THE ROOT

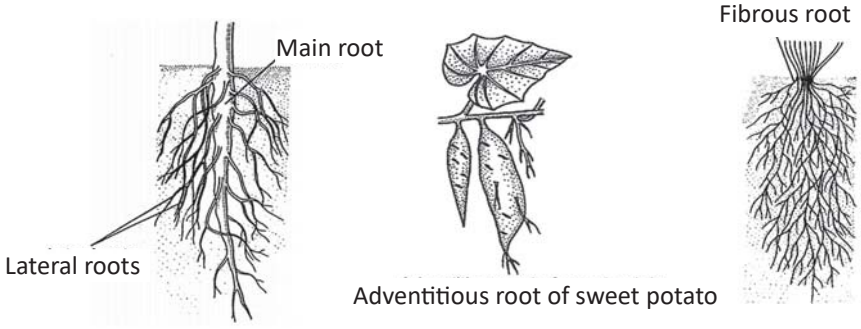
Definition: Root is non-chlorophyllous and underground part of plant. It is positive geotropic, positive hydrotropic and Negative phototropic.

The main characters of root are as follows:

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

Types of Roots

- Tap roots: - In most of the dicot plants, the direct elongation of the radicle leads to the formation of primary root. It 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. Eg. :- mustard plant
- Adventitious roots :- In some plants, like grass, Monstera and the banyan tree, roots develop from parts of the plant other than the radicle and are known as adventitious roots.
- Fibrous roots: - In monocot plants, the primary root is short lived and is replaced by a large number of roots. These roots originate from the base of the stem and constitute the fibrous root system.
  Eg. :- wheat plant



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.

Regions of the root:

- 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.

- Region of meristematic activity: The cells of this region are very small, thin-walled and with Dense protoplasm. They divide repeatedly.
- Region of elongation: The cells proximal to this region undergo rapid elongation and Enlargement and are responsible for the growth of the root in length.
- Region of Maturation: The cells of the elongation zone gradually differentiate and mature. Root hairs are also present in this zone, which help in absorption of water.

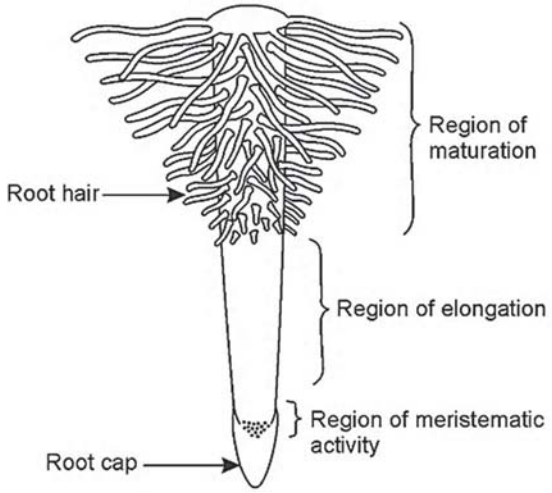


Fig. : The regions of the root-tip

Functions of the root system

- Absorption of water and minerals,
- Provide a proper anchorage to the plant parts,
- Storage of reserve food material (Carrot, radish, turnip, sweet potato and Asparagus)
- Synthesis of PGR (plant growth regulators).

Modifications of Root

The primary function of roots lies in the absorption of water and minerals from the soil. In certain plant species, roots undergo specific modifications in both shape and structure, thereby assuming diverse roles beyond their fundamental absorption function. These modifications are tailored to execute crucial functions such as respiration, storage, and protection.

In essence, roots play a multifaceted role in the overall physiology of plants, extending beyond their conventional role as absorptive organs. The adaptability of roots through modifications underscores their significance in supporting various plant functions and ensuring the overall well-being and survival of the plant.

- **Storage Roots:** Certain plant species exhibit a distinctive modification in their primary tap root, transforming it into a specialized structure designed for the storage of food. This modification results in the development of various shapes and sizes in the storage roots. Examples of such plants include the carrot, turnip, radish, beet, and sweet potato. In these instances, the tap root of plants like carrot, turnip, radish, and beet, as well as the adventitious roots of sweet potato, undergo a swelling process, effectively storing significant amounts of food. This adaptation allows these plants to accumulate reserves in their roots, providing a readily available source of nutrients during periods of growth, reproduction, or environmental challenges. The phenomenon of storage roots exemplifies the diverse strategies employed by plants to enhance their adaptive capabilities in different ecological contexts.

