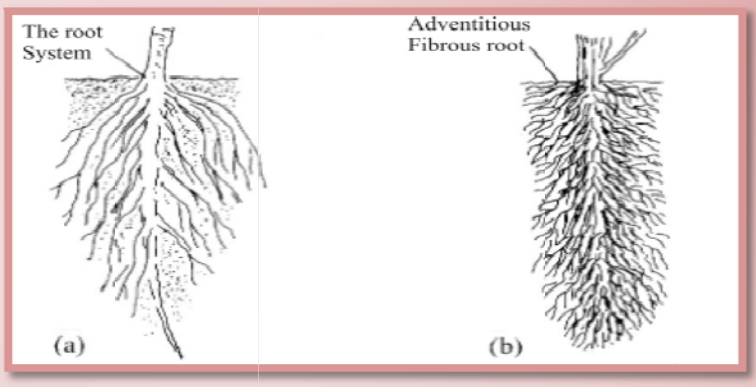
LESSON-6
ROOT SYSTEM

The root system is the descending (growing downwards) portion of the plant axis. When a seed germinates, radicle is the first organ to come out of it. It elongates to form primary or the tap root. It gives off lateral branches (secondary and tertiary roots) and thus forms the root system. Its branches penetrate through large and deep areas in the soil and anchor the plant very firmly. It also plays another vital role of absorbing water and mineral salts from the soil and transporting them upwards.

Root

- The radicle elongates to form the primary or tap root.
- Roots are non-green due to the absence of chlorophyll, lack nodes and internodes, leaves and buds.
- These grow towards gravity (positively geotropic) and water (positively hydrotropic) but grow away from light (negatively phototropic).
- Root systems are of two types – Tap root system (in dicots) and Fibrous root system (in monocots).



- **Tap root** develops from the radicle while **adventitious roots** develop from any part of the plant except the radicle. Apical region of root has 4 regions namely root cap region, region of meristematic cells, region of elongation and region of maturation.

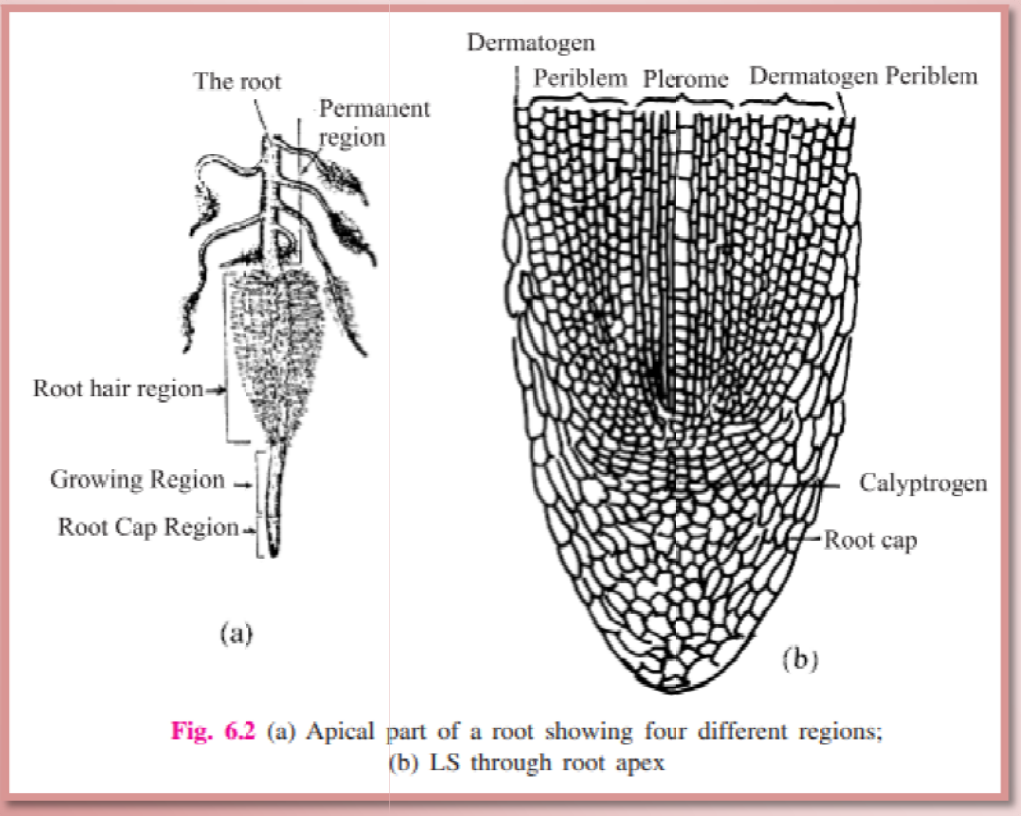


Fig. 6.2 (a) Apical part of a root showing four different regions; (b) LS through root apex

- In some plants, roots undergo modifications in their structure to perform special physiological functions (food storage, assimilation, respiration, absorption of atmospheric moisture and sucking nutrients from host plants) and mechanical functions (stronger anchorage, climbing, buoyancy)
- Tap roots and adventitious roots can get modified into a variety of forms to perform various functions

