

## 5. Morphology of Flowering Plants

### POINTS TO REMEMBER :

- **Morphology:** The study of various external features of the organism is known as morphology.
- **Adaptation:** Any alteration in the structure or function of an organism or any of its part that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.
- **The Root:** The root is underground part of the plant and develops from elongation of radicle of the embryo.

### Various types of root :

- **Tap root:**
  - Originated from the radicle.
  - Persistent in dicot plant. E.g. gram, pea , mango
- **Fibrous root**
  - Originates from the base of the stem.
  - Large number of roots replaces the primary root.
  - This type of root found in monocot plant. E.g. wheat, paddy, grass.
- **Adventitious root**
  - Roots developed from any part of the plant other than radicle.
  - Found in grass, *Monstera* and the banyan tree.

### Function of root :

- Absorption of water and mineral from soil
- Anchorage of the plant body
- Storing reserve food material.
- Synthesis of plant growth regulators.

### Regions of root :

- **Root Cap :** The root is covered at the apex by the thimble-like structure which protects the tender apical part.
- **Region of meristematic activity :**
  - Cells of this region have the capability to divide.
  - The cells of this region are very small, thin-walled and with dense protoplasm.
- **Region of elongation :**
  - Cells of this region are elongated and enlarged.
- **Region of Maturation :**
  - This region has differentiated into matured cells.
  - Some of the epidermal cells of this region form thread-like **root hairs**, which absorbs water and minerals from the soil.

### Modifications of Root :

- Roots are modified for support, storage of food, respiration.
- For support : **Prop roots** in banyan tree, **stilt roots** in maize and sugarcane.
- For respiration: **pneumatophores** in Rhizophora (Mangrove).
- For storage of food: **Fusiform** (radish), **Napiform** (turnip), **Conical** (carrot).

### The Stem :

- Stem is the aerial part of the plant and develops from **plumule** of the embryo.
- It bears **nodes** and **internodes**.
- Bears **bud**, may be **axillary** or **terminal**
- Main function is to spreading branches bearing leaves, flower and fruits.

### Modifications of Stem :

- **For food storage:** Rhizome (ginger), Tuber (potato), Bulb (onion), Corm and Colocasia).
- **For support:** Stem **tendrils** of watermelon, grapevine, and cucumber.
- **For protection:** Axillary buds of stem of citrus, Bougainvillea get modified into pointed **thorns**. They protect the plants from animals.
- **For vegetative propagation:** Underground stems of grass, strawberry, lateral branches of mint and jasmine.
- **For assimilation of food:** Flattened stem of opuntia contains chlorophyll and performs photosynthesis.

### The Leaf :

- Developed from shoot apical meristem, flattened, green structure.
- Manufacture the food by photosynthesis. It has bud in axil.
- A typical leaf has leaf base, petiole and lamina.
- Leaf attached to the stem by **leaf base**.
- May bear two small leaves like structure called **stipules**.
- Leaf base may swollen to form **pulvinus**.
- The structure that holds the leaf called **petiole**.
- The green expanded part of the leaf is called **lamina** or **leaf blade**.

### Venation :

- The arrangement of veins and the veinlets in the lamina of leaf is termed as **venation**.
- Veinlets form a network – **reticulate venation**. (dicot leaf)
- Vein runs parallel to each other – **parallel venation**. (monocot leaf)

### Types of leaf :

- A leaf is said to be **simple**, when its lamina is entire or when incised, the incisions do not touch the midrib.
- When the incisions of the lamina reach up to the midrib breaking it into a number of leaflets, the leaf is called **compound**.
- Bud present in the axil of petiole in both simple and compound leaf.
- Bud never present in the axil of the leaflets of compound leaf.
  - **Pinnately compound leaf:** number of leaflets present in a common axis called **rachis**, which represents the midrib of leaf.
  - **Palmately compound leaves:** leaflets are attached to the common point i.e. at the top of the petiole.

