MORPHOLOGY OF FLOWERING PLANTS

INTRODUCTION

- **Morphology** is the branch of biology which deals with the study of form, structure and relative position of different organs.
- **Flowering plants** (or angiosperms) are seed bearing plants in which seeds are always enclosed in an ovary inside the fruits and the sporophylls are organized into flowers.
- These plants have been classified into **monocots** and **dicots**.
- **Plant morphology** refers to the study of external form and structure of plants.
- The flowering plants consist of an **axis**, **root system** and **shoot system**.
- Shoot system lies above the ground and the root system lies below the ground.
- Shoot system bears branches, leaves, flowers and fruits.
- The root, leaves and branches constitute the **vegetative parts of the plants**.
- The flowers, fruits and seeds form the **reproductive parts of the plants**.

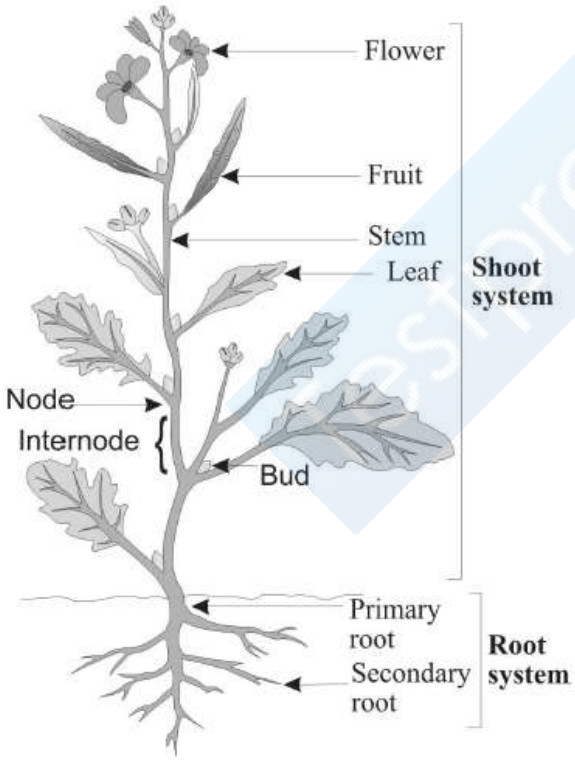


Fig. : Parts of a flowering plant

ROOT

- Root is the descending, non-green, underground part lacking nodes, internodes, leaves and buds.
- Root is responsible for nutrition and support.
- Radicle comes out/arise from the seed coat in the form of soft structure and moves toward the soil. It develops and forms **primary root**.

Roots are of two types : tap root and adventitious root.

- **Tap root** : It develops from radicle which is made up of one main branch and other sub-branches.
- Tap root forms lateral branches (called secondary roots) which further divide to form tertiary roots.
- Tap roots, with the secondary and tertiary roots form tap root system. It is the characteristic of dicot plants.
- **Adventitious roots** : In some plants, after sometime, the growth of tap root stops and then roots develop from other part of plant which are branched or unbranched, fibrous or storage, which are known as adventitious roots.

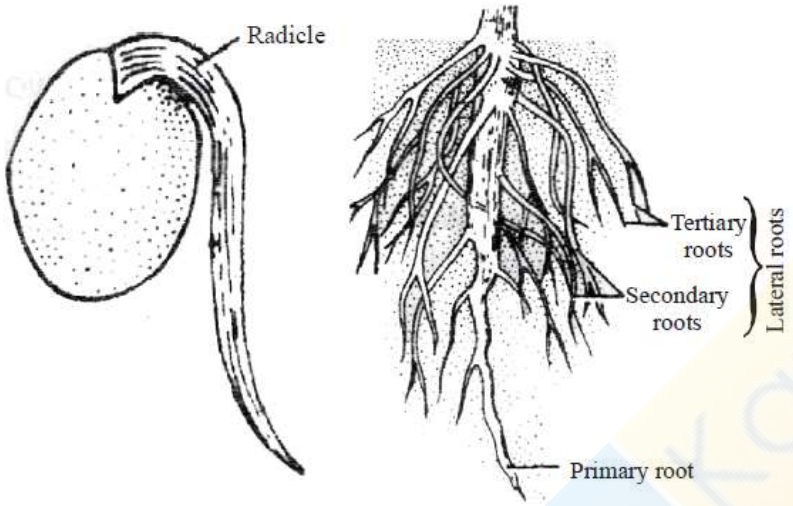


Fig. : Tap root

Fig. : Adventitious roots

- Adventitious roots are mainly found in monocots.
- Adventitious roots can be grouped into 3 types on the basis of their appearance -
  - roots arising from the base of the stem, e.g.,Triticum.
  - roots arising from leaves, e.g., Bryophyllum.
  - roots developing from nodes and internodes of the stem.

REGIONS OF THE ROOT

Root consists of 4 major zones – **root cap**, **meristematic zone**, **zone of cell elongation** and **maturation zone**.

ROOT CAP

- Root cap (also known as calyptra due to its origin from calyptrogen) is a cap like structure made up of thin walled cells that covers the root apex.
- It is made of dead cells and protects the young growing cells of the apical region.
- It is absent in hydrophytes, epiphytes, parasites and mycorrhiza.

MERISTEMATIC ZONE

- It is present just above the root cap.
- It is made up of compactly arranged small, thin walled isodiametric and meristematic cells having dense protoplasm and large nucleus.
- The cells of this region are in active state of division and so this is the main growing region of the root.

ZONE OF CELL ELONGATION

- The region of cell elongation is present above the meristematic zone resulting in an increase in length of the root.
- The external cells of this region possess power of absorption of water and mineral salts from the soil.

MATURATION ZONE

- Maturation zone is present above the zone of cell elongation.
- Secondary growth takes place in this region.
- Region of maturation zone is the area of lateral roots.
- Its only function is to anchor the plant firmly in the soil.
- Unicellular and ephemeral root hairs are formed from the epidermal cells in this zone. Root hairs helps in absorption of water. Root hairs are absent in all the plants where there are no root caps.

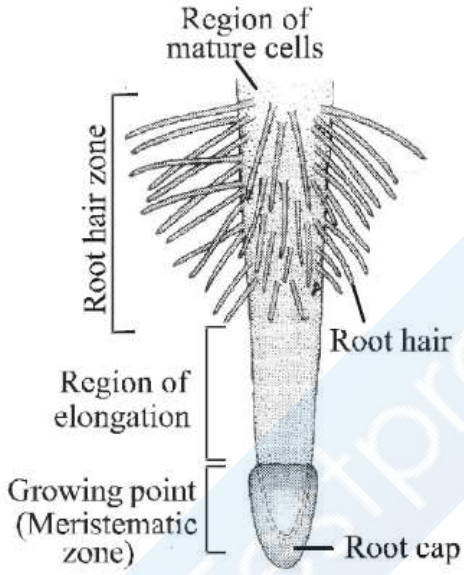


Fig. : Zones or regions of a typical root

MODIFICATION OF ROOTS

Tap and adventitious roots are modified in different forms to perform special functions and are called as modified roots.

MODIFICATION OF TAP ROOTS

Tap root are modified for food storage and respiration.

Modified tap roots for food storage

- **Fusiform roots** : These root are thicker in the middle and tapering on both ends. In this type of roots, both hypocotyl and root help in storage of food. E.g., radish

Fig. : Fusiform root

- **Conical roots** : These roots are thicker at their upper side and tapering at basal end. E.g., carrot.

Fig. : Conical root

- **Napiform roots** : These roots become swollen and spherical at the upper end and tapering like a thread at their lower end. E.g., turnip (Brassica rapa), sugarbeet.

Fig. : Napiform root

- **Tuberous roots** : Such roots do not have a regular shape and get swollen & fleshy at any portion of the root. E.g., Mirabilis.

Fig. : Tuberous root

- **Nodulated roots** : Nodules are formed on branches of roots by nitrogen fixing bacteria (Rhizobium). Nodules are pinkish due to pigment leghaemoglobin which carry oxygen and provide anaerobic environment in nodules for nitrogenase enzyme to fix nitrogen.

E.g., plants of leguminosae family (Papilionaceae) - Pea

Fig. : Nodulated roots

Modified tap root for respiration are pneumatophores

The plants grow in marshy areas, where there is scarcity of oxygen. The plants, which grow in this region have some branches of taproot that grow vertically upward and comes on surface of soil. These roots are called pneumatophores. They have minute pores called pneumathodes or lenticels by which air enters inside the plant and gives oxygen for respiration. E.g., Rhizophora, Mangrove, Heritiera.

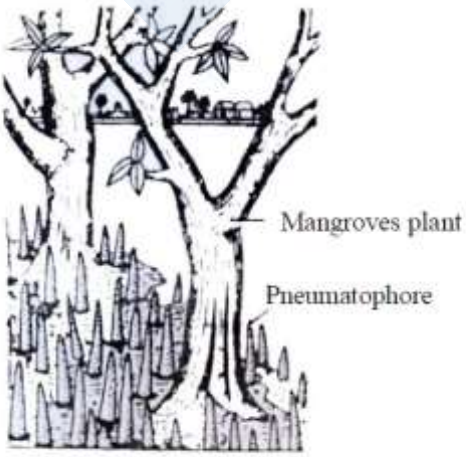


Fig. : Respiratory roots (Pneumatophores) of *Rhizophora*

MODIFICATION OF ADVENTITIOUS ROOTS

- Adventitious roots can be modified on the basis of functions like fleshy for storage (e.g., moniliform, annulated, tuberous, fasciculated, palmate, nodulose), mechanical support and for vital functions.
- **Tuberous adventitious root** : When food is stored in these roots, they become swollen and form a bunch. E.g., sweet potato.
- **Fasciculated roots** : These are adventitious roots occurring in clusters and all of them are more swollen. E.g., Asparagus, Dahlia.
- **Fibrous roots** : Roots are very thin and filamentous. E.g., Grass, Wheat.
- **Nodulose roots** : In this type, tips of roots swell up. Eg. Melilotus.
- **Beaded or moniliform roots** : When root swells up like a bead at different places after a regular interval. E.g., Vitis, Momordica (Bitter gourd), Portulaca.
- **Stilt roots** : When root arises from lower nodes and enter inside the soil and form a rope-like structure, it is known as stilt roots. E.g., Maize, Sugarcane, Pandanus (screwpine).

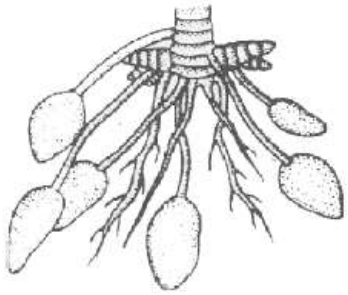


Fig. : Nodulose roots

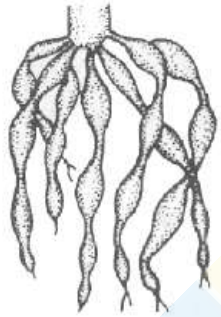


Fig. : Moniliform roots

Fig. : Tuberous roots

Fig. : Stilt roots

- **Prop root or pillar roots** : When root arises from branches of plant and grows downward towards soil function as supporting stem for the plant. This type of roots is called prop roots. E.g., Banyan.
- **Buttress root** : Such roots appear from the basal part of stem and spread in different directions in the soil. E.g., Terminalia.
- **Climbing roots** : These roots arise from nodes of stem and helps the plant in climbing. E.g., Money plant (pothos), Monstera (Betel), Black pepper.
- **Respiratory root** : When the quantity of oxygen is low in soil then some root comes out from the soil and helps in respiration. E.g., Avicennia, Jussiaea.
- **Foliar root or Epiphyllous root** : When roots arise from leaf they are called as foliar roots. E.g., Bryophyllum, Begonia.
- **Sucking or haustorial roots or Parasitic roots** : In parasitic plants, roots enter in the stem of the host plant to absorb nutrition from host. E.g., Dendrophthoe, Cuscuta, Viscum.