Modifications of roots

Tap root modification	Adventitious root modification
(i) Conical root	(i) Tuberous root
(ii) Fusiform root	(ii) Fasciculated root
(iii) Napiform root	(iii) Nodulose roots
(iv) Tuberous root	(iv) Moniliform roots
	(v) Annulated roots
	(vi) Assimilatory roots
	(vii) Epiphytic roots
	(viii) Pneumatophores/Respiratory roots
	(ix) Sucking roots or haustoria
	(x) Prop roots
	(xi) Stilt roots
	(xii) Climbing roots
	(xiii) Clinging roots
	(xiv) Floating roots

1. Tap root modifications

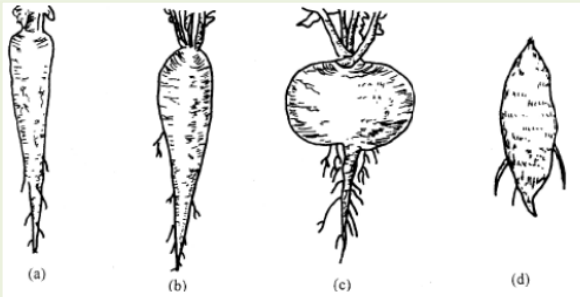


Fig.6.3 Modifications of tap root (a) Conical (carrot); (b) Fusiform (radish); (c) Napiform (turnip); (d) Tuberous (4 o'clock plant)

2. Adventitious root modifications

o Modifications for food storage

Fig. 6.4 Adventitious root modifications (a) Tuberous root (sweet potato); (b) Fasciculated roots (*Dahlia*); (c) Nodulose roots (mango ginger); (d) Moniliform roots (grass); (e) Annulated roots (*Ipecac*); (f) Assimilatory and epiphytic roots (orchid)

o Modification for better gaseous exchange

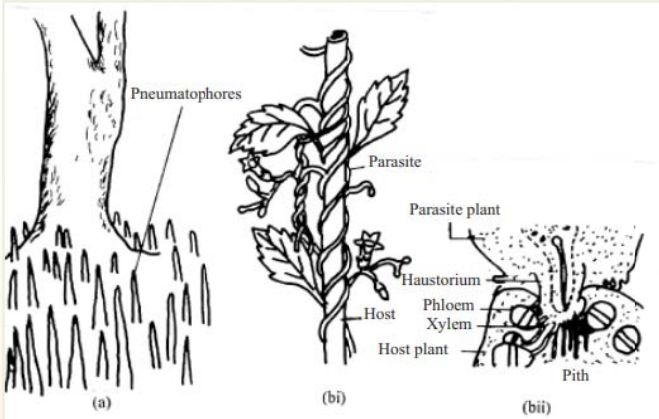


Fig. 6.5 Adventitious root modifications (a) Pneumatophores of a mangrove plant; (bi) *Cuscuta* (parasite) on host; (bii) Section showing sucking root or haustorium penetrating the host plant

