MORPHOLOGY OF ANGIOSPERMS

- Branch of science which deals with the study of external form, structure and various modifications of plants is called Plant Morphology.
- Body of a common angiosperm plant is differentiated into underground root system and aerial shoot system. Shoot system includes stem, branches, leaves & flowers.
- Root, stem and leaves represent vegetative part of a plant while flowers show reproductive part of a plant. Habit : Angiospermic plants are of three types on the basis of habit.



ROOT

Definition: Root is non-chlorophyllous and under ground part of plant. It is positive geotropic, positive hydrotropic and Negative phototropic.

The main characters of root are as follows:

- (1) Roots usually develop from Radicle of seed.
- (2) Roots do not bear nodes and internodes.
- (3) Roots possess unicellular root hairs.
- (4) Lateral roots arise endogenously from pericycle.
- (5) Roots do not bear buds for vegetative propagation except sweet potato and Indian rose wood.

Types of roots:



- (1) Tap roots: They develop from radicle in acropetal succession, e.g. Dicot plants.
- (2) Adventitious roots: They arise from any part of the plant body other than radicle, e.g. Monocot plants, Grasses, *Monstera*, Banyan tree.
- Note: NCERT places Fibrous root system separately but it comes under adventitious root system.

Differences between Tap root and Adventitious root					
S.No.	Tap root	Adventitious root			
1	They arise from the radicle of embryo.	They arise from stem as well as leaves.			
2	It is single main root.	Many long roots arise in a group.			
3	Main root is quite thick as compared to the others.	All the roots are fibrous.			
4	Primary root is perennating.	Primary root is short lived.			
5	They are always underground.	They may be underground or aerial.			
6	Distinction of primary, secondary & tertiary roots is quite conspicuous.	There is no such distinction.			

Region of roots:

- (i) Root cap: It is a smooth cap shaped structure present at the apex of root. It secretes mucilage, which lubricates the passage of root through the soil. In Hydrophytes, root cap is either absent or replaced through root pockets. e.g. *Pistia, Eichhornia*.
- (ii) **Zone of cell division:** The cells of this region are in active state of division, having thin wall and dense protoplasm.
- (iii) Zone of cell elongation: Maximum growth in the cells occurs. These cells lose the power of division.
- (iv) Zone of cell Maturation: The cells of this region are differentiated into permanent tissue. Root hairs are also present in this zone, which help in absorption of water.



The main function of the root system are absorption of water and minerals from the soil, providing anchorage to the plant storing reserve food material and synthesis of plant growth regulators.

Modifications of Roots:

- (I) Modifications of Tap roots:
 - (1) Fleshy taproot : They are modified for storage of food.
 - (i) Fusiform : It is thickest at middle and spindle shaped. e.g. Radish.
 - (ii) Conical : It is cone shaped. It is thickest at the base and gradually tapering at the apex. e.g. Carrot.



- (iii) Napiform: It is quite thick at the base and abruptly tapering at the apex. e.g. Turnip and beet root.
- (iv) Tuberous: They are swollen taproots and do not possess any definite shape e.g. *Mirabilis jalapa*.

(2) Nodulated roots:

- These are found in the plants of sub-family Papilionaceae.
- The secondary, tertiary roots and sometimes the primary root develop numerous small or large irregular swellings called root nodules.
- The latter contains symbiotic nitrogen fixing bacteria Rhizobium. e.g. Pea, groundnut and soyabean.

(3) Reproductive Roots:

 Adventitious buds develop at some taproots or their branches that help in vegetative reproduction e.g. Dalbergia, Populus.



(4) Pneumatophore or Respiratory roots:

These are found in plants growing in mangroves or saline swamps near of the seashore. e.g. Rhizophora, Sonerattia, Avicennia.



(II) Modifications of Adventitious roots:

(1) Fibrous roots: They are underground roots, which arise in groups either at the base of the erect stem or the nodes of a horizontal stem. They remain near the soil surface and are called surface feeders. e.g. Wheat & Grasses.

Storage for food:

- (2) Fleshy Adventitious roots: It includes following types(i) Fasciculated roots:
- Roots are swollen due to storage of food and occur in cluster. e.g. Asparagus & Dahlia.



- (ii) Tuberous root:
- The swollen roots do not assume a definite shaped, they occur singly e.g. Sweet potato or *lpomoea batata*.

(iii) Nodulose root:

Apical portions swell up due to storage of food. e.g. Curcuma amada (Mango ginger).