- **Annulated roots** : If the swelling is in a series of rings on the roots, it is called annulated roots. E.g., Ipecac.

STEM

- Stem is a part of plant which lies above from surface of soil i.e. it shows negative geotropic growth. It has nodes and internodes. Branches, leaves, flower buds and bracts are developed from nodes.
- Stem facilitates conduction of water, minerals and food materials. It also produces and supports leaves and reproductive structures.
- Stem develops from the plumule.
- Forms of stem are :
  - **Caudex** : It is unbranched, erect, cylindrical stout stem and marked with scars of fallen leaves as in palms. E.g., Palm.
  - **Culm** : Stem is jointed with solid nodes & hollow internodes. E.g., Bamboo (Gramineae).
  - **Scape** : In some monocotyledons there is no aerial stem instead there are aerial shoot (branch) which bears flowers. E.g., Onion and aroids.
  - **Prostrate or procumbent** : If the stem trails on the ground and lies prostrate. E.g., Evolvulus and Oxalis (Wood sorrel).
  - **Decumbent** : Stem trails for some distance and then tends to rise at its apex. E.g., Tridax, Portulaca.
  - **Diffuse** : When the branches of the stem are spread out in all directions on the ground. E.g., Euphorbia, Boerhaavia.
  - **Climbers** : Stem which attach themselves to nearby object by means of some special devices like hooks. E.g., Bougainvillea (by hook), wild pea (by tendrils)

MODIFICATION OF STEM

Modification of stem are of three types - **subaerial**, **underground** and **aerial modification**

SUB-AERIAL MODIFICATION

- Sub aerial stems are feeble and weak and aerial part of them grows horizontally on the ground while some parts remain underground and help in vegetative propagation.
- It is of 4 types – *runner, stolon, sucker and offset*.
- **Runner** : In this, stem grows and spread on the surface of soil. Roots are developed at lower side and leaves from upper side from node E.g., Cynodon dactylon (Doob grass), Oxalis.
- **Stolon** : In this, branches are small and stem is condensed and grow in all directions. After sometime of growing, their apical region comes out from the soil. E.g., Fragaria (Wild strawberry), Jasmine, Peppermint.
- **Sucker** : In this, the main stem grows in the soil but branches develop from nodes above the soil. E.g., Mint, Pineapple, Chrysanthemum.
- **Offset** : Generally these are aquatic plants which have a short and fragile stem. E.g., Pistia, Eichhornia.

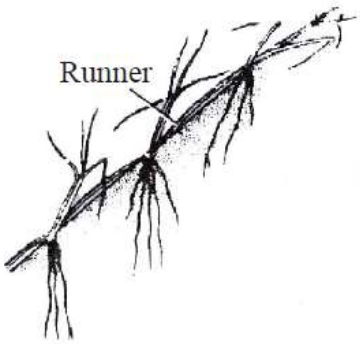


Fig. : Runner

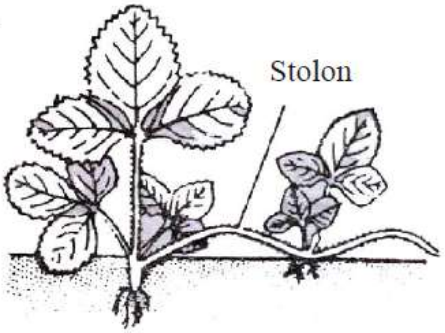


Fig. : Stolon

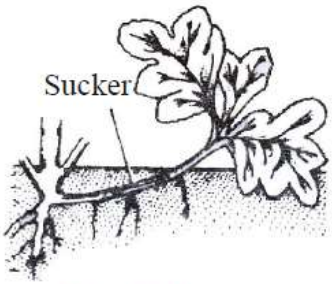


Fig. : Sucker

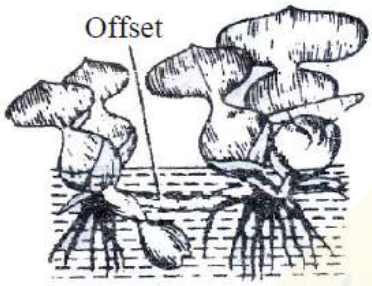


Fig. : Offset

UNDERGROUND MODIFICATION

- Underground stems are non-green stem and this type of modification occurs generally for food storage and vegetative propagation.
- Modified underground stems are of four types – *tubers, rhizome, corm and bulb.*
- **Tuber** : It is irregularly shaped swollen stem. The tips of branches become swollen in the soil. Eyes are found on them which are axillary buds and covered with scaly leaves. E.g., Potato.

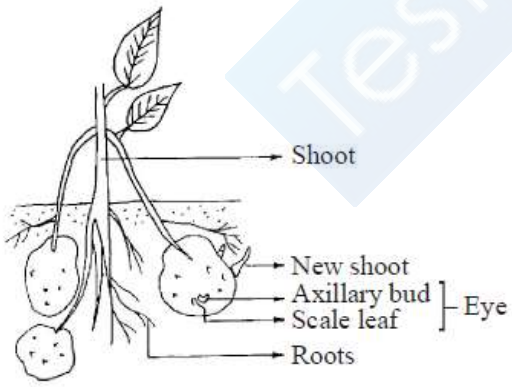


Fig. : Tuber of potato

- **Rhizome** : It is fleshy and horizontally found below the soil. Small nodes and internodes are found which are covered by scaly leaves. E.g., Ginger, Turmeric, Canna, Water lily.

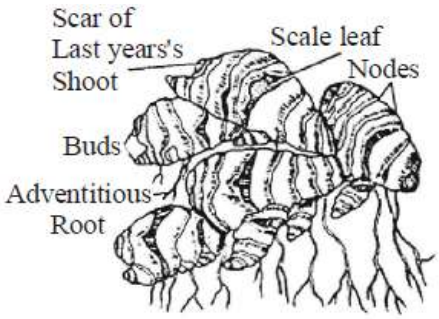


Fig. : Rhizome of Ginger

- **Corm** : It is a condensed structure which grows vertically under the soil surface. It is highly swollen vertical stem.

E.g., Colocasia, Alocasia, Zaminkand, Saffron.

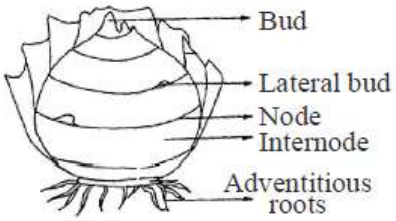


Fig. : Corm of Crocus

- **Bulb** : This stem has a disc like structure and surrounded with numerous fleshy scaly leaves. Many roots arise from its base. The bulbs are of two types – scaly or imbricate (e.g., garlic) and tunicate (e.g., onion).

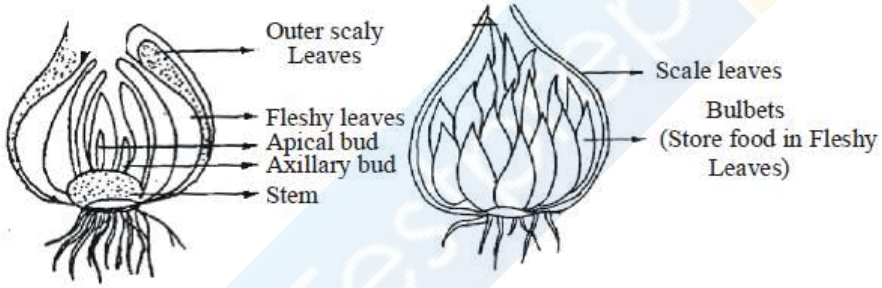
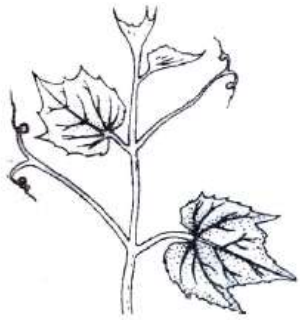


Fig. : Bulb of garlic

AERIAL MODIFICATION

- The aerial modification helps the plants to survive during unfavourable conditions by storing food, propagation and providing support and protection.
- Aerial modifications are of following types - stem tendril; phylloclade; prickle and hooks, stem thorn/thorn; and cladode.
- **Stem tendril** : In this type, axillary bud forms tendril in place of branches and helps in climbing of those plants which have a weak stem. E.g., Grapes, Passiflora, Cucumber, Pumpkins, Watermelon.



Fig, : Stem tendril

- **Phylloclade** : Stem is modified into a flat, fleshy and green leaf like structure and carries out photosynthesis like leaf. The leaves are modified into spines. E.g., Opuntia, Euphorbia, Casuarina.

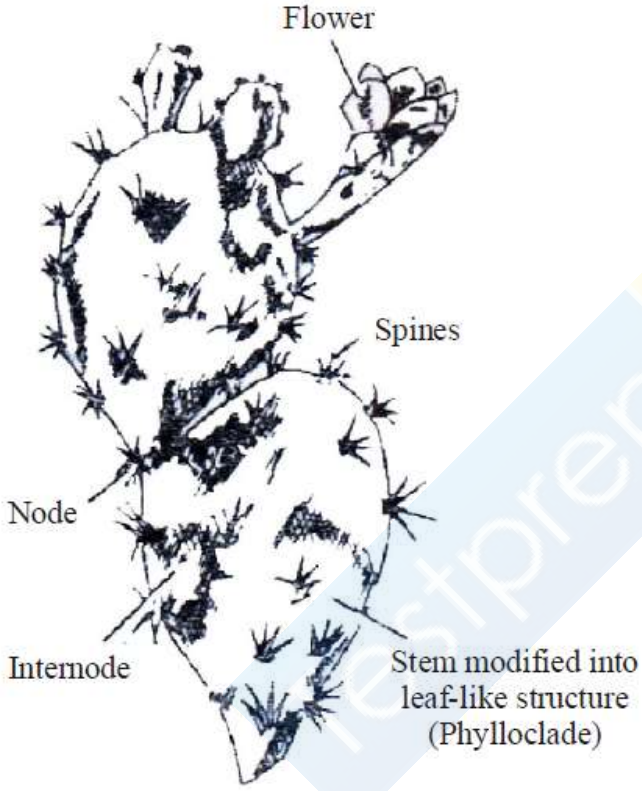


Fig. : Phylloclade

- **Prickle and hooks** : These develop only from cortex and epidermis and found at nodes or internodes. It helps in climbing. It is exogenous in origin. E.g., Rose, Smilax.
- **Stem thorn/Thorn** : It is developed from axillary buds or terminal bud of the stem. It may bear leaves, flowers. It is endogenous in origin. E.g., Catissa (Karonda), Bougainvillea, Pomegranate, Citrus.

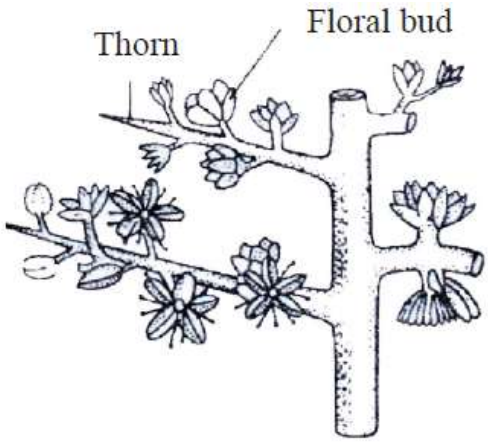


Fig. : Thorn

- **Cladode** : They are green stems of limited growth generally one or two internode long that perform the function of photosynthesis. E.g., Asparagus (one internode long) and Ruscus (2 internode long).

