER - III
CCB - III (A)
Theory Paper - VI
Plant Anatomy

UNIT - I :⇒ Meristematic Tissue

INTRODUCTION

The term meristem was derived from the Greek word 'Meristos = divisible'.

Def^{n} :⇒ The group of cells which undergoes continuous state of division, such type of tissues are reffered as "meristematic tissue".

(or)

"The cells which has the capacity of division" are called as Meristematic tissues".

General characters of Meristematic Tissue

1) It is a group of fundamental and identical cells.
2) They are thin walled cells.
3) These are rectangular, uniform, rounded or polygonal in shape.
4) These are compactly arrenged cells, without intercellular spaces between them.
5) They have dense cytoplasm with a large nucleus.
6) vacuoles are absent but in few cases there is presence of vacuoles which are distributed in the cytoplasm.

7) These tissues are divide continously and adds new cells into plant body.

8) New cells retain their meristematic activity but some of them stop dividing and becomes permanent tissues.

9) The process in which change of meristematic tissue into permanent tissue takesplace is called "differentiation".

10) cells of meristematic tissue are elastic and made up of cellulose.

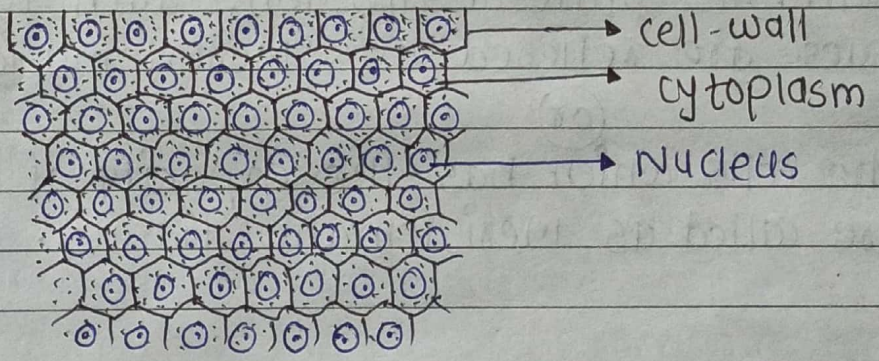

fig. Meristematic tissue with polygonal cells.

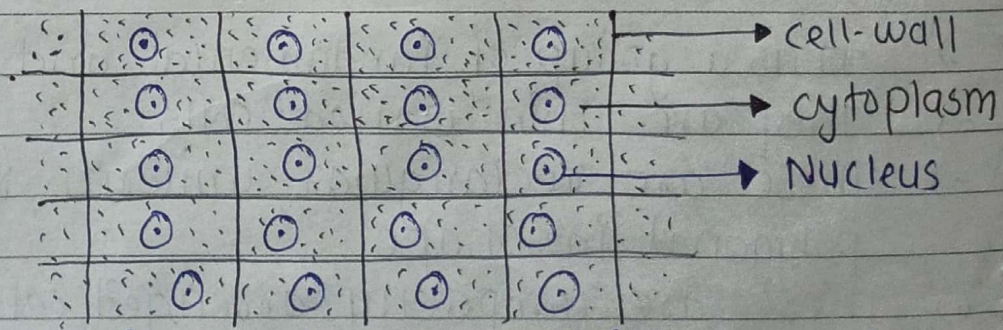

fig. meristematic tissues with rectangular cells.

Classification of Meristematic Tissue:

A Classification of Meristematic Tissue on the basis of origin / Development :⇒

on the basis of origin meristematic tissue are classified into following three types :⇒

1) Promeristem
2) Primary meristem
3) secondary meristem

1) Promeristem / primordial meristem / Eumeristem :⇒

A group of earliest and youngest meristematic cells of a growing organ are reffered as "Promeristem".

→ It is the early embryonic meristem from which other advanced meristems are derived.
→ In plant it occupies a small area at the tip of stem and root.
→ Promeristem further divides and forms primary meristem.
→ It is also called as "embryonic meristem".

2) Primary Meristem :⇒

→ The meristem which is derived from the promeristem it is called "primary meristem".
→ It is developed after the few divisions of cells.
→ From the embryonic stage there is presence of primary meristem.
→ Such type of meristem persists throughout the life of plant body.
e.g. Apical meristem intrafascicular cambium, Intercalary meristem

→ It forms primary permenant tissue by differentiation process.