### Phyllotaxy :

- It is the pattern of arrangement of leaves on the stem of branch.
  - **Alternate** : a single leaf arises from each node
  - **Opposite** : a pair of leaves arise at each node and lie opposite to each other.
  - **Whorled** : more than two leaves arise at a node and form a whorl.

**Modifications of leaves :** leaves are often modified to perform functions other than photosynthesis.

- Modified to **tendrils** for climbing as in peas.
- Modified to **spines** for defense as in cacti.
- **Fleshy leaves** of onion store food.
- In Australian acacia, the leaves are small the short-lived. The **petioles** expanded, become green and synthesize food.
- In insectivorous plant leaves are modified to **trap insects** e.g. pitcher plant, Venus fly trap.

**THE INFLORESCENCE :** The arrangement of flowers on the floral axis of stem.

- **A flower is a modified shoot –**
  - Apical meristem changes to floral meristem.
  - Internodes do not elongate and the axis gets condensed.
  - The apex produces different kinds of floral appendages laterally at successive nodes instead of leaves.
- **Racemose :** the main axis continues to grow; the flowers are borne laterally in an acropetal succession.
- **Cymose :** the main axis terminates in flower, hence limited to grow. The flowers are borne in a basipetal order.

**THE FLOWER :**

- Atypical flower has **four** different kinds of whorls arranged successively on the swollen end of the stalk or pedicel called **thalamus** or **receptacle**.
  - The four whorls are:-
- **Calyx, corolla, Androecium and Gynoecium.**
- Calyx and corolla are accessory organs.
- Androecium and Gynoecium are reproductive organs.
- In flower like **lily**, the calyx and corolla are indistinct and are called **perianth**.
- **Bisexual:** flower having both Androecium and Gynoecium.
- **Unisexual:** flower having either stamens or carpel.

**Symmetry :**

- **Actinomorphic:** radially symmetrical.
- **Zygomorphic:** bilaterally symmetrical.
- **Asymmetrical:** when a flower cannot be divided into two equal half in any plane.

**Pattern of flower :**

- A flower may be **trimerous**, **tetramerous** or **pentamerous** when the floral appendages are in multiple of 3, 4 or 5 respectively.
- Reduced leaf found at the base of the pedicel are called **bract**.
- Flowers which bears bract are said to be **bracteates**.
- Flowers without bract are said to be **ebracteate**.

**Position of floral parts on thalamus :**

- **Hypogynous :**
  - Gynoecium occupies the highest position.
  - Other whorls are present below the Gynoecium.
  - Ovary is said to be superior. E.g. mustard, China rose and brinjal.
- **Epigynous :**

- The thalamus encloses the ovary.
- Thalamus fused with ovary.
- The other whorl arises above the ovary.
- Ovary is inferior. E.g. guava, cucumber, ray florets of sunflower.
- **Perigynous :**
  - Ovary is said to be half inferior.
  - The Gynoecium situated in the centre.
  - Other whorls located on the rim of the thalamus almost at the same level. E.g. plum, Rose, peach.

#### Parts of a flower :

##### Calyx :

- It is the outermost whorl
- Each member called sepals.
- Sepals are green leaf like protect the flower in the bud stage.
- **Gamosepalous:** sepals are united.
- **Polysepalous:** sepals are free.

##### Corolla :

- It is the second whorl of a flower.
- Each member called petal.
- Usually brightly colored to attract insect for pollination.
- **Polypetalous:** petals are free.
- **Gamopetalous:** petals are united or fused.

**Aestivation :** the mode of arrangement of sepals or petals in the floral bud with respect to the other members of the same whorl is known as aestivation.

- **Valvate :** sepals or petals in a whorl just touch one another at the margin, without overlapping. E.g. Calotropis.
- **Twisted :** one margin of the appendage overlaps that of the next one and so on. E.g. china rose.
- **Imbricate :** the margin of sepals or petals overlap one another but not in any particular direction as in Cassia and gulmohur.
- **Vexillary :** The large petal (standard) overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (keel).