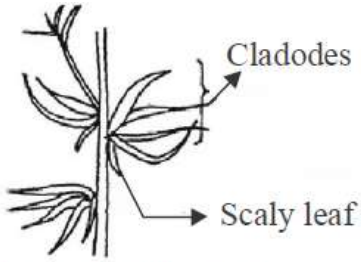


Fig. : Cladodes of *Asparagus*

LEAF

- The leaves develop from the nodes. Their main function is photosynthesis and food making. Axillary buds are found in its axil.
- Leaf is divided into 3 main parts :

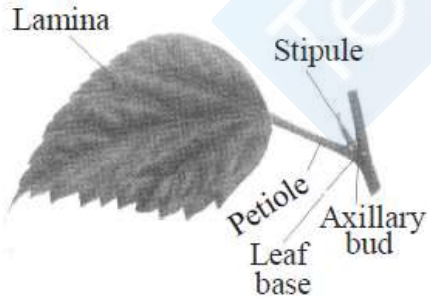


Fig. : Parts of a leaf

- **Leaf base (= hypopodium)** : The part of leaf attached to stem is leaf base.
- **Petiole** : The part of leaf connecting the lamina with the branch or stem. Petiolated or stalked leaves are known as petiolate and when petiole or stalk is absent then leaves are called sessile. In Eichhornia, petiole swells and in Citrus, it is winged.
- **Lamina or leaf blade** : It is a broad and flattened part of leaf. Photosynthesis and transpiration occur in this.

- Depending upon the incision lamina leaf may be simple or compound.
- **Simple Leaf** is a leaf which may be incised to any depth, but not down to the midrib or petiole. E.g., mango, guava, papaya etc.

- **Compound leaf** is a leaf in which the leaf blade is incised up to the midrib or petiole, thus dividing it into several small parts, known as leaflets.

It is of two types : pinnately and palmate compound leaf.

- **Pinnately compound leaf** : In this type of leaf, mid rib is known as rachis. Leaflets are arranged on both sides of rachis. E.g., Neem.
- **Palmately compound leaf** : In this type, incision of leaf is directed from leaf margin to apex of petiole and all leaflets are attached on the upper end of the petiole. E.g., Silk cotton.
- Leaves of some plants have lateral appendages on either side of leaf base, known as **stipules**. If stipules are present in leaf it is called **stipulated leaf**, if it is absent then the leaf is called **ex-stipulated**.
- **Duration of Leaf** :
  - **Persistent/Evergreen** : Leaves of such plants are found in all seasons and do not (fall) shed. E.g., Pine, Saraca indica, Date palm.
  - **Deciduous** : All leaves of such plants shed at the same time. E.g., Azadirachta, Ficus.
  - **Caducous** : Leaves are shed as the bud formation takes place. E.g., Rose.

TYPES OF LEAVES

According to the origin and function

- **Foliage leaf** : They are usually green coloured and their main function is photosynthesis.

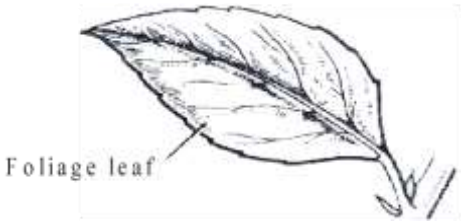


Fig. : Foliage leaf

- **Cotyledonary leaf** : This leaf comes out during germination and helps in nutrition until the first leaf is not formed.

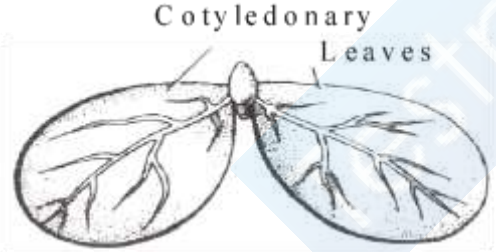


Fig. : Cotyledonary leaf

- **Scale leaf** : Such leaves are usually dry membrane like and they cannot perform photosynthesis.

Fig. : Scale leaf

- **Bract** : Bracts are the leaves which contain flower in their axil.

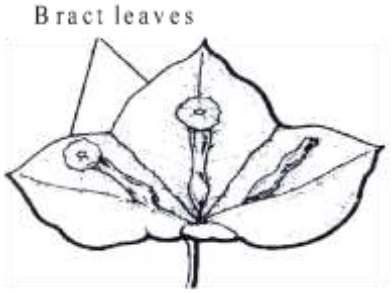


Fig. : Bract

- **Bracteole** : These are leaf like structures found on pedicel.
- **Floral leaf** : Sepals, petals, stamens and carpel are found in a flower which are included in this type of leaf.

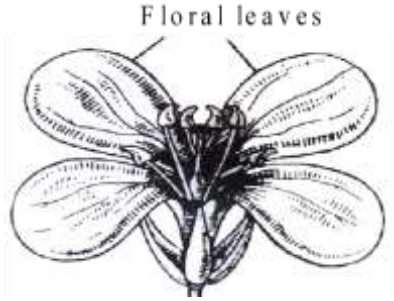


Fig. : Floral leaf

VENATION OF LAMINA

- The arrangement of veins and veinlets in leaves (lamina) is known as **venation**.
- Venation is of 2 types - **reticulate** and **parallel**.

RETICULATE VENATION

- In reticulate venation, many veins divide into various branches (veinlets) and form a net like structure. It is found in dicots, exception - Calophyllum (It has parallel venation)
- Reticulate venation is of 2 types unicostate and multicostate.
- **Unicostate or pinnate** : This type of venation has only one principal vein or midrib that gives off many lateral veins which proceeds toward margin and apex of lamina of the leaf and forms a network. E.g., Mango, Guava, Peepal.
- **Multicostate or palmate** : In this type of venation, many principal veins arise from the tip of petiole and proceed upward. E.g., Camphor, Zizyphus, Tejpata, China rose, plum.

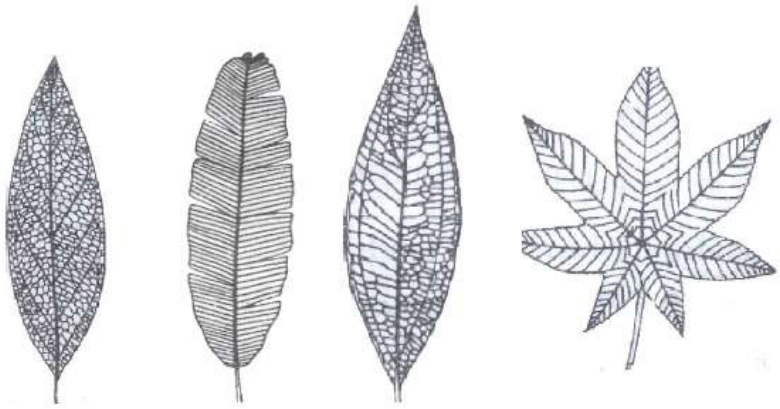


Fig. : Reticulate unicostate (Pinnate) | Parallel pinnate (Unicostate) | Multicostate (Palmate) | Multicostate (Palmate)

PARALLEL VENATION

- In this type of venation, all veins run parallel to each other and they do not form network.

It is found in monocots.
Exception - Smilax (It has reticulate venation).

- They are of 2 types – unicostate and multicostate.
- **Unicostate or pinnate** : This type of pattern has only one principal vein, that gives off many lateral veins, which proceed towards the margin of the leaf blade in a parallel manner but they do not have veinlets. E.g., Banana, Ginger, Canna.
- **Multicostate or palmate** : This type has many principal veins arising from the tip of the petiole and proceeding upwards.

PHYLLOTAXY

- Phyllotaxy is the arrangement of leaves on both main stem and branches.
- Arrangement of phyllotaxy is made to facilitate the leaves to obtain maximum light for photosynthesis.
- It is of three types - **alternate**, **opposite** and **whorled** arrangement.

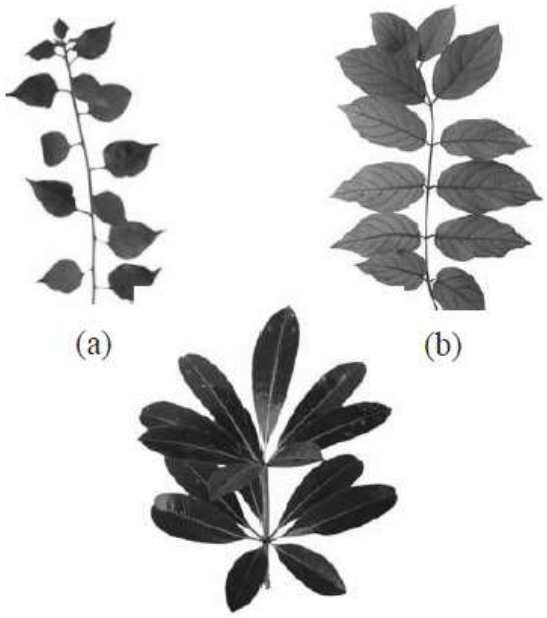


Fig. : Different types of phyllotaxy : (a) Alternate (b) Opposite (c) Whorled

- In **alternate (spiral) arrangement**, only one leaf is borne at a node and leaves are arranged alternately giving a spiral form. E.g., mango, mustard, etc.
- In **opposite arrangement**, each node gives rise to two leaves arranged opposite to each other. Opposite phyllotaxy is of two types - opposite superposed (e.g., lxora etc) and opposite decussate (e.g., Ocimum etc)
- In **whorled arrangement**, more than two leaves are formed from each node, e.g., Nerium etc.

MODIFICATION OF LEAVES

- When leaf is modified into different structure, it is called modification of leaves. E.g., leaf tendrils, leaf spine etc.
- **Leaf tendril** : The whole leaf is modified into a wire like structure which is called leaf tendril. E.g., Lathyrus aphaca (wild pea).
- **Leaf spine** : Leaves or any part of leaflets are modified into pointed spine. (E.g., Opuntia, Aloe, Argemone.) either to escape transpiration or for protection.
- **Leaf scale** : Leaves become thin, dry and form a membrane or paper like structure and serve to protect the axillary buds as in Ficus and Tamarix, Ruscus or store food and water as in onion.
- **Leaf pitcher** : Leaves of some plants are modified to pitcher shape. E.g., Nepenthes, Dischidia.
- **Leaf bladde**r : In some plants, leaves are modified into bladder like structure, e.g., Utricularia. The bladder like structure is meant for catching the aquatic insects etc. for their nitrogen content.
- **Leaf Hooks** : In some plants, terminal leaflets are modified into curved hooks for helping the plant in climbing. E.g., Argemone,Opuntia,Aloe, Cat's nail (Bignonia unguis-cati).
- **Phyllode** : In this, petiole becomes flat and functions as a normal leaf. E.g., Australian acacia. It also performs the function of synthesis of food.
- **Leaflet tendril** : When a leaflet is modified into tendril like structure than it is called leaflet tendril. E.g., Pisum sativum (Garden Pea), Lathyrus odoratus (sweet pea).