(iv) Moniliform or Beaded roots:

The roots are swollen at regular intervals like beads of necklace. e.g. Momordica, Portulaca, Vitis.



(v) Annulated roots:

The thicken roots contain a series of swelling or ring like outgrowth. e.g. lpecac (Cephaelis).

(vi) Palmate roots:

The fleshy roots are thickened like the palm of human hand. e.g. Orchis.

For Mechanical Support:

(3) Prop roots:

- They are pillar like roots which appear from large horizontal branches in trees.
- These grow downwards, which may finally enter into soil and provide mechanical support to the tree. e.g. Banyan (*Ficus bengalensis*).

(4) Stilt roots:

- They appear from the basal nodes near the soil.
- They grow downwards and fix the erect stem with soil to provide extra support. e.g. Zea mays, Saccharum officinarum, Pennisetum typhoides.



They may arise from nodes (e.g. Betel), Internodes (e.g. Ficus pumila) or both (e.g. Ivy).



They penetrate the cracks for the support (e.g. Pothos) or secreting sticky juice at their tips (e.g. Ivy) which on drying stick the plant to subtratum.

(6) Contractile roots:

- These are found in the underground stem of some plants.
- * The apical part of these roots contract and fixes the plant in the soil e.g. Crocus, Allium cepa.



For vital functions:

- (7) Parasitic or haustorial roots:
- They occur in parasites for absorbing nourishment from the host. e.g. Amarbel or Dodder (Cuscuta reflexa), Loranthus, Viscum.
- (8) Assimilatory roots:
- They arise from the nodes of stem. They are green roots (Contain chlorophyll), thus they form food through photosynthesis. e.g. *Trapa, Tinospora*.

(9) Epiphytic roots or hygroscopic roots: They are irregular, thick roots hanging in the air, they bear velamen tissue which is able to absorb humidity from atmosphere. e.g. Orchid-Vanda.



(10) Reproductive roots: In some plants, adventitious buds arise on roots, which take part in vegetative propagation. e.g. Agave, Sweet potato.



Resonate the Concept

- 1. In many aquatic plants, roots are absent due to limited necessity of water & minerals absorption. e.g. *Wolffia, Utricularia, Ceratophyllum*.
- 2. In some aquatic plants roots maintain balance of plant. e.g. *Pistia, Lemna*, while in some plant they fix plant e.g. *Hydrilla*.
- 3. Aldrovanda is rootless angiosperm plant.
- 4. Longest root is found in *Adansonia digitata*.
- **5.** In some plants, roots are associated with fungi to form Mycorrhiza. The latter are helpful in the absorption of nitrogen and phosphorus. e.g. *Pinus* (Gymnosperm)
- **6.** In some plants like *Acanthorhiza*, some adventitious roots are modified into hard, thick sharp thorns they are called Root thorns.
- 7. Floating roots: They contain air which is helpful for floating of aquatic plants on water surface e.g. *Jussiaea* (*Ludwigia*).
- 8. Leaf roots: In case of *Salvinia*, one leaf of each node is modified into roots for balancing the plant in water.
- 9. Herbs: Stem is soft, less than 2m in height.
 - (1) Annual herbs e.g. Pea, Wheat, Mustard.
 - (2) Biennial herbs e.g. Radish, Turnip, Carrot, Cabbage, Sugar beet.
 - (3) Perennial herbs e.g. Turmeric, Musa.
- 10. Shrubs : Perennial, medium sized plants with a hard and woody stem, e.g. Rose, Heena.
- 11. Trees : Perennial tall plants with hard and woody stem. e.g. Saraca indica, Mangifera indica.

	Test your Resonance with concept					
1.	Roots are used in veg (1) Potato	etative propagation in (2) Sweet Potato	(3) Ginger	(4) Onion.		
2.	Leguminous plants po (1) Napiform roots	ssess (2) Nodulated roots	(3) Tuberous roots	(4) Fusiform roots.		
3.	Sweet Potato is modif (1) Leaf	ication of (2) Root	(3) Stem	(4) Flowering axis.		
4.	Pneumatophores are ((1) Respiration	useful in (2) Transpiration	(3) Guttation	(4) Protein synthesis.		
5.	Root formed from prol (1) Primary root	ongation of radicle is - (2) Secondary root	(3) Tertiary root	(4) Seminal root		
	Answers 1. (2)	2. (2) 3. (2)	4. (1)	5. (1)		