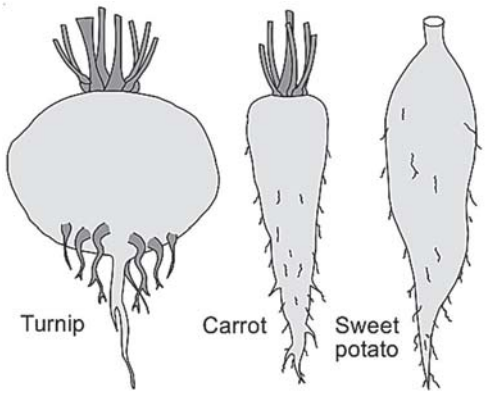


Fig. : Modification of root for storage

- **Respiratory Roots:** Certain plant species, exemplified by Rhizophora found in swampy environments, demonstrate a unique adaptation in their root system to facilitate respiration. In these plants, numerous roots emerge from the soil and extend vertically upwards, serving the specific purpose of obtaining oxygen for respiratory processes. These specialized roots are referred to as pneumatophores. The development of pneumatophores is a distinctive response to the challenges posed by waterlogged or swampy conditions, where the availability of oxygen in the soil may be limited. By growing vertically above the ground, these respiratory roots enable the plant to access atmospheric oxygen directly, aiding in essential respiratory functions. The presence of pneumatophores illustrates the remarkable diversity of root adaptations that plants employ to thrive in distinct ecological niches.

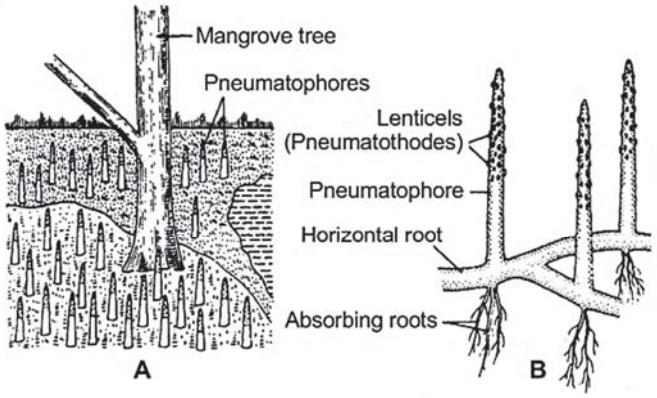


Fig. : Pneumatophores or respiratory roots : A - Mangrove tree with pneumatophores, B - Pneumatophores with lenticels

- **Prop Roots:** Prop roots represent a distinctive type of root modification that originates from the branches of the stem. Their primary function is to offer crucial mechanical support to heavy branches, essentially acting as pillars for the overall structural integrity of the plant. A notable example of prop roots can be observed in the banyan tree. In this adaptation, the roots emerge from the branches and grow vertically downward, eventually reaching the ground. Once these roots make contact with the soil, they provide additional support to the weighty branches, preventing them from sagging or breaking under their own mass. The utilization of prop roots is a strategic mechanism employed by certain tree species, like the banyan, to ensure stability and resilience in the face of environmental challenges, such as the need to sustain large and expansive canopies. This adaptation exemplifies the diverse ways in which plants evolve specialized structures to thrive in specific ecological contexts.

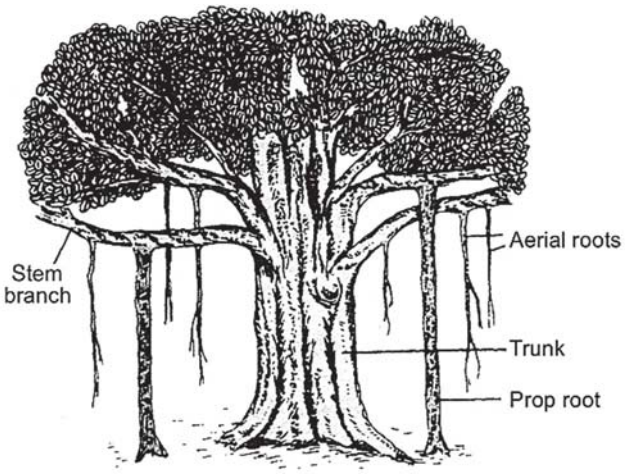


Fig. : Prop or pillar roots of *Ficus benghalensis* (banyan tree)

- **Stilt Roots:** Stilt roots are a distinctive type of root modification that originates from the lower nodes of the stem in certain plant species. Their primary function is to provide essential support to the main axis or stem of the plant. Unlike traditional roots that grow vertically into the soil, stilt roots take on an oblique orientation, entering the soil at an angle. This unique characteristic is observed in plants such as sugarcane and maize. The development of stilt roots represents an adaptive strategy employed by these plants to enhance stability and anchorage, particularly in environments where the main axis may face challenges such as wind-induced stress or uneven terrain. By extending obliquely into the soil from the lower nodes of the stem, stilt roots effectively contribute to the structural integrity of the plant, ensuring resilience against external forces and supporting the overall growth and development of the species. This adaptation exemplifies the diverse ways in which plants tailor their root structures to meet specific functional requirements in varying ecological contexts.

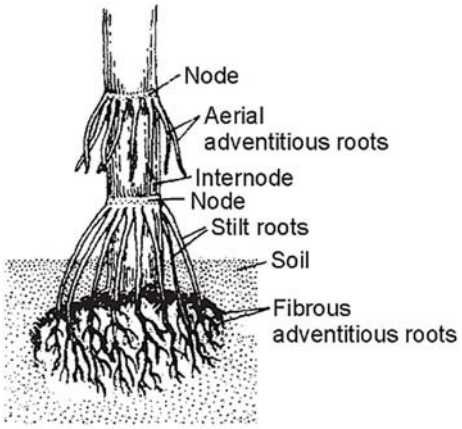


Fig. : Stilt roots of Maize