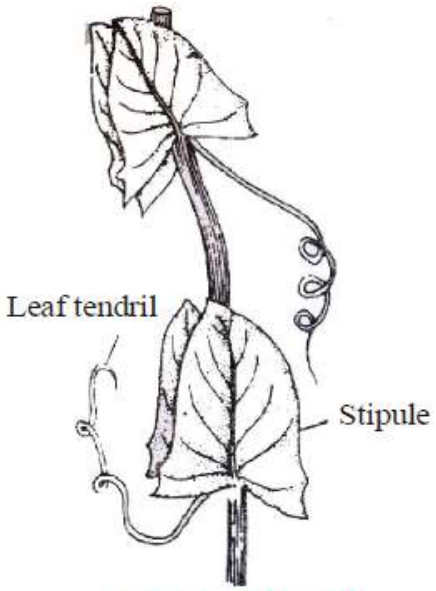


Fig. : Leaf tendril

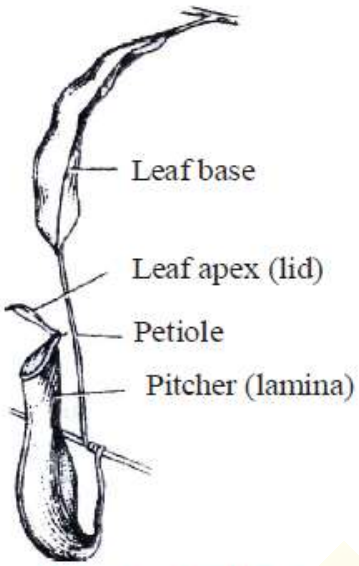


Fig. : Leaf pitcher

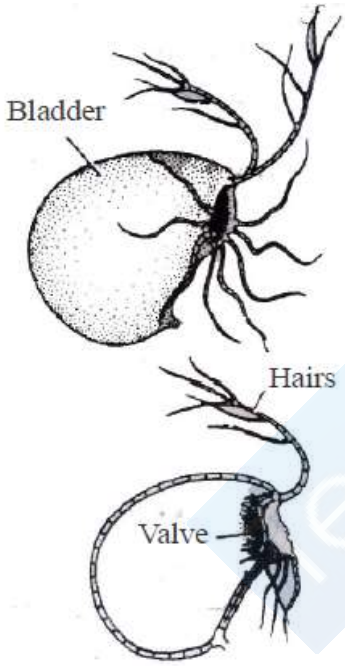


Fig. : Leaf bladder

Fig. : Phyllode

Fig. : Leaflet tendril

INFLORESCENCE

- Arrangement of flower on floral axis (peduncle) is called inflorescence.
- Types of inflorescence are - **racemose**, **cymose**, **special types of inflorescence** and **mixed inflorescence**.

RACEMOSE

- In this type of inflorescence, the main axis continues to grow and does not terminate in a flower and gives off flowers laterally in an acropetal manner (where old flowers are arranged on lower side and young flowers on upper side).
- Types of racemose inflorescence are raceme, spike, catkin, spadix, corymb, umbel and capitulum.
- **Raceme** : When peduncle (or main axis) is elongated and flowers are pedicellate. E.g., Radish. Mustard.

When the peduncle is branched and each branch bare pedicellated flowers like racemose and are arranged in acropetal manner then it is known as compound raceme or panicle. E.g., Gulmohar, Neem.

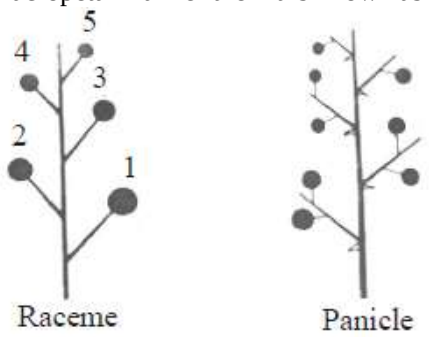


Fig. : Raceme or panicle

- **Spike** : In spike, peduncle is elongated but flowers are sessile. E.g., Achyranthes.

When peduncle is branched and each branch bears spike like inflorescence then the small branches having flower is called spikelet and this arrangement is called as spike of spikelet. E.g., members of the grass family (Gramineae) - wheat.

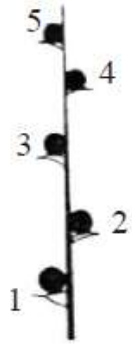


Fig. : Spike

- **Catkin** : In catkin, peduncle is thin, long and weak, and flowers are sessile and unisexual. E.g.. Mulberry, Betula, Oak.

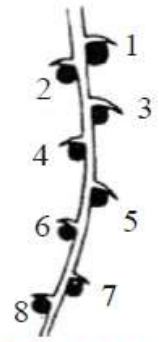


Fig. : Catkin

- **Spadix** : In spadix, peduncle is thick, long and fleshy and has small sessile and unisexual flowers covered with one or more green or colourful bracts. E.g., Colocasia, Maize

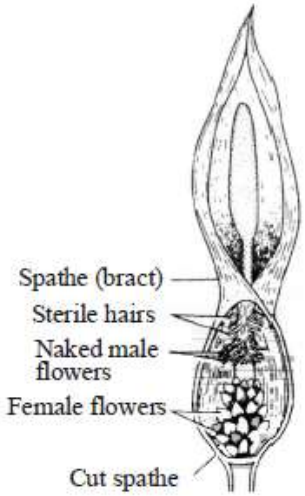


Fig. : Spadix

- **Corymb** : In corymb, peduncle is short and all the flowers are present at the same level because the lower flower has much longer pedicel than the upper one. E.g., Candy tuft (Iberis amara).

In this type of inflorescence, peduncle is branched, and each branch has flower cluster. This type of inflorescence is called compound corymb.

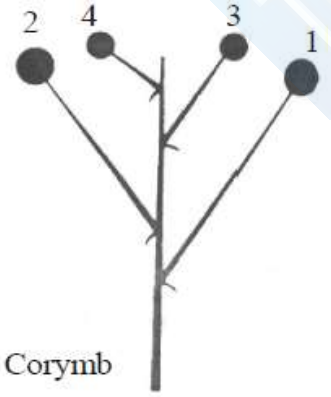
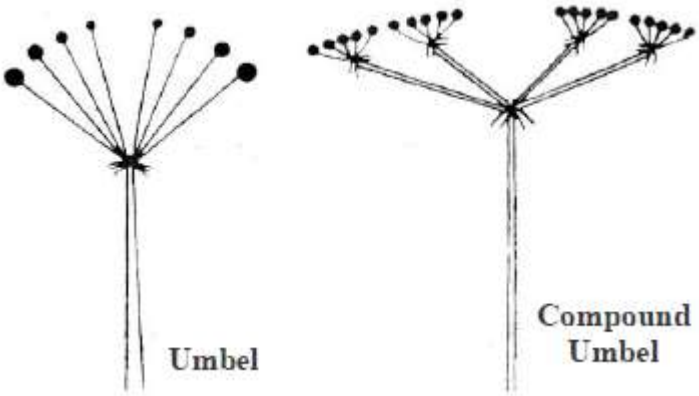


Fig. : Corymb

- **Umbel** : An inflorescence in which the flower stalks of more or less equal length arise from the same point is called umbel. At the base of the flower stalk, there is whorl of bracts forming the involucre. E.g., Cantella.

If in this type of inflorescence, peduncle is branched then each branch has flower cluster then this type of inflorescence is called compound umbel. E.g., Coriander, Foeniculum, Cuminum.



- **Capitulum/Racemose head** : In this, the growth of peduncle is retarded and it becomes broad, flattened concave or convex. On it, small flowers are found. These flowers are called floret.

If all the flower of capitulum are same, then it is called homogamous. If the younger flowers are present towards centre and older towards the periphery, then it is known centripetal order. The flowers which are present in the centre is called disc floret and flowers at periphery are called as ray floret and arrangement of this type is called heterogamous. In this type of inflorescence, florets may be unisexual, bisexual and sterile. This inflorescence is surrounded by one or more involucre. It is most advanced type of inflorescence, because all flowers are pollinated at same time.
E.g., Sunflower, Zinnia, Marigold.

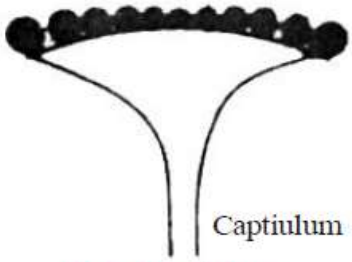


Fig. : Captiulum

CYMOSE

- In cymose inflorescence, the growth of the main axis is limited and the rachis or peduncle terminate in a flower. The older flowers are present at the upper portion and young buds are arranged towards base. This arrangement is called **basipetal succession**.
- Cymose inflorescence are of following types – *uniparous, biparous and multiparous* cyme.
- **Uniparous cyme/Monochasial cyme** : In this, the peduncle ends in a flower and produces lateral branch at the time of ending in a flower. It is of two types –
  - **Helicoid cyme** : When all lateral branches develop on the same side on the peduncle then it is called helical cyme. E.g., Heliotropism, Saraca.
  - **Scorpioid cyme** : In this, the lateral branch develops on one side and the other branch will develop opposite to the first one, i.e. they lie alternate to each other. E.g., Begonia, Vine.

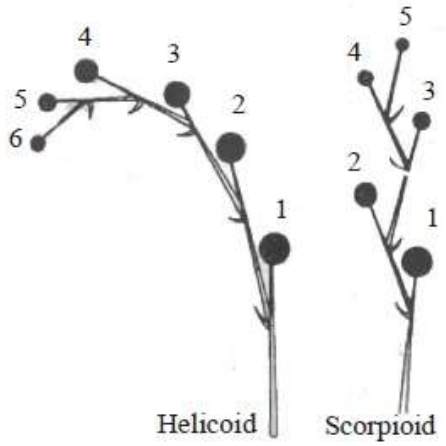


Fig. : Helicoid and Scorpioid

- **Dichasial / Biparous cyme** : In this, peduncle ends in a flower and from the basal part of the peduncle two lateral branches arise which also end in a flower. This same arrangement occurs on these lateral branches. E.g., Bougainvillea, jasmine, teak, Datura, Mirabilis.

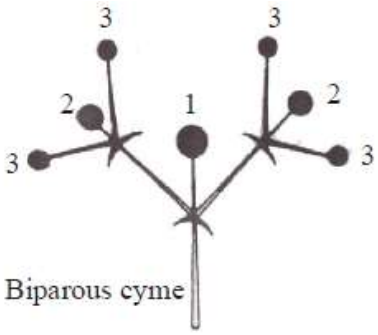


Fig. : Biparous cyme

- **Multiparous cyme/Polychasial** : In this, peduncle ends in a flower and from the base of it many lateral branches arise, which also terminate in flower. This arrangement now also occurs on these lateral branches and is known multiparous cyme. E.g., Calotropis (madar), Nerium, Asclepias.

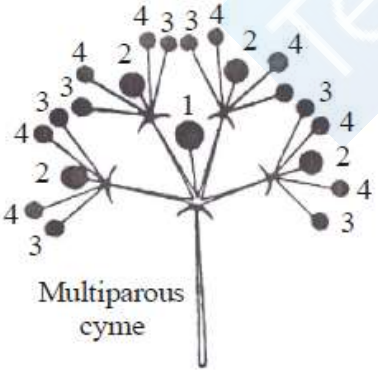


Fig. : Multiparous cyme

SPECIAL TYPE OF INFLORESCENCE

- **Cyathium** : The bracts or the involucre become fused to form a cup shaped structure. On the margin of it, secretory glands are found. In the central part of the cup shaped structure, a female flower is found which matures earlier. Due to the growth of pedicel, this comes out from the cup shaped structure. Female flowers are surrounded by small male flowers. These are also found on pedicel. The male flower, which lies toward centre mature earlier than the flowers which are towards the periphery.

This inflorescence is found in euphorbiaceae family like Euphorbia, Poinsettia, Pedilanthus.

