

CONCEPT MAP

MORPHOLOGY OF ROOTS

- Root constitutes the lower part of plant axis which develops from radicle and typically grows towards gravity.
- Roots are usually non-green, underground, cylindrical or sub-cylindrical, and tapering. They do not have nodes, internodes and leaves.
- Root branches develop from interior (usually pericycle) of the parent root. Such an origin is called endogenous.

Parts of a typical root

A typical root possesses four parts - root cap, zone of cell formation, zone of cell elongation and zone of cell maturation.

- Root cap:** It is a thimble-shaped or cap-shaped parenchymatous, multicellular structure which covers the apex of root. It provides protection to the young apical cell against soil particles.
- Zone of cell formation (Region of meristematic activity):** It is subterminal. The cells of this region are thin walled, with dense cytoplasm and large nucleus. These cells are in active state of division and thus their number increases continuously.
- Zone of cell elongation:** This region is situated just above the meristematic zone. The cells of this region lose the power of division and elongate rapidly. This increases length of root.
- Zone of cell maturation:** The cells of this region are differentiated into permanent tissues depending upon the functions they have to perform. From this region some of the epidermal cells form fine, delicate, thread like structure called root hairs which absorb water and minerals from the soil.

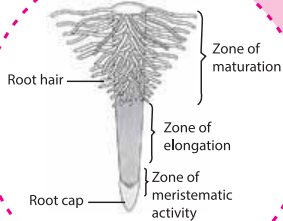


Fig.: Parts of a typical root

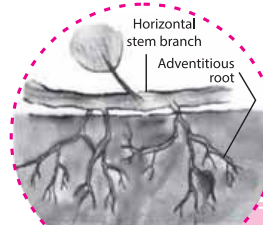


Fig.: Adventitious root system

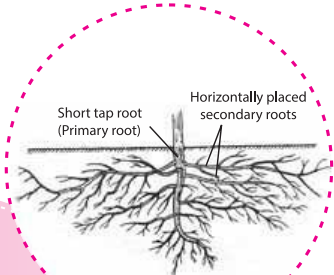


Fig.: Fibrous root system

Types of root system

Root systems are of three types: tap root system, fibrous root system and adventitious root system.

- Tap root system:** In majority of dicots, direct elongation of the radicle leads to the formation of primary root which bears lateral roots of several orders that are referred to as secondary, tertiary roots, etc. The primary roots and its branches constitute the tap root system.
- Fibrous root system:** In monocotyledons, the primary root is short lived and is replaced by a large number of roots. These roots originate from base of stem and constitute the fibrous root system.
- Adventitious root system:** Adventitious roots develop from any part of the plant other than radicle. These roots constitute adventitious root system.

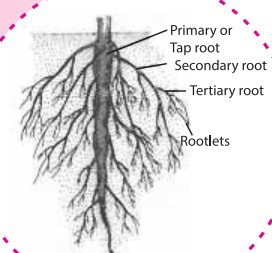
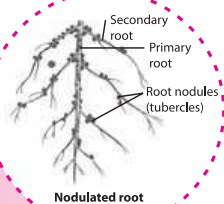


Fig.: Tap root system

Modifications of root

In addition to normal work of anchorage, absorption of water and minerals, roots perform some special functions for which they get variously modified.



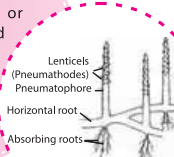
Nodulated root

Nodulated roots

The secondary, tertiary roots, sometimes primary roots also develop numerous small or large irregular swellings called nodules or tuberules. These are found in leguminous plants and harbour numerous nitrogen fixing bacteria.

Pneumatophores

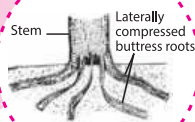
They are breathing or respiratory roots, found in plants growing in mangroves or saline swamps, e.g., *Rhizophora*.



Pneumatophores

Buttress roots

They are horizontal roots that arise jointly from the bases of tap root and the trunk. They provide extra support, e.g., pipal.



Buttress roots

Storage of food

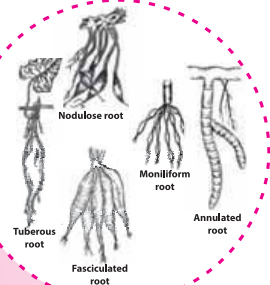
Tuberous: These roots arise from nodes of stem and become tuberous and fleshy for storage of food, e.g., *Ipomoea*.

Fasciculated: These roots arise in bunches from lower nodes of stem and become thick and fleshy, e.g., *Asparagus*.

Moniliform: These roots are swollen at regular intervals like beads of necklace, e.g., *Momordica*.

Annulated: In these roots swelling at different places takes place in such a way that closely placed ring like structures are formed, e.g., *Psychotria*.

Nodulose: In these roots apical portion swell up, e.g., *Curcuma amada*.



Vital functions

Assimilatory roots: Roots of some plants develop chlorophyll and perform photosynthesis, e.g., *Tinospora*.

Haustorial roots: These roots occur in parasites for absorbing nourishment from the host. They are also called sucking roots or suckers, e.g., *Cuscuta*.

Epiphytic roots: These roots are found in epiphytes. They hang in air. These roots have spongy tissue called velamen for absorption of atmospheric moisture, e.g., orchids.

Contractile roots: These roots can shrink 60-70% of the original length which brings an underground organ to its proper depth in soil, e.g., *Crocus*.

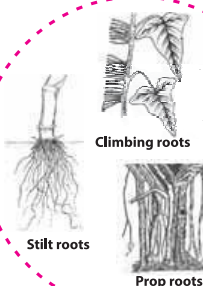
Modifications of adventitious roots

Mechanical support

Prop roots: They are thick pillar-like adventitious roots which grow from and support heavy horizontal branches of trees. e.g., *Ficus benghalensis*.

Stilt roots: They are short but thick supporting roots which develop obliquely from basal nodes of stem, e.g., sugarcane.

Climbing roots: They are non-absorptive adventitious roots which are found in climbers. They may arise from nodes, internodes or both e.g., betel, Ivy. The apices of these roots produce a viscous substance which dries in the air and so the roots get attached to substratum.



Modifications of tap roots

Fleshy tap roots

Tap roots become swollen and fleshy with stored food. These are of following types:

Conical: These roots get thicker on the upper end to store food and tapering at the lower end, e.g., carrot.

Fusiform: These roots get thicker in the middle and tapering on both ends, e.g., radish.

Napiform: These roots get very much swollen and spherical at the upper end for storage of food and taper downwards into a thread like structure, e.g., turnip.

Tuberous: These roots get swollen in any portion, thus they do not have a regular shape, e.g., *Mirabilis*.