3] <u>secondary meristem</u> :⇒

"It is derived from the permanent tissues" or some non-meristematic tissues.

→ Permanent tissues generally don't have ability to divide & redivide.

→ Some cells of permanent tissues under certain conditions regain power of cell division.

e.g. In dicot stem, parenchymatous cells of medullary rays regain power of division & it divides-redivides & forms <u>intrafascicular cambium</u>.

* In dicot root permanent cells of pericycle & pith becomes meristematic & divides-redivides & forms <u>cambium</u>.

* cortical parenchymatous cells becomes meristematic & forms <u>cork cambium</u>.

→ In above cases <u>cambium</u> is formed secondarily from permanent tissues, hence it is called or known as secondary meristem.

Classification of Meristematic tissue on the basis of position

On the basis of position, meristem is classified into following three types :

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

(1) Apical Meristem :⇒

→ Meristem, which is present at the apex of plant body is called as "apical meristem".

→ It is also called as growing point or growing tip.

→ It lies at the apex of stem and root of the vascular plants.

→ Sometimes these are also observed at the apices of leaves.

→ Due to activity of meristem plant organs increases in their length.

→ Initial growth takesplace by one or more cells located at the tip of plant organ.

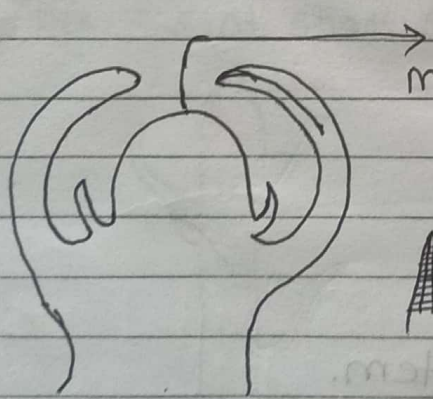

Fig. Shoot Apex

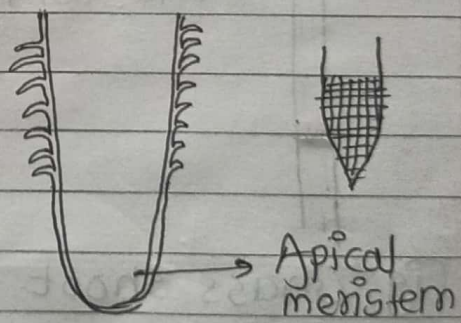

Fig. Root Apex

Fig. Apical meristem

→ These cells always maintain their individuality & position hence called as apical cells / apical initials.
e.g. Root apex & Shoot apex.

② Intercalary Meristem :⇒
The meristem which is present at the base of internodes near the nodal region of shoot is called "intercalary meristem".
→ It lies between permanent tissue.
→ Length of internodes increases due to continous activity of intercalary meristem
e.g. Grasses, Leaf base of Pinus, internodal base of Equisetum, etc.

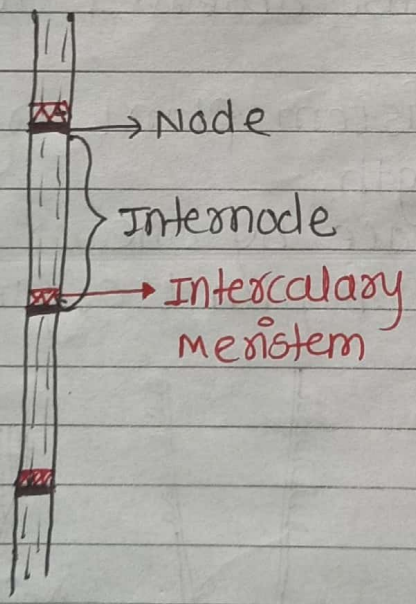

Fig. Grass shoot showing Intercalary meristem.

(3) Lateral meristem :⇨

→ These are present along the longitudinal axis of roots and shoots.
→ These are also arranged parallel to the sites of organs.
→ Lateral meristem gives rise to secondary permanent tissue, after division.
→ It is present in the form of strips between & inside the vascular bundles.
→ It is also present in cortex of dicot shoot and root.
e.g. Intrafascicular cambium, Cork cambium.
→ Thickness / girth of plant body increases due to the activity of lateral meristem.