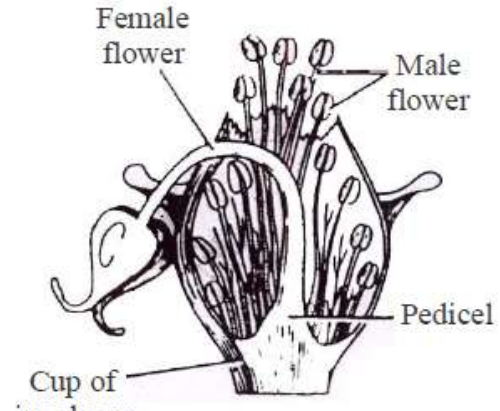


Fig. : Cyathium

- **Verticillaster** : This type inflorescence is found in Labiatae/Lamiaceae family. In this type of inflorescence, leaves are arranged in an opposite manner on stem. From the axil of each leaf inflorescence develop. From the main axil, lateral axil arises, on which flowers are found. Now from these branches lateral branches also develops. On these branches, flowers are found. In this inflorescence, each dichasial cyme changes into monochasial (scorpioid) cyme.

E.g., Salvia, Ocimum, Coleus.

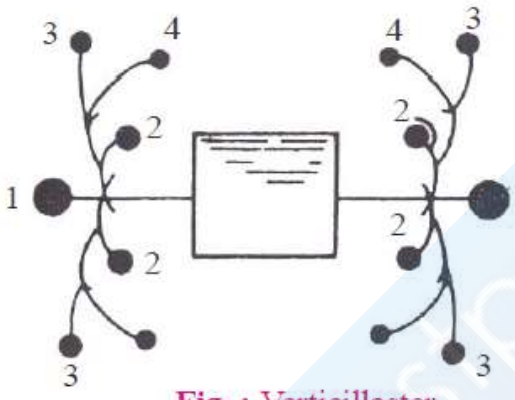


Fig. : Verticillaster

- **Hypanthodium** : In this, peduncle is modified in to narrow cup like structure. At the base of the cup, female flowers develop while towards mouth male flower develops. All the three types of flowers are present in this inflorescence. E.g., Banyan, Peepal, Syconus, Ficus species.

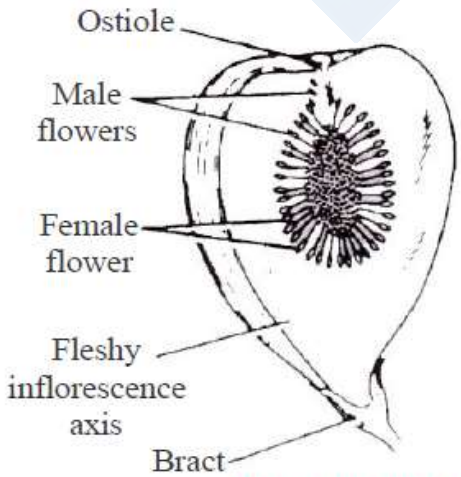


Fig. : Hypanthodium

MIXED INFLORESCENCE

- Sometimes, flowers are arranged in both racemose and cymose manner on the same peduncle and is called as mixed inflorescence.
- Examples –
  - Mixed spadix - Banana
  - Cymose raceme - Grapes

FLOWER

- Flower is a specialized branch of limited growth which bears floral leaves that carry on sexual reproduction and gives rise to seeds and fruits.
- The study of flowers is called anthology.
- The part from where flower arises is called bract.
- Flowers are borne on short or long stalk which is called **pedicel**.
- The upper part of the pedicel is swollen, spherical shaped or conical which is called **thalamus/receptacle**. Floral leaves are present on it.
- In a flower, 4 types floral leaves are found. These are - sepal, petal, stamen and carpel.

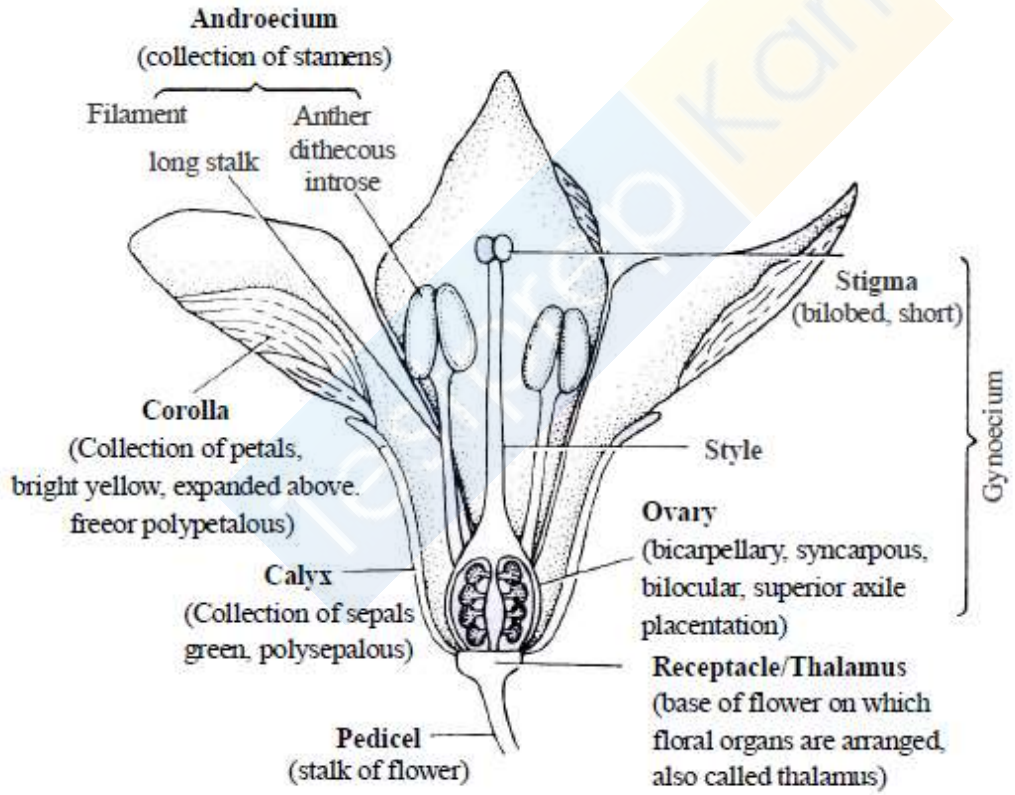


Fig. : Parts of a flower

- If the floral leaves are cyclically arranged in a flower, then it is called **cyclic flower**. If floral leaves are spirally arranged then it is called **spiral or acyclic flower**.
- When a flower is divided by any vertical plane into two equal halves, then it is called **actinomorphic / radial / regular** flower. E.g., Mustard, China rose, Datura, Chilli.
- When the flower is divided into two equal halves only by one vertical plane, then it is called **zygomorphic / bilateral** flower. E.g., Pea, bean, Gulmohur, Cassia.
- When the flower cannot be divided into two equal halves from any plane, then it is called **asymmetrical / irregular** flower. E.g., Canna.

NOTES:-

- **Anthophore** : Internode between calyx and corolla is called anthophore. E.g., Silene.
- **Androphore** : Internode between corolla and androecium is called androphore. E.g., Passiflora.
- **Gynophore** : Internode between androecium and gynoecium is called gynophore. E.g., Capparis.
- **Gynandrophore or Androgynophore**

When both conditions of androphore and gynophore are found in the same flower then this condition is called gynandrophore or androgynophore. E.g., Cleome gynandra.

- The part of the flower which lies near to mother axis is posterior part while the part which is far from mother axis is the anterior part of flower.
- The relative position of gynoecium changes with respect to floral parts and on this basis, it is divided into three parts –

○ **Hypogynous condition**

When petals, sepals and stamens are situated below the ovary, the flower is called hypogynous and in this condition ovary will be superior.
E.g., Mustard, China rose, Brinjal.

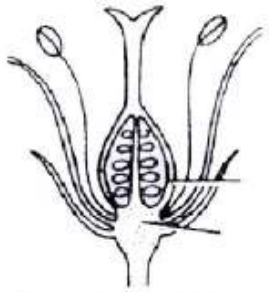


Fig.: Hypogynous

○ **Perigynous condition**

In this, thalamus grows upwardly and form as cup shaped structure. On the margin of the thalamus, floral parts are attached except gynoecium which lies at the basal part. So in this condition, gynoecium is situated below floral part. The ovary in this condition is said to be half inferior.
E.g., Rose, Plum, Peach.

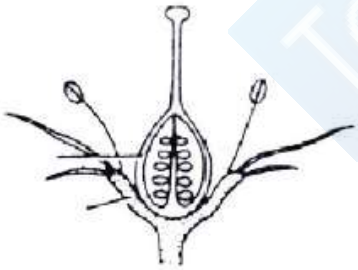


Fig. : Perigynous

○ **Epigynous condition**

When petals, sepals & stamens are situated above the ovary, then the ovary is said to be inferior and rest of the floral parts are superior. E.g., Guava, Apple, Cucumber and the ray florets of sunflower.

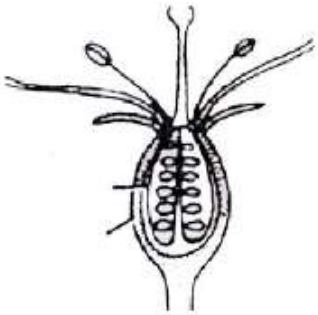


Fig. : Epigynous

- The flower which arises from the axils of bract is called **bracteate flower**.
- The whorl of bract surrounding peduncle is called **involucre**.
- In flowers, when a large bract completely encloses whole inflorescence, then it is called **spathe**. E.g., Banana, Maize
- When the size of bract of flower is greater than size of flower and these are of various colours then it is called petaloid bract. E.g., Bougainvillea.
- Small, dry, scaly bracts are called **glumes**. E.g., Wheat, Grass

PARTS OF FLOWERS

A typical flower has four main parts - **calyx**, **corolla**, **androecium** and **gynoecium**.

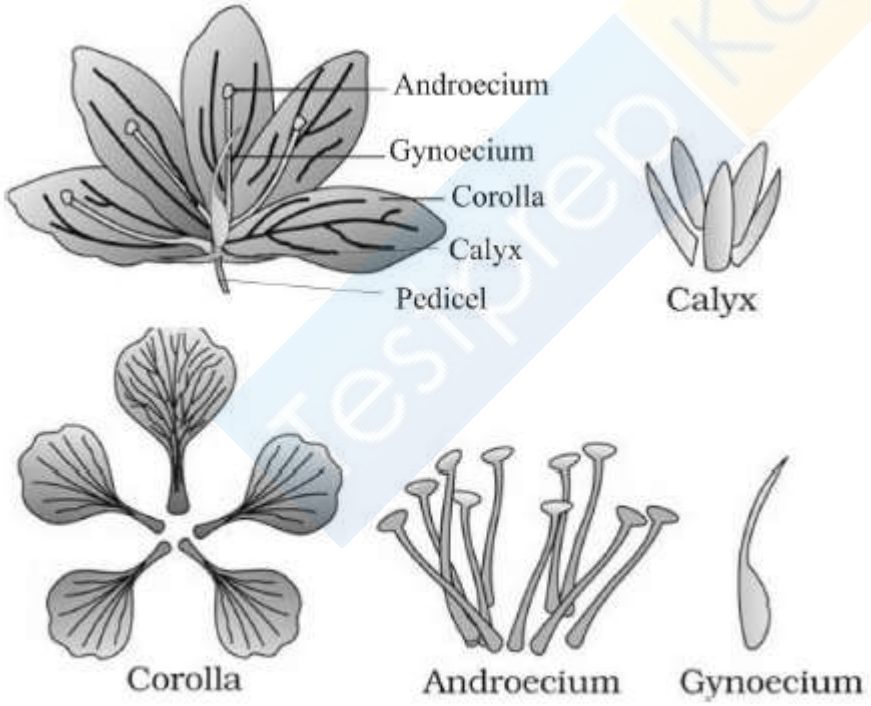


Fig.: Part of flowers

The individual units of a
Calyx = Sepals
Corolla = Petals
Androecium = Stamens or microsporophyll
Gynoecium = Carpels or megasporophyll

Calyx and corolla are helping or accessory whorls and androecium and gynoecium are reproductive whorls.

