

Topic: Morphology of root, stem, leaf, inflorescence, flower, fruit and seeds of plant

Plant body is broadly divided into an **underground root** and **aerial shoot** system

1. ROOT

- The root is **descending part** of the plant axis which grows below the soil.
- It is **positively geotropic & hydrotropic** and **negatively phototropic**.
- Develops from **radicle** of a germinating seed.
- Normal functions are **Anchorage** (Mechanical support), **absorption & conduction** of water & minerals.

Modification of Roots

(A) Modification for storage: The swelling & storage may involve the taproot and adventitious roots

According to the shaped assumed

- **In Tap roots**
 1. **Fusifform:** Swollen in middle & gradually tapering towards both ends. Eg. *Raphanus sativus*(Raddish)
 2. **Conical:** Broadest on the top & gradually tapering towards the lower ends. Eg. *Daucus carota*(Carrot)
 3. **Napiform:** Very much swollen above, abruptly tapering towards the lower end. Eg. *Brassica compestris* (Turnip), *Beta vulgaris*(Beet)
- **In Adventitious roots**
 1. **Root tuber:** Root grows from the nodes of running stem. They become swollen & Form the edible root tuber. Eg: *Ipomoea batatas* (Sweet potato)
 2. **Fasciculated roots:** Roots occurs in cluster & all these are swollen. Eg: Dahlias, Asparagus.
 3. **Palmate tuberous:** Roots are palmately lobed & Tuberous .Eg: Orchid

(B) Modification for Mechanical Support:

1. **Stilt roots:** These are additional roots growing from the lower nodes of the plant, providing additional support as well as anchorage to the stem. Eg: *Zea mays*(maize), *Pandanus foetidus*

2. **Prop or Columnar roots:** The horizontal aerial branches of the tree give rise to aerial roots, which grow vertically downwards, they are 1st thin which latter become thick & give support like pillars to branches. Eg: *Ficus bengalensis*

3. **Climbing roots:** In some climbers cluster of small adventitious roots arise from the nodes & secrete a sticky juice which quickly dries in the air & helps the plant in climbing.
Eg: Piper betle (Betal vine)

(C) Modification for Adaptive Function:

1. **Respiratory or Pneumatophores:** These are the special roots which grow vertically from the soil (negatively geotropic) they help in exchange of gases. They are characteristic of saline plants (mangrove plants) growing in soil with poor amount of oxygen. Atmospheric air enters these roots through the minute pores called Lenticles (Pneumatodes) on exposed root tip, hence they are called respiratory root. Eg: *Avicenna*

2. **Epiphytic or Aerial absorbing roots:** The aerial roots are greenish & covered with a spongy velamen tissue. They absorb atmospheric moisture, also carry carbon assimilation because of the chlorophyll. Eg: *Vanda*

3. **Haustoria or Sucking roots:** The roots penetrate the vascular tissue of plants to absorb nutrient. It is characteristic of parasitic plants. Eg: *Cuscuta*

4. **Buttress roots:** In this type instead of stilt roots, there are plank like roots radiating from the base of the tree like wings. They are partly roots & partly stem. Eg: *Terminalia catappa*, *Ficus elastica*, *Ficus sp*, *Bombax ceiba*.

2. SHOOT

- It consists of stem and leaves
- It is **ascending axis** developed out of the **plumule**
- It gives mechanical strength to the plants

Modification Of Stem:

(A) Underground Modification for perennation, vegetative propagation & Storage:

1. **Rhizomes:** are dorsiventral stem or branches growing horizontally under the surface of the soil. Rhizomes are rather fleshy due to the storage of much food material. Eg: *Zingiber officinale* (Ginger), *Curcuma longa* (Turmeric)

2. **Stem-tuber:** Tuber is general term applied to any fleshy part of the plant which may store food used as a food. Eg: *Solanum tuberosum* (potato)

3. **Corm or Solid bulb:** a solid very much condensed vertical roostock with a long apical bud. There are some scale leaves on its body & adventitious roots grow either from its base or all over its body. Eg: *Amorphophallus campanulatus*

(B) Sub- aerial Modification for Perennation & Vegetative propagation:

1. **Runner:** It is long cylindrical prostrate branch arising from the axil of lower leaf. It runs horizontally along the ground & gives roots at the nodes. Eg: *Oxalis*

2. Offset: A type of runner but is shorter & thicker. Found in floating plants (aquatic plants)
Eg: *Eichhornia*

3. Bulbil: Axillary vegetative bud gets stouter due to storage of food. When they rail on the ground, they give rise to new plant. Eg: *Dioscorea*