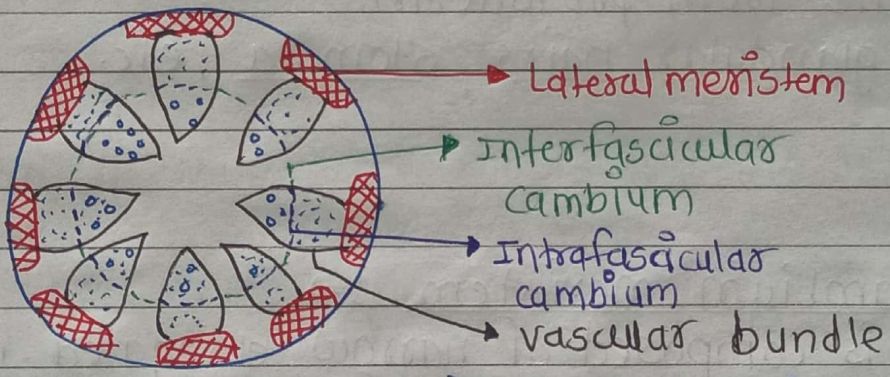

fig. T.S. of shoot showing lateral meristem.

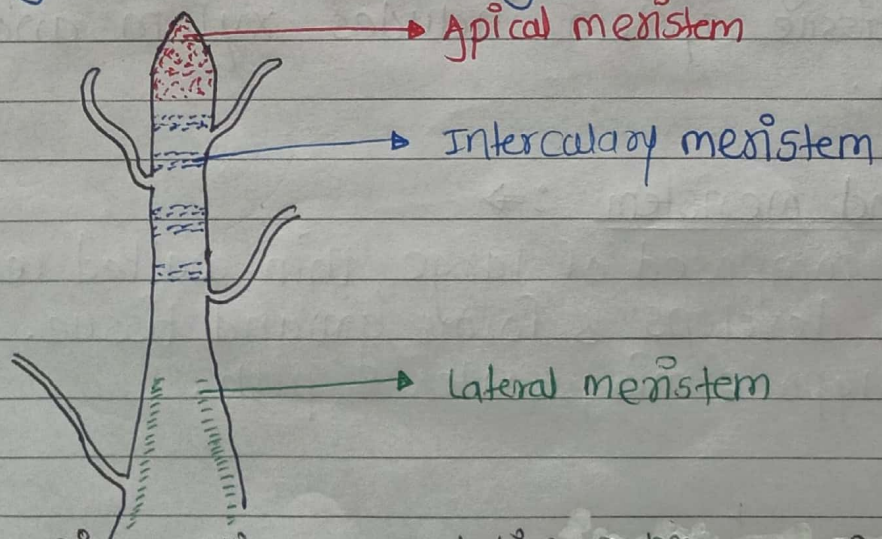

fig. Digramatic representation of different positional meristem

Classification of Meristematic Tissue based on their function

On the basis of function of meristematic tissue these are classified into three classes which are as follows :⇒

1) Protoderm meristem
2) Procambium meristem
3) Ground meristem

1) Protoderm meristem :⇒

→ It is the outermost layer of young growing region.
→ It develops to form epidermal tissue system.
→ Dermal tissue system in plant is formed ~~by the~~ from protoderm.
e.g. glandular hairs, stomata, etc.

2) Procambium meristem :⇒

→ It is composed of narrow, elongated, meristematic cells that gives rise to vascular tissue system.
→ This tissue system includes xylem and phloem.

3) Ground meristem :⇒

→ It is composed of large, thin-walled cells, which develops & forms ground tissue.
e.g. Hypodermis, cortex & pith.

Organization of Root Apical Meristem [RAM]

Root apex is consists of apical meristem or growing tip of root. It is few milimeters to few centimeters in length.