##### Androecium :

- It is the male sex organ of the flower.
- Composed of stamens.
- Each stamen consists of a stalk or **filament** and an **anther**.
- Each anther is usually bilobed and each lobe has two chambers, **pollen sac**.
- Pollen grains are produced inside the pollen sacs.
- A sterile stamen is called **staminode**.
- **Epipetalous:** stamens attached to the petals. E.g. brinjal.
- **Epiphyllous:** stamens attached to the perianth. E.g. lily.
- **Polyandrous:** stamens are free.
- **Monadelphous:** stamens united into one bunch or one bundle e.g. China rose.
- **Diadelphous:** stamens fused to form two bundles as in pea.
- **Polyadelphous:** stamens fused to form more than two bundles as in citrus.

### Gynoecium :

- It is the female reproductive part of the flower.
- Members are called carpel.
- Each carpel has three parts namely stigma, style and ovary.
- **Ovary** is the enlarged basal part on which lies the elongated tube, the **style**.
- The stigma usually at the tip of the style.
- **Stigma** is the receptive surface for pollen grain.
- Each ovary bears one or more ovules.
- Ovule attached to a flattened cushion-like placenta in the ovary.
- When more than one carpel is present they may be:-
  - **Apocarpous**: all carpels are free. E.g. rose, lotus
  - **Syncarpous**: carpels fused. E.g. Tomato mustard.
- After fertilization:-
  - Ovules develop into seed.
  - Ovary developed into fruit.

**Placentation** : arrangement of ovules within the ovary is known as Placentation.

- Marginal: Placenta forms a ridge along the ventral suture of ovary.
- Axile: Margins of carpels fuse to form central axis.
- Parietal: Ovules develop on inner wall of ovary.
- Free central: Ovules borne on central axis, lacking septa.
- Basal: Placenta develops at the base of ovary.

### THE FRUIT :

- It is the ripened or matured ovary after fertilization.
- Parthenocarpic fruits developed from the ovary without fertilization.
- Generally fruits consist of a wall or **pericarp** and seeds.
- Pericarp may be dry or fleshy.
- Pericarp differentiated into –
  - Outer epicarp.
  - Middle mesocarp.
  - Inner endocarp.
- Fruit developed from monocarpellary superior ovary and are one seeded. Such fruit is said to be **drupe** as in mango and coconut.
- Edible part of the mango is mesocarp.
- Mesocarp of coconut is fibrous.

### THE SEED :

- After fertilization ovules developed into seed.
- A seed is made of seed coat and embryo.
- The embryo is made up of
  - A radicle
  - An embryonal axis
  - One or two cotyledons.

**Structure of dicotyledonous seed :**

- Outer most covering of seed is seed coat.
- Seed coat has –
  - **Outer testa**
  - **Inner tegmen.**
- The **hilum** is a scar on the seed coat, the point of attachment of developing seed with the fruit.
- Above the hilum is a small pore called the **micropyle**.
- Embryo present inside the seed coat, consists of -
  - An **embryonal axis**.
  - **Two cotyledons**
- Cotyledons are fleshy and store reserve food.
- At the two end of embryonal axis are present the **radicle** and the **plumule**.
- In some seed **endosperm** store the reserve food as in castor.
- Mature seed without endosperm called **non-albuminous** seed or **non-endospermous** as in bean, gram and pea.

#### **Structure of monocotyledonous Seed :**

- Generally monocotyledonous seeds are **endospermic**, orchids are non-endospermic.
- In seeds of cereals such as maize, the seed coat is fused with the fruit wall.
- The outer covering of separates the embryo by a proteinous layer called **aleurone layer**.
- Embryo is small and located one side of the endosperm and consists of
  - One large shield shaped cotyledon known as **scutellum**.
  - A short axis with **radicle** and **plumule**.
  - Plumule covered by a sheath called **coleoptile**.
  - Radicle covered by a sheath called **coleorhiza**.