(C) Aerial Modification:

1. Tendrils: They are modification for support. Axillary bud modified into tendril. Eg: *Passiflora* Apical bud modified into tendril. Eg: *Vitis quadrangularis*

2. Phylloclade: In many Xerophytes stem become flat green and carry out photosynthesis.
Eg: *Opuntia*

3. Clodode: It is a phylloclade with a single internode which is flattened structure and more leaf like. Eg: *Asparagus racemosus*

4. Thorn: It is hard woody pointed structure, it is characteristics of xerophytes plants.
Eg: *Punica*- Axillary bud modifies into thorns. Eg: *Carissa carandus*- Apical bud bifurcates & gets modifies into thorns.

3. LEAF

- These are flat lateral appendages growing on a stem at the nodes.
- They are wide, thin & green in color.
- Main functions are Photosynthesis, gaseous exchange and transpiration.

A typical foliage leaf has three main parts viz. Leaf Base, Petiole and Lamina

A) Phyllotaxy or Leaf Arrangement:

1. **Alternate:** Single leaf arises at each node. Eg. Mango

2. **Opposite:** Two leaves situated at the same node, one on each side of the stem or axis.

Opposite Decussate: each pair at right angles to the next. Eg. *Ocimum*

Opposite Superposed: Placed one above the other pair. E.g Guava

3. **Whorled:** Three or more leaves arising from one node and form a whorl around. E.g *Nerium*

B) **Leaf Types:** On the basis of incision of lamina, leaves may be of two types:

a) **Simple:** Single leaf blade or lamina is present. Eg. Mango

b) **Compound:** Lamina is divided into number of segments known as leaflets or pinnae.

Compound leaves are of two types

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- 1) **Pinnately compound leaves:** in this type the leaflets are arranged laterally on a common axis called rachis. E.g. Tamarind, Gulmohar
- 2) **Palmately compound leaves:** in this type the leaflets are attached at a common point i.e. at the tip of petiole like fingers of the palm.

(C) Leaf Incisions:

In some leaves, lamina is not entire but it shows cuts. The pattern of leaves incision depends on type of venation. In pinnately lobed leaf, there is a single midrib and hence the incisions progress towards the midrib. In palmately lobed leaf, the venation is diverted hence the incisions progress towards the bases of the leaf.

1. **Pinnatifid** : The incisions are less than half from the margin to the midrib of lamina
E.g.: *Chrysanthemum*
2. **Pinnatipartite** : The incisions are more than half from the margin to the midrib of lamina E.g.: *Argemone*
3. **Pinnatisect**: The incisions extend almost to the midrib due to which the lamina is deeply lobed. The lobed are called segment E.g. marigold , coconut
4. **Palmatifid** : The incisions extends less than half way from the margin to base of lamina E.g. Cotton
5. **Palmatipartite** : The incisions extends less than half way from the margin to base of lamina E.g. Castor
6. **Palmatisect**: Incisions extends upto almost to the base due to which the lobes are fanned E.g. *Ipomoea palmata*

INFLORESCENCE:

The arrangement of flowers on **peduncle**, the floral axis, is called inflorescence.

Inflorescences are two types Racemose and Cymose

Racemose: Axis indefinite, elongated, flowers arranged into **acropetal manner**.

1. **Simple Raceme:** axis indefinite , elongated, flower pedicellate and arrange into acropetal manner Eg: *Caesalpinia*
2. **Spike** : axis indefinite , elongated, flower sessile & arranged in acropetal manner Eg :Tuberose
3. **Catkin:** axis indefinite , elongated, thin, pendulous, sessile unisexual flowers in acropetal manner eg: *Acalypha*
4. **Spadix:** axis indefinite, elongated, thick, fleshy having unisexual flowers covered by large boat shaped bract called spathe. Eg. *Anthurium*
5. **Coryomb:** axis indefinite, Short, flower pedicellate, arranged at same level with lower flowers with long pedicel & upper flowers with short pedicel. Eg. *Cassia*

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6. **Umbel:** Axis indefinite, shortened, flower pedicellate arranged in centripetal manner.
Eg. Onion
7. **Capitulum:** Axis indefinite, flat forming a receptacle on which ray & disc florets are arranged in centripetal manner. Bracts form involucre at the base. Eg: Sunflower.

Cymose: Axis definite, elongated, Flowers arranged into **basipetal manner**.