→ L.S. of root apex shows three distinct regions which are as follows :

1) Dermatogen
2) Periblem
3) Plerome

1) Dermatogen :⇒

→ It is the outermost layer of root apex.
→ It is single layered.
→ It is also known as "peliferous layer".
→ Cells of dermatogen at apex divide-redivide and gives rise thin walled, narrow, rectangular cells called "calyptrogen".
→ Later on this calyptrogen gives rise to a protective covering of root, which is called as "root cap".
→ During the process of penetration of root into soil root cap gets crushed which is again reformed by calyptrogen.
→ Root caps are totally absent in aquatic plants & these root caps are replaced by similar structures called "root pockets".
→ cells of dermatogen grows towards upper side and forms "root hairs".

2) Periblem :⇒

→ It is present just below the dermatogen.
→ It is single layered at apex & multilayered towards upward side.
→ After repeated division of cells of periblem there is formation of root cortex takesplace.

3) Plerome :⇒

→ It is present in the central region of root apex.
→ Cells of this region divides irregularly, just behind the growing point & produces new cells.
→ Some of the new cells become much elongated & finally gives rise to promeristem & procambium which later on gives rise the vascular bundles of root.
→ remaining new cells gives rise to pericycle & pith of root. [stele = Pericycle + pith]

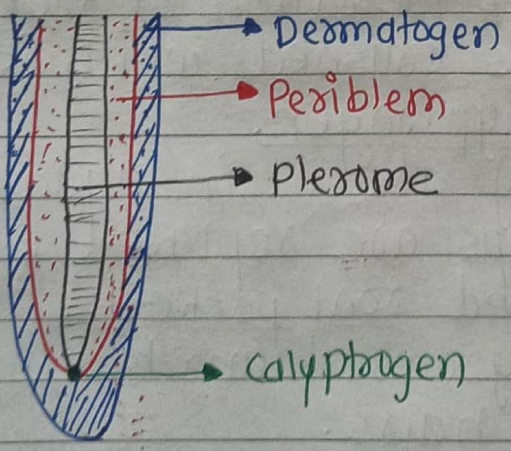

Fig. L.S. of Root apex.

Organization of Shoot Apical Meristem [SAM]

Shoot apex is consists of apical meristem or growing point/tip of shoot. It is few milimeter in length.

→ L.S. of shoot apex shows following three regions :

1) Dermatogen
2) Periblem
3) Plerome.

1) Dermatogen :⇒

→ It is the outermost layer of shoot apex.
→ It is single layered.
→ Cells of dermatogen undergoes repeated division & gives rise epidermis of stem.
→ This region possesses many small prolongations called leaf premordia.
→ These leaf premordia protects the shoot apex.

2) Periblem :⇒

→ Just below the dermatogen, periblem is present.
→ It is single layered at apex & multilayered towards downward side.
→ Cells of this region gives rise cortex of stem.
→ Cortex is differentiated into hypodermis general cortex & endodermis in dicot stem.

3) **Plerome** :→

→ It is central region of shoot apex.
→ After repeated division cells of plerome adds new cells.
→ Some of the new cells becomes much elongated & gives rise to procambium.
→ Pro. Later on procambium gives rise to tissues of stem.
→ Rest of the new cells gives rise to pericycle & pith of stem.

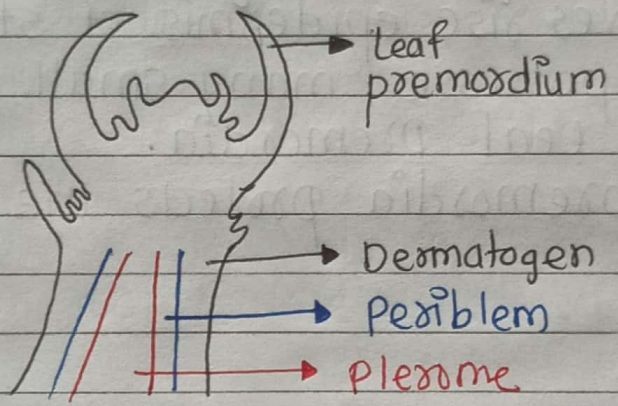

Fig. L.S. of Shoot apex

Theories of organization of Apical Meristem

To explain the structure of apical meristem different theories was given by different scientist.

Some of the important theories of organization of apical meristem are as follows :⇒

1) Apical cell theory
2) Histogen theory
3) Tunica carpus theory

1) Apical cell theory :⇒

→ This theory was given by Nageli (1958)
→ This theory is applicable for the both organizations i.e. root and shoot apical meristem.
→ According to this theory single cell is present at the apex of root & shoot which is known as apical cell.
→ This single apical cell is structural and functional unit.
→ This theory is most applicable to lower plants i.e. algae fungi, bryophytes, some pteridophytes.
→ This theory is not applicable for higher plants.

