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™ Organisation of Root Apical meristem:-

[1] Organisation of the root apex-

The root has a group of undifferentiated cells at its apex. It comprises the apical meristem of the primary root. These cells are meristematic and possess the following characteristics-

- a) **They have dense protoplasmic contents.**
- b) **Their nuclei are large.**
- c) **They undergo active division.**
- d) **Under electron microscope these cells have been seen to possess small vacuoles.**

By various processes of growth and differentiation the cells of the apical meristem give rise to the various tissues of the mature root. Such cells are called initials. Three types of apices have been recognized in the spermatophyte-

[A] Root apices with two layers of initials-

One gives rise to vascular cylinder and the other gives rise to epidermis and root cap. It is the commonest type in the Gymnosperms.

[B] Root apices with three layers of initials-

One giving rise to cortex, the second to vascular cylinder and the third to the epidermis and the root cap. It is common in Angiosperms.

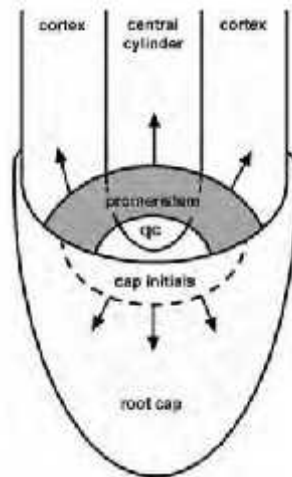


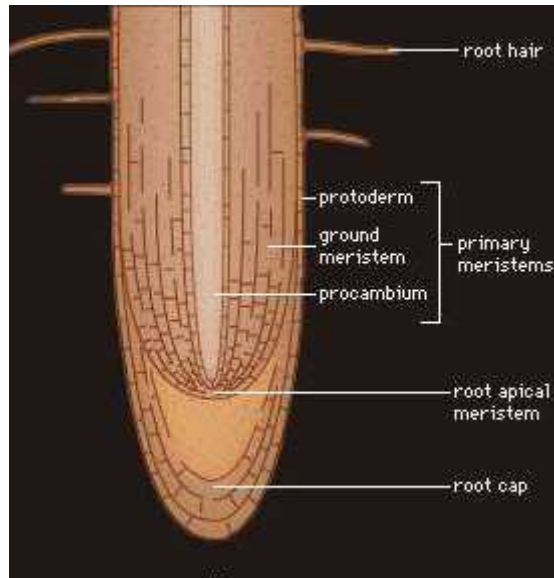
Diagram of root apical organization

***Above diagram taken from Google**

[C] Root apices with three sets of initials-

That give rise to the vascular cylinder, cortex and epidermis. In such apices the root cap arises from the fourth set of initials known as the 'Calyptragen'. This type is common in the monocots. These sets of initials are also known as histogens meristem levelled them as dermatogens, periblem and pleurome. The former was supposed to give rise to the epidermis alone, the second to the cortex and endodermis whereas third gives rise to the vascular cylinder and pericycle.

The above three types of root apices are not find but a few more types have also been added by workers suggest that the region of cells situated at the periphery of a central group of inactive cells or the quiescent centre.



Root Apical Meristem.

***Above diagram taken from Google**

[2] Tissue Differentiation:-

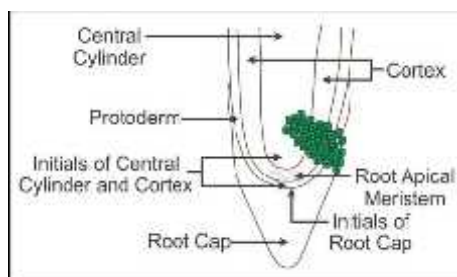
The apical initials or the initial cells of the promeristem that lie around the quiescent centre divide periclinally. The inner cells remain meristematic whereas the outer cells by further divisions differentiate into various tissues of the root. The Root cap either differentiates from a separate layer of initials or from the same layer of initials that give rise to the cortex or the epidermis. The epidermis, cortex & vascular cylinder start differentiating well behind the Root apex.