CALYX

- The outermost whorl of flower is called **calyx**.
- Each member of this whorl is called **sepal**.
- When all the sepals are free from each other, then the flower is called **polysepalous**, e.g., Mustard, Radish. When the sepals are fused with each other then it is called gamosepalous e.g., Cotton, Datura, Brinjal.
- In the green calyx of Mussaenda, one of the sepals enlarge and form a leaf like structure. It may be white or brightly coloured. It attracts the insects.
- In Trapa, calyx is **modified into spines** and helps in protection of fruit.
- In Argemone, spines are present on the surface of sepal which protects the flower bud.
- In Larkspur and Balsam, the posterior part of sepal is modified into a narrow tube. This structure is called **sepal spur** for attraction of insects in it and storing nectar.
- In the family of sunflower, sepals are modified into hairy structure. It is called **pappus**. The pappus helps in dispersal of fruit.
- Some plants in which sepals fall just at the time of opening of flower bud then are called caducous sepals, e.g., Poppy.
- In some plants, sepals fall after pollination then these are called deciduous, e.g., mustard.
- Upto fruit formation, if sepals do not fall and remain attached to fruit, then these are called persistent. E.g., Tomato, Capsicum, Brinjal, Cotton, Datura.
- Sometimes below calyx, a whorl similar to sepals is found which is called epicalyx. E.g., in Malvaceae family (China rose)

COROLLA

- The second whorl of flower is called corolla and each member of it is called petals.
- Corolla is brightly coloured and attracts insects for pollination and protects the inner essential whorls from injury.
- Corolla lies above calyx. When the shape and size of petals are similar then it is called symmetrical while when they are not similar, then they are asymmetrical.
- When all the petals are free, then it is called polypetalous corolla while when petals are fused, then these are called gamopetalous corolla.
- **Forms of polypetalous corolla are** :

○ **Cruciform** : In cruciform, 4 petals are found. The lower part of the petal which is narrow is called claw while the outer broad part is called limb. These petals are arranged crosswise. e.g., Mustard, Radish.

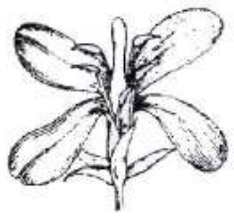


Fig. : Cruciform

○ **Caryophyllaceous** : It consists of 5 petals. The claw of petals are short and the limb of petals form right angles to the claw, e.g., Dianthus, Gypsophila.

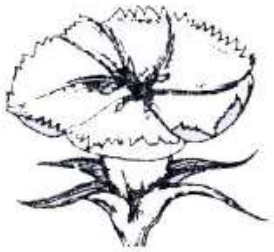


Fig. : Caryophyllaceous

- **Rosaceous** : It consists of 5 or more petals. Claws are absent in it and limbs are spread regularly outwards. e.g., Rose, Coconut.

Fig. : Rosaceous

- **Forms of Gamopetalous corolla are** :
- **Campanulate** : In this type of corolla, 5 gamopetalous petals are present. It's shape is similar to a bell. E.g., Tobacco, Raspberry, flowers of Campanula.
- **Funnel shaped** : In this, 5 gamopetalous petals are found. It's shape is similar to a funnel. E.g., Datura, Railway creeper.
- **Tubular** : In this, 5 gamopetalous petals are found which form tubular or cylindrical structure. E.g., Disc florets of sunflower which are situated in the centre.
- **Rotate** : In this, 5 gamopetalous petals are found and the fused part is formed above small tube and the petals are arranged in a whorl above the tube. E.g., Brinjal.

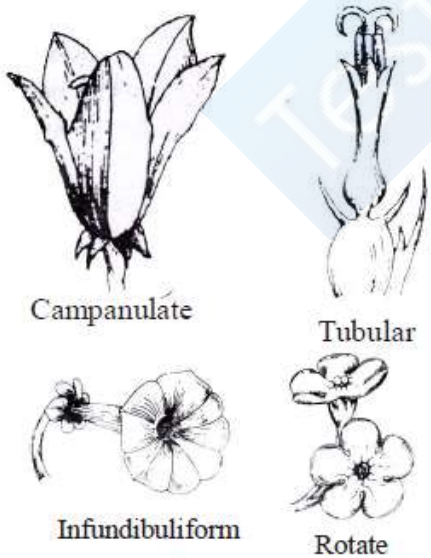


Fig. : Forms of Gamopetalous corolla

- Zygomorphic polypetalous corolla is papilionaceous. In this, five petals are found. It's posterior part is largest and is known as standard or vexillum. Vexillum covers two lateral petals which are called as wings and the innermost basal parts are united to form a keel or carina. Both lateral parts covers the keel. E.g., Pea, Gram, Arhar

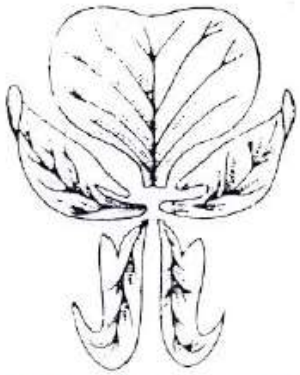


Fig. : Papilionaceous

- The mode of arrangement of sepals or petals in floral bud with respect to the other members of the same whorl is known as **aestivation**.
- Aestivation is of following 4 types :

○ **Valvate** : In this, the petal of a whorl lies adjacent to other petals and just touches it. E.g., Calotropis, Custard-apple.

○ **Twisted** : In this, one part of a petal covers adjacent petals and the other part is covered automatically by posterior petal. E.g., Cotton, Ladyfinger, China rose.

○ **Imbricate** : When both margins of the one petal are covered by the other two petals and both overlap one another at margins and rest are arranged in a twisted manner.

It is of two types :

▪ **Ascending imbricate** : The posterior petal is innermost i.e., both its margins are overlapped. E.g., Caesalpiniaceae such as Cassia, Bauhinia, Gulmohar etc.

▪ **Vexillary or Descending imbricate** : The anterior petal is innermost and posterior petal is outermost & largest. In it, standard or vexillum covers two lateral petals. These two laterals cover two anterior ones. This vexillary arrangement is present in pea family. E.g., Pea, Bean.

○ **Quincuncial** : It is a modification of imbricate type. Out of the five petals, two are completely internal, two completely external and in the remaining petal, one margin is internal and the other margin is external. E.g., Murraya.

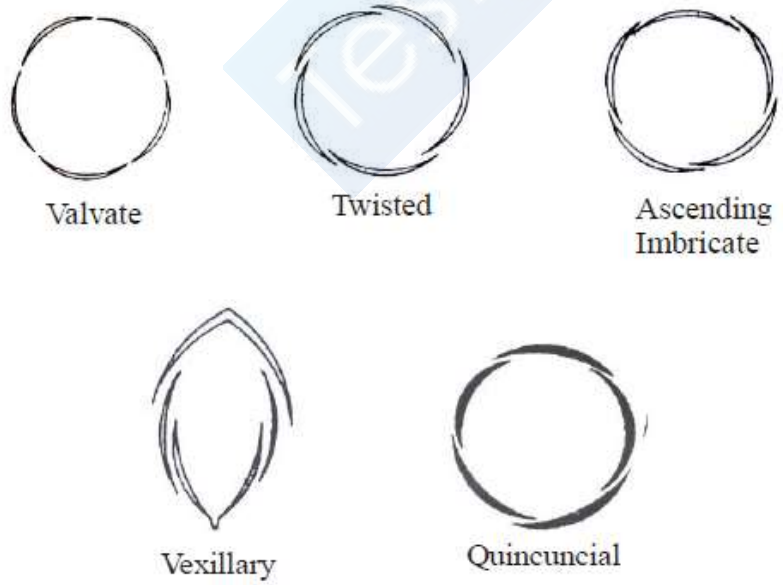


Fig. : Aestivation

ANDROECIUM

- **Androecium** is the outer essential whorl consisting of stamens.

Each stamen is distinguishable into **anther** and **filament** formed by **connective**.

- Each anther consists of two anther lobes and each lobe contains two pollen sac.
- Sterile and undeveloped stamens are called **staminodes**.
- When four stamens are present, out of them two are long and two are short, then it is called **didynamous**. E.g., Lamiaceae/Labiatae family.
- When there are six stamens and they are arranged in two whorls. In the outer whorl, there are two short stamens while in the inner whorl, there are four long stamens. This condition is called **tetradynamous**. E.g., Cruciferae family.

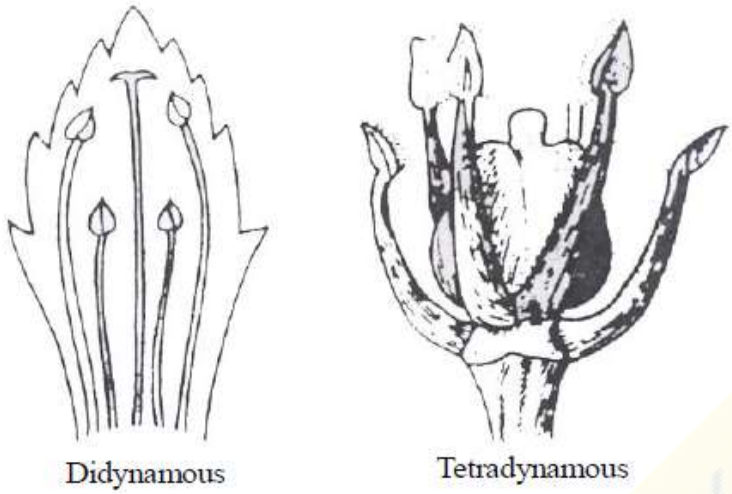


Fig. : Didynamous and Tetradynamous

- When the floral parts of similar whorl are fused, then it is called **cohesion**.
- When the stamens of an androecium are free from one another, it is called **polyandrous condition**.
- When stamens are united by their filament only, it is called **adelphi**.

It is of following types –

- **Monadelphous** : In this, all the filaments are united into a single bundle but anthers are free from each other. In this type of cohesion, a tube is formed around the gynoecium which is called staminal tube. E.g., Cotton, Hollyhock, Ladyfinger.
- **Diadelphous** : When the filaments are united in two bundles but the anther remains free. E.g., Gram, Pea, bean.

In these plants from 10 stamens, 9 stamens are arranged in a bundle while 1 remains free.

- **Polyadelphous** : When the filaments are united into more then two bundles. E.g., Castor, Citrus.

- **Synandrous** : When anthers as well as filaments of stamens are united e.g., Colocasia, Alocasia, Momordica, Cucurbitaceae family.
- **Syngenesious** : When only anthers are united in a bundle but filaments remain free, e.g., compositae family.