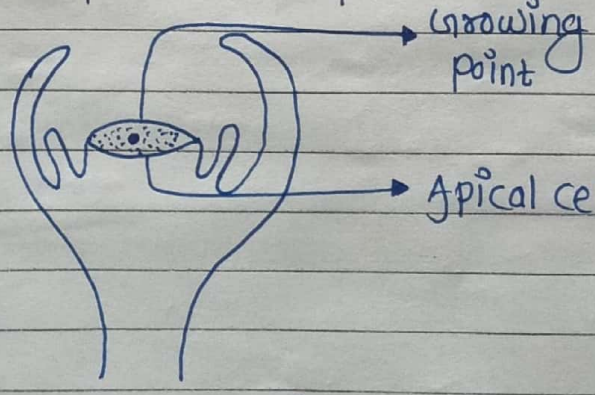

fig. Shoot apex showing apical cell.

2) Histogen theory :⇒

→ This theory was proposed by Hanstein (1870)
→ This theory was given to explain organization of root and stem apical meristem.
→ According to this theory apical meristem is composed of different zones.
→ Each zone consists of initial cells, which are also known as Histogen / tissue builders.
→ According to this theory three regions are there viz. Dermatogen periblem & plerome.
→ Dermatogen gives rise to epidermis, periblem gives rise to cortex and plerome gives rise to stelar region of root and stem.
[stelar region = pericycle + pith]
→ This theory is most applicable to the flowering plants.

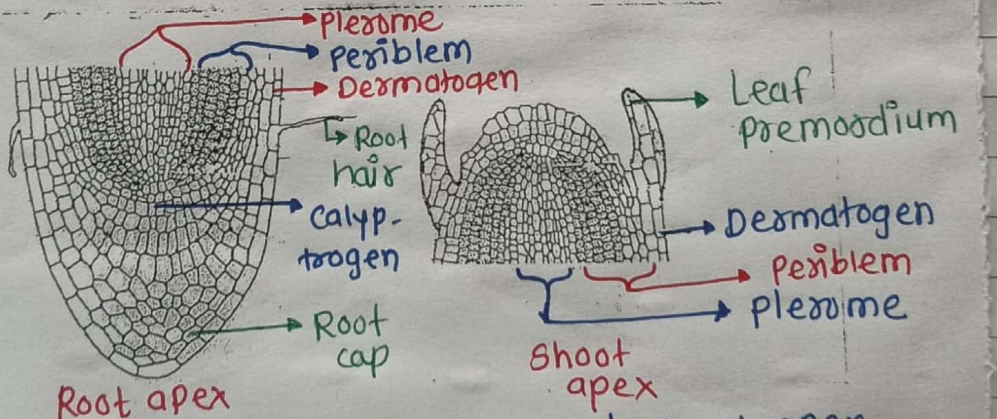

Fig. L.S. of root apex and shoot apex showing Histogens.

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3) Tunica corpus Theory :⇒

→ This theory is proposed by schmidt (1924).
→ This theory is applicable for only the organization shoot apical meristem.
→ In higher plants apical meristem is consists of / composed of two zones i.e. Tunica & Corpus
→ Tunica :⇒ It is outer zone of shoot apical meristem.
  → Tunica consist of variable layers of cells.
  → This Tunica gives rise to epidermal tissue system of shoot.

Corpus :⇒ It is the [illegible]rmost zone of shoot apical meristem.
  → Corpus zone consists of large and irregular cells.
  → This zone gives rise to all the tissue system except epidermis.

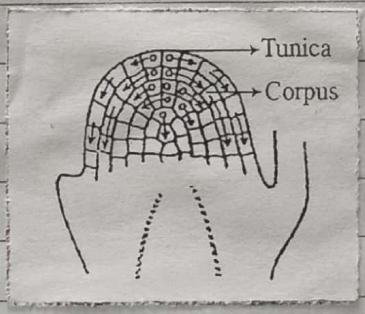

Fig. L.S. of shoot apex showing tunica & corpus