o Modification for strong support

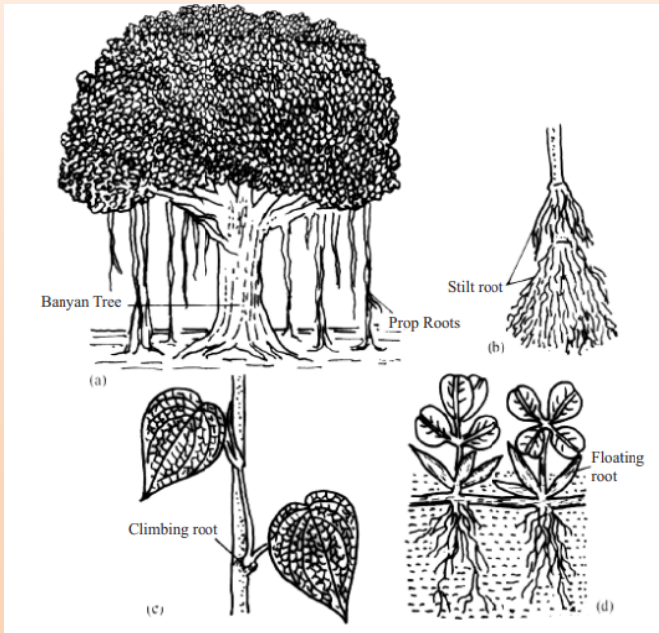
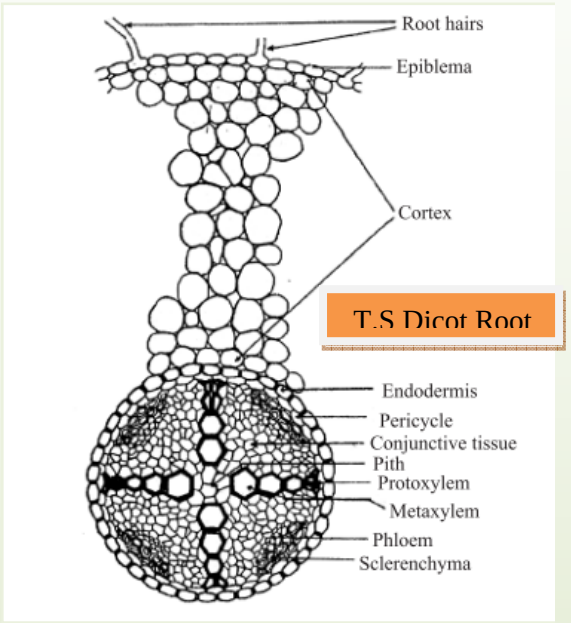
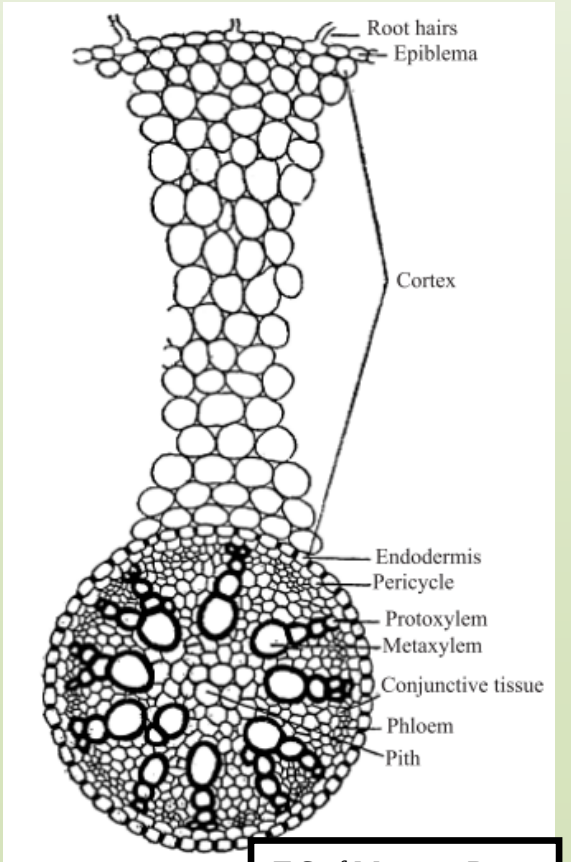


Fig.6.6 Adventitious root modifications – (a) Prop roots in banyan; (b) Stilt roots of sugarcane; (c) Climbing roots of betel; (d) Floating roots of *Jussiaea*.

- Internal structure of root shows unicellular hairs, single-layered epiblema, large multilayered cortex, prominent one-layered endodermis with casparian strips and some passage cells. The stele consists of single layered pericycle, radial vascular bundles, exarch xylem and pith.
- Dicot root differs from monocot root in having lesser number of vascular bundles (2-6), very small pith and presence of cambium (secondarily formed).



T.S Dicot Root



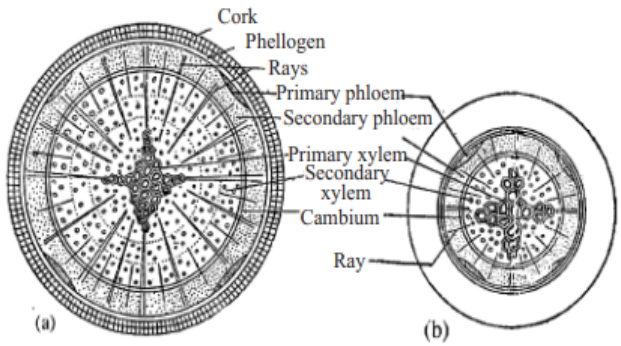
T.S of Monocot Root

Characters	Dicot root	Monocot root
1.Number of vascular bundles	2-6 (*di-hexarch*)	Many (*polyarch*)
2. Pericycle	Seat of origin of lateral roots, vascular and cork cambium	Seat of origin of lateral roots only
3. Cambium	Present	Absent
4. Secondary growth	Present	Absent
5. Pith	Very small or absent	Large

- Origin of lateral roots is endogenous.
- Number of lateral roots corresponds to the number of xylem bundles.
- Lateral roots, vascular cambium and cork cambium originate from pericycle in dicot roots.
- Due to the presence of cambium dicot roots undergo secondary growth

SECONDARY GROWTH IN DICOT ROOTS

- The dicot roots grow in girth by undergoing secondary growth due to the involvement of lateral meristems (vascular cambium and cork cambium).
- Vascular cambium originates as a strip in pericycle cells lying outside the protoxylem and in conjunctive tissue inner to each phloem bundle.
- Initially the cambium is wavy but later becomes circular.
- The vascular cambium gives rise to secondary phloem towards periphery and secondary xylem towards centre.
- Primary medullary rays differentiate outer to protoxylem.
- Cork cambium (phellogen) also differentiates in the pericycle and gives rise to cork (phellem) towards periphery and secondary cortex (phelloderm) towards inside.
- Phellem, Phellogen and Phelloderm together form the periderm which is protective in function



Test Yourself

1. Mention any four adventitious root modifications
2. Differentiate between dicot and monocot root.
3. Write anote on secondary growth in dicot roots.