Epidermis :-In some angiosperms & majority of Gymnosperms the epidermis arises from the layer of apical initials that give rise to the Root cap & the cortex . In majority of dicots the epidermis arises from a separate layer of initials that also give rise to the Root cap. In monocots the epidermis arises from a separate layer called Dermatogen which does not give rise to any other tissues. In them Root cap arises from a separate layer calyptragen. In the aerial roots of some Orchids the epidermal initials divide periclinally to form a many layered or a multiple epidermis or Velamen. In other angiosperms the epidermal layer doesnot divide periclinally & remains single layered.

The Root hair develops from some epidermal cells in the root hair zone. They are unicellular & are the tubular outgrowth from the epidermal cells. Presence of specialized cells called trichoblast has

been reported in the epidermis of many plants. These cells give out root hair. The nuclei of the trichoblasts continue to synthesize DNA & become endopolyploid & larger in size.

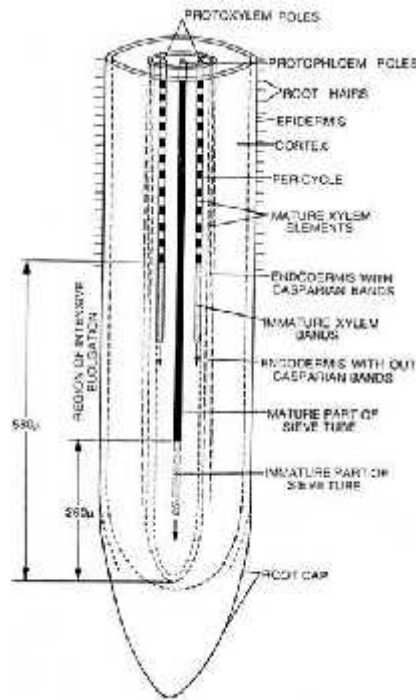
Cortex :-It develops from the periblem. Its cells divide anticlinally & periclinally to form the many layered centre. The differentiating cortical cells enlarge considerably in size & are usually irregularly arranged with small large intercellular spaces. In some root especially in water plants, the cortical cells are regularly arranged in concentric circles.



Organization of Root Apical Meristem

***Above diagram taken from Google**

Endodermis :- The inner most layer of centre differentiates into an endodermis. Endodermis is made up of cells that differ in structure & function from the layer of cells on either side their metabolic activities are quite different. The cells usually develop casparian bundles bands on their radial walls. These are thick bands of suberin. The cells contain enzyme like peroxidase, cytochrome, oxidase, polypheral, oxidase & several others. In majority of monocot root the suberin lamella usually develops along the entire inner & radial walled cells usually develop. Opposite the phloem elements & spread radially. Some cells usually opposite the protoxylem elements remain thin walled & are called the passage cells.



L. S of root tip showing various level of tissue differentiation & mature proximal root.

***Above diagram taken from Google**

Pericycle :- It is single layered & parenchymatous in the roots. It is derived from the same initial of promeristem that give rise to the vascular tissue. The cells of the pericycle retain their meristematic activity & give rise to the lateral roots & a portion of the cambium. The pericycle is also designated as pericambium.

Vascular tissues :- The vascular tissue differentiate from the procambium which differentiates from the more mature region of the root towards the root apex i.e. acropetalous . The procambium develops from the cells cut off by the root apex initial i.e promeristem destined to give rise to the vascular tissue (pleron) . The procambium cells are meristematic & are filled with dense & granular cytoplasm that is easily stainable & have large nuclei . The cells in the entire central cylinder of the root usually constitute the procambium. In some dicot & majority of monocots the central pith also develops. In this case the portion desired to give rise to the pith is called the “Ground Meristem”.

The protoxylem starts differentiating at the periphery of the procambial strands & are the first obtained elements to become lignified. The metaxylem elements differentiate towards the entire

mature later so that xylem is exarch. The protophloem elements differentiated at alternate radii & appear as angular cells in a T.S. The metaphloem elements appear later, next to the protophloem.

Reference books:-

1.Life science by Dr. A.P Singh & Kumar Pushkar

2.Plant anatomy by Dr. B.P.Pandey (S. chand)

3. A text book of plant anatomy by S. K. Sinha

4. Plant anatomy by Neeraj Tandan