

Vivekanand College, Kolhapur (Empowered Autonomous)

DEPARTMENT OF BOTANY

B. Sc. I, (NEP)

TOPIC: ROOT MODIFICATION

Dr. B. T. Dangat,

M.Sc., Ph.D.

Root

The part of a plant that attaches it to the ground or to a support, conveying water and nourishment to the rest of the plant.

Modifications of Roots

Roots sometimes have special functions to perform and in such cases their form and structure differ from those of normal roots.

The modified roots may be underground or aerial.

Underground Root Modifications

Taproot and adventitious roots may undergo certain modifications to perform the function of storage and vegetative propagation.

Tap Root Modifications (for storage of food)

In some plants the tap roots store reserve food for which they become swollen and assume different shapes. There are three types :

- (i) Fusiform:
- (ii) Napiform:
- (iii) Conical:
- (iv) Tuberos or tubercular:
- (v) Pneumatophores:

(i) Fusiform:

It is a modified tap root. The primary root is swollen in the middle while both the ends gradually taper forming a spindle shaped structure, e.g., Radish (*Raphanus sativus*).

(ii) Napiform:

The hypocotyls region is considerably swollen, becoming almost spherical and then abruptly tapering towards the lower end, e.g., Turnip (*Brassica campestris* var. *rapa*) and beet (*Beta vulgaris*).

(iii) Conical:

The roots swell, becoming broad at the base and gradually taper towards apex forming a cone like structure, e.g., Carrot (*Daucus carota*).

(iv) Tuberos or tubercular:

In this case, the root is thick and fleshy but does not form any definite shape, e.g., *Mirabilis jalapa*.

(v) Pneumatophores:

These roots grow vertically up and come out of the water or marshy soil like conical spikes. They occur in large numbers around the tree trunk. Such roots are provided with numerous pores (breathing pores) through which air is taken for respiration, e.g., *Rhizophora*.

Fusiform root - In radish the modified tap root is thickened in the middle and tapers towards both ends.
e.g., *Raphanus sativus* (Radish)

Napiform root - In beetroot the modified tap root is greatly swollen at the base, but abruptly narrows into a tail-like portion.
e.g., *Beta vulgaris* (Beetroot)

Conical root - In carrot the modified tap root is conical. It is broad at the base and gradually tapers towards its apex.
e.g., *Daucus carota* (carrot)



Raddish



Beetroot



Carrot

Adventitious Root Modifications

- Tuberous or tubercular root, e.g., Ipomoea batatas (Sweet potato)

Here, the modified adventitious root is swollen without any definite shape. It is always produced singly and not in clusters.

- Fasciculated roots e.g., Asparagus, Dahlia

In Dahlia and Asparagus a number of adventitious roots arise as a cluster, from almost the same level at the base of the stem.



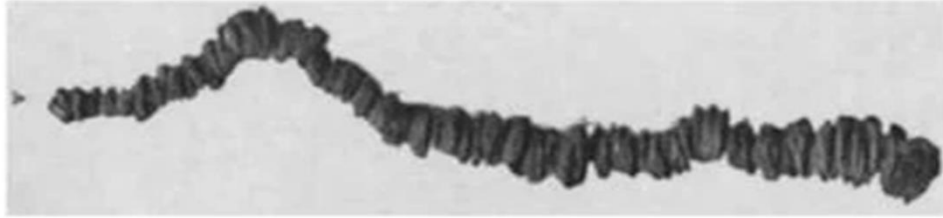
Tuberos root

Fasciculated roots



Adventitious Root Modifications

- **Nodulose roots** e.g., Curcuma amada, (mango ginger) Here, the root becomes swollen at its tip.
- **Moniliform roots** e.g., Momordica. Here, the roots show beadlike swellings at frequent intervals.
- **Annulated roots** E.g., Ipecac. Here, the adventitious roots have a series of ring-like swellings on their surface.



Annulated roots



Moniliform roots



Nodulose roots

Aerial Root Modifications

Aerial roots are adventitious roots which develop from the aerial parts of the plant to perform various functions.

- A. **For Mechanical Support**
- B. **For Vital Functions**

For Mechanical Support

- Prop roots
- Stilt roots
- Climbing roots

For Vital Functions

- Haustoria or sucking roots
- Respiratory roots or breathing roots or pneumatophores.
- Floating roots
- Epiphytic roots

Prop roots

e.g., *Ficus benghalensis* (Banyan): In banyan the adventitious roots arise from the horizontal branches and grow vertically downwards. After reaching the soil they become thick and woody. Thus, they function as pillars giving mechanical support to the branches. Hence, they are also known as columnar roots.



Stilt roots

e.g. Pandanus : In Pandanus the adventitious roots arise from the lower part of the main stem and grow obliquely towards the soil. They serve to keep the plant erect by giving additional support.



Climbing roots or clinging roots

e.g., Piper betel, Pothos, etc : These roots arise from the nodes and help in attaching the climbing stem firmly to a support like a tree or a wall, by various mechanisms.



Haustoria or sucking roots e.g. *Cuscuta* : Parasites like *Cuscuta* develop a kind of root which penetrates into the tissue of the host plant and help to draw nutrients from the host by sucking it. The parasitic plants are not completely equipped to prepare their food. Hence, such plants have to depend on host plants for nutrients.

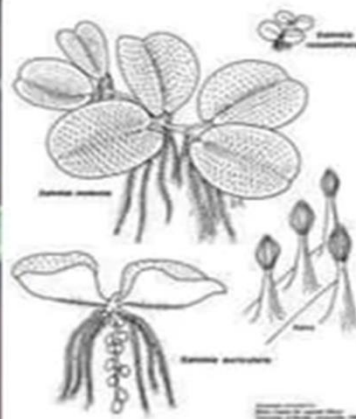


Respiratory roots or breathing roots or pneumatophores

e.g., *Avicennia*, *Rhizophora*. A number of plants growing in marshy water-logged soils which contain almost no air, develop some branches which grow vertically upwards into the air. These roots are called breathing roots or pneumatophores. Each such root is provided towards the upper end with numerous pores through which gases diffuse in and out.



Floating roots e.g., Jussiaea: In Jussiaea which is an aquatic plant, special spongy roots called floating or respiratory roots arise from the plant. They are adventitious and enclose a tissue called aerenchyma. These roots usually develop above the level of water and serve to store up air and help in buoyancy of the plant. In addition, the floating roots may also perform the respiratory function.



Epiphytic roots e.g., Vanda: In epiphytes like orchids which grow on other plants, special adventitious roots called epiphytic roots are produced. The outer region of the root is made up of a special tissue called the velamen. This tissue absorbs moisture from the air and makes it available to the plant. These roots do not penetrate the host tissue like parasitic roots.



Summary of Root Modifications

Underground roots for storage		Aerial roots for various functions
Tap roots	Adventitious roots	
1. Fusiform root e.g., Raddish	1. Tuberos roots e.g., Sweet potato	A. For mechanical support 1. Prot roots e.g., Banyan 2. Stilt roots e.g., Pandanus 3. Climbing roots e.g., Betel
2. Napiform root e.g., Beetroot	2. Fasciculated roots e.g., Dahlia	B. Sucking roots e.g., Cuscuta
3. Conical root e.g., Carrot	3. Nodulose roots e.g., Mangoginger	C. Respiratory roots - Pneumatophores e.g., Aricennia
	4. Moniliform root e.g., Momordica	D. Floating roots e.g., Jussiaea
	5. Annulated roots e.g., Ipecacuanha	E. Epiphytic roots e.g., Vanda