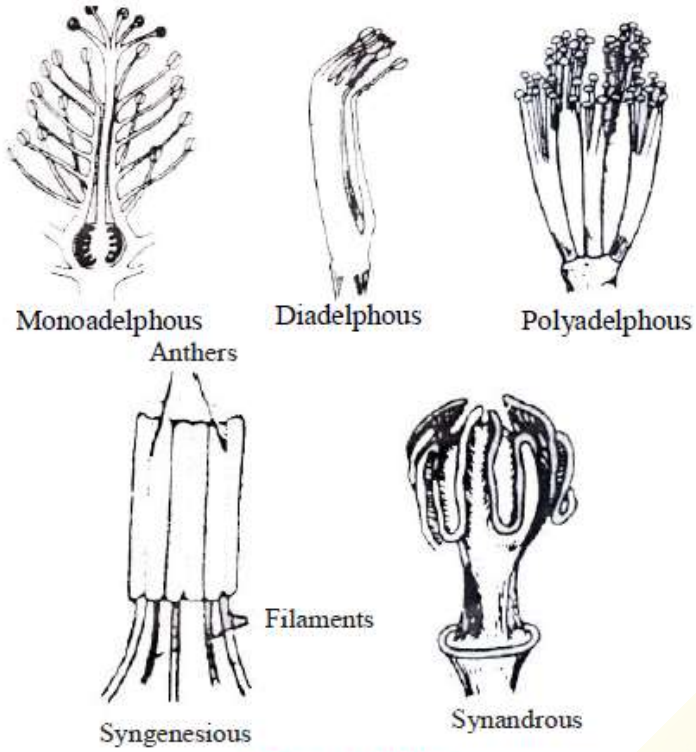


Fig.: Adelphy

- When the stamens are attached to other parts of flower, then it is called adhesion of stamens. It may be of following types –
  - **Epipetalous** : When stamens are attached to the petals. E.g., Brinjal, Datura. Tobacco, Sunflower, Potato.
  - **Epiphyllous** : When stamens are attached to tepals. E.g., Onion, Lily.
  - **Gynandrous** : When filaments of stamens are attached to gynoecium or by anthers only. E.g., Calotropis, Aristolochia.

GYNOECIUM

- Gynoecium is the female reproductive part of the flower. It constitutes the inner essential whorl of flower comprising carpels.
- Carpel consists of 3 major parts -
  - Stigma (pollen receiving region)
  - Style (connects ovary to stigma)
  - Ovary (ovule bearing region)
- If only one carpel is present in gynoecium, this condition is called **monocarpellary**.
- If more than one carpel is present in gynoecium, this condition is called **polycarpellary**.
- If all the carpels in polycarpellary/multicarpellary condition are free, then the condition is called **apocarpous**.
- If all the carpels are fused together, then the condition is called **syncarpous**.
- In syncarpous gynoecium, four types of cohesion are found:
  - When many ovaries are fused then they form syncarpous ovary. But in it, stigma and style are separated with each other, E.g., Dianthus, Plumbago
  - In carpels ovary and style are fused but stigma are not fused. E.g., Malvaceae family, Hibiscus rosa sinensis, cotton.
  - When stigma are fused but the ovary and style are free. E.g., Calotropis, Casia fistula, Nerium.

- Carpels are completely fused. This condition is found in maximum flowers. E.g., Mustard, Raphanus sativus, Lycopersicon.

- The ovules are attached on ovary walls on one or more cushion is called placenta. The manner in which placenta are arranged on ovary wall is known as **placentation**.

Placentation is of following types:

- **Marginal** :This type of placentation is found in monocarpellary gynoecium. The placenta develops along the junction of two fused margins. E.g., Pea and other leguminous plants.
- **Parietal** : This type of placentation is found in unilocular syncarpous ovary. In this, the ovule is formed by the fusion of two or more carpels by their adjacent margins and two or more placenta forms. In this type of placentation, the no. of placenta is equal to the no. of carpels. E.g., Cucurbita, Argemone, and Cruciferae family (Mustard)
- **Axile** : It is found in multicarpellary syncarpous gynoecium. The fusing margin of carpels grows inward and meet in the centre of the ovary. Thus, an axis forms in the centre of ovary, and ovary becomes multi chambered. The ovules are born on the central axis. Number of these chambers are equal to the number of carpel. E.g., Potato, China rose, Onion, Lemon, Orange, Tomato, etc
- **Free central** : This type of placentation is found in syncarpous gynoecium. In this, the ovary is unilocular and the ovules are borne on the axis in the centre of the ovary.

Placentation is axile in beginning. After sometime, walls of chamber are destroyed and only ovulated central axis left. E.g., Primrose Dianthus (Caryophyllaceae)

- **Superficial** : This type of placentation is found in a multicarpellary syncarpous gynoecium. The ovules are attached on the walls of loculi. E.g., Nymphaea (Water lily).
- **Basal** : The ovary is unilocular and a single ovule is borne at the base of ovary. E.g., Marigold, Sunflower (Asteraceae family).

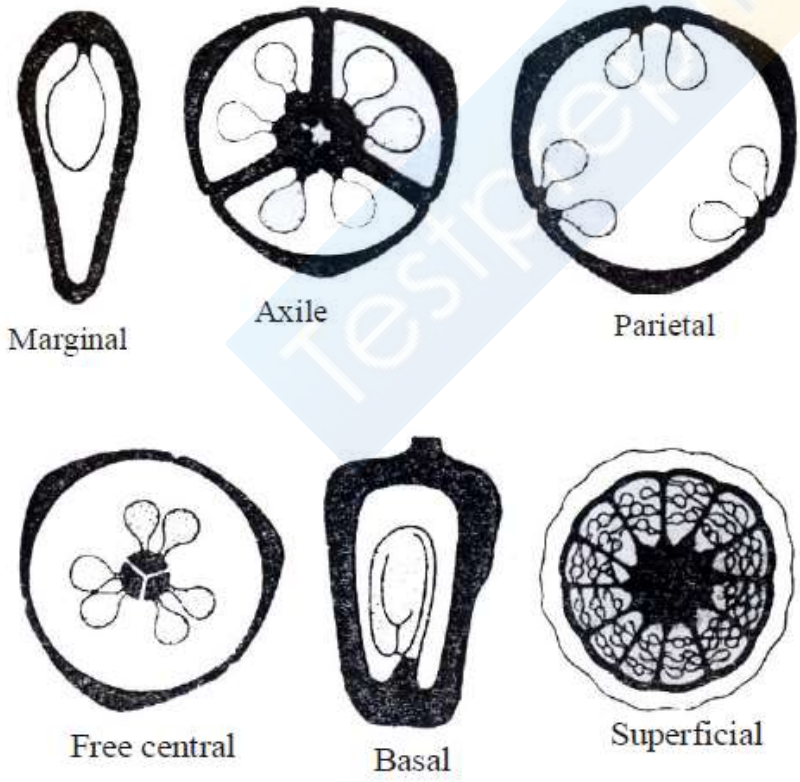


Fig.: Placentation

FRUIT

- **Fruit** is a matured ovary developed after fertilization.

- After fertilization, ovary forms fruits and ovules form the seeds.
- **Pomology** is the study of fruits.
- The seeds are protected inside fruit. But in some fruits, seeds are not found in grapes, banana and such type of fruits are called **parthenocarpic** or **seedless fruit**.
- After ripening, the ovary wall changes into **pericarp**. This pericarp may be thick and fleshy or thick and hard or thin and soft.
- Pericarp is made up of 3 layers :
  - **Epicarp** : It is the outermost layer. It is thin and is either hard or soft. It forms outermost layer of fruit which is also called rind.
  - **Mesocarp** : It is the middle layer which is thick and fleshy in mango, peach, date palm. In coconut, this layer is made up of fibres which is also called coir.
  - **Endocarp** : It forms the innermost layer. It may be thin membrane (eg. orange, date palm) or thick and hard. (eg. Mango, coconut).

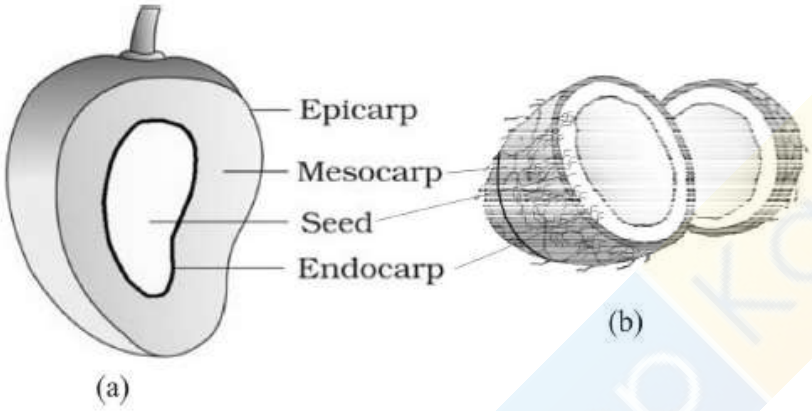


Fig. : Parts of a fruit : (a) Mango (b) Coconut

- When the fruit is developed only from the ovary, the fruit is called as true fruit. E.g., Mango, Coconut, Zizyphus.
- In some fruits, in place of ovary, some other parts of flower like thalamus, inflorescence, calyx are modified to form a part of fruit. These types of fruit are called false fruits or pseudocarp. E.g., Apple, Strawberry.

CLASSIFICATION OF FRUITS

On the basis of presence of carpels in gynoecium, (whether free or infused) or role of one or more flowers in formation, fruits are divided into : **simple**, **aggregate** and **composite**.

Simple fruit : These fruit develop from monocarpellary ovary or multicarpellary syncarpous ovary and only one fruit is formed by the gynoecium.
Simple fruits are of two types : **fleshy fruit** and **dry fruit**.

Fleshy fruit

- In fleshy fruit, fruit wall is differentiated into epicarp, mesocarp and endocarp.
- These fruits develop from superior or inferior syncarpous gynoecium. These may be unilocular or multilocular.
- These fruits are indehiscent. Dispersal of fruit occurs after pericarp is destroyed.
- Drupe is a fleshy fruit

Drupe fruit : These fruit develop from mono or multicarpellary, syncarpous, superior ovary. In these fruits, endocarp is hard and stony, so these fruits are also called stony fruits. E.g., Mango, coconut, almond, peach, walnut, plum. In mango, the outermost cover or rind is called epicarp. Edible fleshy part is mesocarp and the part where seed is protected is called as endocarp. In ber, epicarp and mesocarp both are edible part while endocarp is drupe.

The rind of Almond and walnut are endocarp and their edible part is seed. In coconut, epicarp is hard and thin while mesocarp is thick and consists of hard fibres. The endocarp is hard and seed is protected in it. The sweet water and edible part of coconut are liquid and solid endosperm.