1. **Helicoid cyme:** Uniparous cymose inflorescence, only one lateral branch at a time on one side of the axis. E.g. *Hamelia*
2. **Scorpioid cyme:** Uniparous cymose inflorescence, only one lateral branch at a time on either side of axis in alternate fashion. Eg. *Heliotropium*
3. **Dichasium:** Axis definite, two lateral branches on either side of the axis. Flowers arranged in basipetal manner. E.g. Jasmine
4. **Polychasium:** Axis definite, more than two lateral branches. Flowers grouped together around a central flower. Eg: *Ixora*

Flower:

It is highly **modified and condensed reproductive shoot**, specially designed for **sexual reproduction**.

A typical flower consists of

- 1) **Pedicel:** Stalk of the flower. If present flower is Pedicellate and if absent Sessile.
- 2) **Thalamus:** Terminal swollen or expanded end of pedicel.
- 3) **Floral whorls:** Modified leaves arranged in a cyclic manner on the thalamus.
Floral whorls are further divided into two types:
 - A) **Accessory whorls:** They do not directly participate in sexual reproduction. It includes Calyx and Corolla
 - a) **Calyx:** outermost floral whorl made up of Sepals. Main functions are photosynthesis and protection in bud conditions.
 - b) **Corolla:** Largest floral whorl made up of Petals. Main functions are protection and to attract agencies for pollination.
 - B) **Essential whorls:** They are reproductive whorls. **Androecium** is male reproductive whorl made up of stamens while **Gynoecium** is female reproductive whorl made up of carpels.

Types of Flower

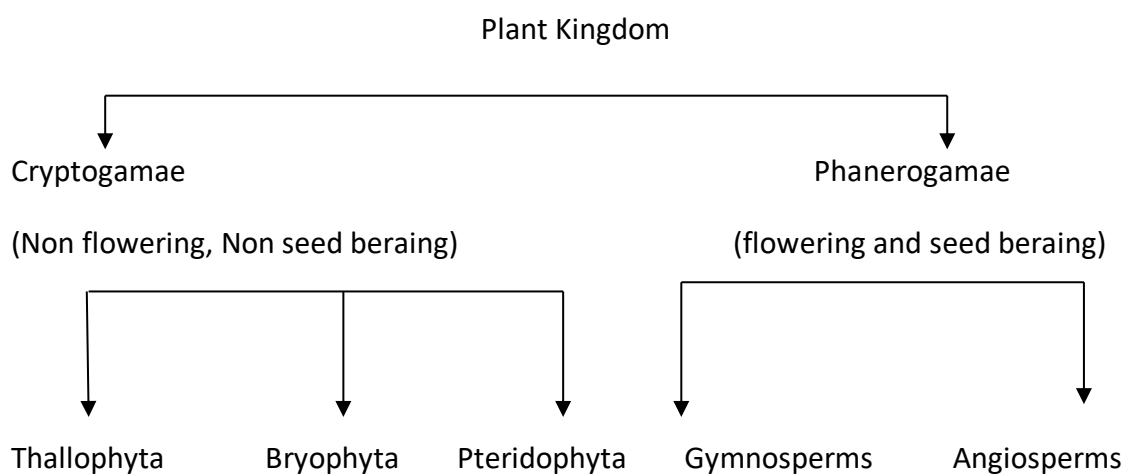
1. **Complete Flower:** When all the four whorls are present in a flower.
2. **Incomplete Flower:** When any of the four sets of floral leaves are absent in a flower
3. **Bisexual Flower:** When both reproductive whorls viz. androecium & gynoecium are present in a flower
4. **Actinomorphic (Regular) Flower:** Flower with radial symmetry.
5. **Zygomorphic (Irregular) Flower:** Flower with bilateral symmetry.

ANDROECIUM:

It represents the male reproductive part of the flower made up of **Stamen**. Each stamen consists of a slender stalk called **Filament** and a fertile sac like structure **Anther** at the tip.

GYNOECIUM:

It represents the female reproductive part and the innermost whorl of the flower made up of carpels. Each carpel consist of three parts: the basal swollen chamber called Ovary, the middle slender stalk called Style and the apical knob like structure called Stigma.



Fruit: It is a fertilized ovary. A typical fruit consists of two parts

- a) **Pericarp:** Wall of the fruit, differentiated into Epicarp, Mesocarp and Endocarp in fleshy fruits like Mango, in dry fruits like Pea there is no such differentiation.
- b) **Seed:** the ovule after fertilization develops into seed. It consists of Seed coat, Embryo and endosperm.