Table : Edible parts of some important fruits

S.No	Scientific/common Name	Type of fruit	Edible part
1.	*Abelmoschus esculentus*/*Lady's* Finger /Okra/Bhindi	Capsule	Whole fruit (vegetable)
2.	*Achrus sapota*/Sapodilla/Cheeku	Berry	Mesocarp and endocarp
3.	*Aegle marmelos*/Wood Apple/Bel	Amphisarca	Pulpy endocarp (inner pericarp) and placentae.
4.	*Anacardium occidentale*/Cashewnut/Kaju	Nut	Cotyledons and Peduncle
5.	*Ananas comosus*/pineapple	Sorosis	Outer fleshy axis, bracts fused to form perianth, pericarp
6.	*Annona squamosa*/Custard Apple/Sitaphal	Etaerio of Berries	Mesocarp (Pericarp)
7.	*Arachis hypogaea*/Groundnut/Peanut	Lomentum	Seeds/Cotyledons
8.	*Areca catechu*/Betel or Areca Nut	Berry	Seed/ Endosperm
9.	*Artocarpus integrifolia*/Jack Fruit	Sorosis	Bracts, perianth and seeds (as vegetable and fruits)
10.	*Carica papaya*/Papaya/Papita	Berry	Mesocarp and Endocarp
11.	Cereals, *Avena sterilis* (Oat), *Oryza sativa* (Rice,)*Hordeum vulgare* (Barley), *Triticum durum* (Durum Wheat), *Triticum aestivum* (Bread Wheat), *Zea mays* (Maize)	Caryopsis	Whole fruit (Endosperm and embryo)
12.	*Citrus reticulata*/Orange, *Citrus sinensis* /Sweet Orange, *Citrus aurantifolia*/Lime	Hesperidium	Glandular hair
13.	*Cocos nucifera*/Cocunut	Drupe	Endosperm
14.	*Cucumis melo*/Musk Melon	Pepo	Mesocarp, endocarp & seeds
15.	*Cucumis vulgaris*/Water melon	Pepo	Mesocarp, endocarp & seeds
16.	*Cucumis sativus*/Cucumber	Pepo	Mesocarp, endocarp and young seed

17.	*Ficus carical Fig*/ Anjeer	Syconus	Fleshy receptacle
18.	*Fragaria vesca*/Strawberry	Etaerio of achenes	Fleshy thalamus
19.	*Grewia asiatica*/Dhamin/Phalsa	Drupe	Mesocarp
20.	*Juglans regia*/Walnut	Drupe	Lobed cotyledons
21.	*Litchi chinensis*/Litchi	Nut	Aril
22.	*Lycopersicon esculentum*/Tomato	Berry	Pericarp and placenta
23.	*Pyrus malus* (M. sylvestris)/Apple	Pome	Thalamus
24.	*Mangifera indica*/Mango	Drupe	Mesocarp
25.	*Morus alba*, M. nigra/Mulberry	Sorosis	Fleshy perianth, Fleshy axis
26.	*Phoenix dactylifera*/Date	Berry	Pericarp
27.	*Prunus amygdalus*/Almond	Drupe	Seed (cotyledons and embryo)
28.	*Musa paradisiaca*/Banana	Berry	Less developed mesocarp and well developed endocarp
29.	*Psidium guajava*/Guava	Berry	Thalamus, pericarp and placenta
30.	Pulses	Pod	Seed
31.	*Punica granatum*, Pomegranate/Anar	Balausta	Testa
32.	*Pyrus communis*/Pear	Pome	Fleshy thalamus
33.	*Solanum melongena*/Brinjal	Berry	Pericarp & Placenta
34.	*Tamarindus indica*/Tamarind	Lomentum	Pericarp (Mesocarp)
35.	*Trapa bispinosa*/Water Chestnut/Singhara	Nut	Seed
36.	*Vitis vinifera*/Grape	Berry	Pericarp and placenta
37.	*Zizyphus mauritiana*/Z.jujuba/Jujube	Drupe	Epicarp and mesocarp

SEED

- Seed is a fertilized or ripened ovule.
- Seed is characteristic of gymnosperms and angiosperms.
- Seed is a dormant structure containing protective coverings (**seed coats**), **reserve food** and **embryo** (2n).
- Seed coat develops from integuments of ovule. The outer seed coat is called testa while the inner one is called **tegmen**. Seed coat is membranous, generally fused with fruit wall.
- The seed is attached to the fruit wall or pericarp by means of stalk called **funicle**. The point of attachment of the funicle to the body of mature seed is called **hilum**.
- The surface of seed possess a fine pore at one end called micropyle. The micropyle permits the entry of water needed at the time of germination.

Seeds are of two types -

- **Albuminous (endospermic) seeds** : In these seeds, food is stored in the endosperm. E.g., corn, wheat, onion etc.
- **Exalbuminous (non-endospermic) seeds** : They usually store reserve food material in cotyledons. In these seeds, the endosperm is used up and not present in mature seeds. E.g., bean, gram and pea.

STRUCTURE OF DICOTYLEDONOUS SEEDS

- A dicotyledonous seed contains seed coats, two cotyledons and an embryonal axis.
- The embryonal axis is attached to the cotyledons for absorbing nutrition from them.
- The embryonal axis consists of two ends - radicle and plumule.
- Radicle gives rise to root system and plumule gives rise to shoot system.

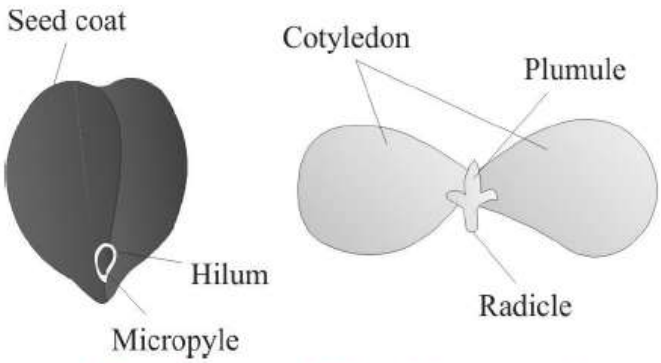


Fig. : Structure of dicotyledonous seed

- The portion of the embryonal axis between the radicle and the point of attachment of the cotyledons is called **hypocotyl** whereas the portion between the plumule and cotyledons is called **epicotyl**.
- Most of the dicotyledonous seeds are exalbuminous. A few dicotyledons like castor, bean have albuminous seeds. Their cotyledons are thin and papery.

STRUCTURE OF MONOCOTYLEDONOUS SEEDS

- Monocotyledonous seeds are endospermic but some (as orchids) are non-endospermic.
- Maize grain shows structure of a typical monocotyledonous seed. In maize grain, the seed coat is fused with the pericarp.
- Major part of the grain is occupied by a large endosperm which is rich in starch
- The endosperm has one to three layered peripheral protein layer (called aleurone layer) which separates the embryo from endosperm.

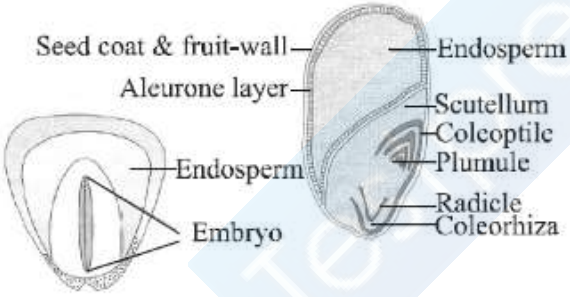


Fig. : Structure of a monocotylendous seed

- The embryo consists of a cotyledon and an embryonal axis.
- The cotyledon is also called **scutellum** in cereals.
- The lower end of the axis is called the radicle which has a protective sheath termed **coleorhiza**. The upper part of the axis is called the **plumule** which is covered by coleoptile.

DISPERSAL OF FRUITS, AND SEEDS

- Most of the plants do not move from one place to another. They grow, produce flowers and fruits while remaining fixed at one and the same place. The seeds falling directly under the mother plant have to germinate and develop under limited food supply and space. To overcome this problem, the fruits and seeds have developed several special devices for wide dispersal.
- Dispersal is essential to avoid struggle for existence for colonization of new areas and production of mixed population.
- The natural agents like wind, water and animals and even mechanism of dehiscence in some fruits, help the seeds and fruits to disperse from one place to another, and to long distances from the parent plant.

WIND

- In the species, where the seeds are light in weight or have some accessory part to help dissemination, are dispersed by the air current (called anemochory).
- The seeds of drumstick and Cinchona and (fruits of yam, maple) aridisol tree, are provided with one or more appendages in the form of thin, flat and membranous wings, which help them to float in the air and be carried away to long distances.
- In the members of Asteraceae, the calyx is modified into hair like structures called pappus. They persist in fruit and open out like umbrella, helping the seeds to float in the air.
- In poppy and prickly poppy (Argemone), the fruit dehisces and seeds are thrown out to distances away from the parent plant. The seeds of Calotropis, Alstonia and cotton are provided with hair and cover sufficient distances along with the wind.
- The seeds of orchids and some grasses are very small and light in weight and may be easily carried away by the wind to far off places.

WATER

- Hydrochory is the mode of dispersal of fruits and seeds by water.
- The fruits and seeds with specialised devices which may be in the form of spongy and fibrous outer walls as in coconut and spongy thalamus as in lotus, and small seeds with airy aril as in water lily, float very easily in water, and are carried away to long distances with the water current.

ANIMALS

- The fruits and seeds with hooks, spines, bristles, stiff hair, etc., get attached to the body of hairy and woolly animals and are carried away by them to distant places.
- For instance, fruits of Xanthium and Urena bear curved hooks, spear grass has a bunch of stiff hair, Tribulus has sharp and rigid spines, Boerhaavia has sticky hair which help in dispersal by animals.
- The edible fruits like guava, grapes, figs and plums are dispersed by birds and even human beings, either by feeding on them and passing out undigested seeds with faeces or by carrying them to other places for later feeding.

SEMI-TECHNICAL DESCRIPTION OF A TYPICAL FLOWERING PLANT

The symbols used for Angiosperms for floral formula :

- Bracteate = Br
- Ebracteate = Ebr
- Actinomorphic = ♁
- Zygomorphic = % or ⊕
- Bisexual = ⚥
- Unisexual male (staminate) = ♂
- Unisexual female (Pistillate) = ♀
- Epicalyx = Epi
- Calyx = K or if joined = $K_{( )}$
- Corolla = C or if joined = $C_{( )}$
- Perianth = P or if joined = $P_{( )}$
- Androecium = A or if joined = $A_{( )}$
- Gynoecium = G or if joined = $G_{( )}$
- Superior ovary = Hypogynous flower = $\underline{G}$

- Inferior ovary = Epigynous flower = $\overline{G}$
- Ovary half inferior or half superior = Perigynous flower = $G-$

Adhesion

- Epiphyllous = $\overset{\frown}{P\ A}$
- Epipetalous = $\overset{\frown}{C\ A}$

FAMILY - SOLANACEAE

SYSTEMATIC POSITION

Class - Dicotyledonae
Subclass - Gamopetalae
Series - Bicarpellatae
Order - Polemoniales
Family - Solanaceae

- Many ovules are present in the ovary so many seeds are formed as in tomato, brinjal etc.
- Most plants of this family are herbs. Some of them are shrubs, rarely trees.
- The tap root system is present in these plants.
- Leaves are simple and ex-stipulate. Bicollateral vascular bundles are present in stem

INFLORESCENCE

Solitary, axillary or cymose inflorescence.

FLOWER

Flowers are bracteate or ebracteate, bisexual, complete, hypogynous, pentamerous and actinomorphic but in few of them is zygomorphic such as in Henbane, Hyoscyamus and Salpiglossis, Schizanthus.

CALYX

- Sepals -5, gamosepalous, valvate aestivation and persistent. (Accrescent)
- The sepals in some of the plants changed into membranous balloon like structures which help in dispersal of fruits. E.g., Physalis (Rasbhari).
- The sepal grows with the growth of the fruit and becomes thickened and elongated. They are known as accrescent such as in Brinjal.
- The odd sepal in solanaceae is posterior.

COROLLA

- Petals -5, gamopetalous, aestivation - valvate or imbricate with various shapes of corolla.

ANDROECIUM

- Stamens -5, polyandrous means no cohesion, epipetalous means adhesion, introrse, filaments basifixed and anthers dithecous.
- The dehiscence of anther is longitudinal but in Solanum, dehiscence occurs through the apical pores.

- Exceptions: 4 -stamens are present in Salpiglossis in which two are elongated means didynamous in condition. 2 stamens are present in Schizanthus.

GYNOECIUM

- Bicarpellary, syncarpous, bilocular and axile placentation, superior ovary.
- Special features : Swollen placenta is present. Ovaries arranged obliquely on thalamus carpels move at ∠45° in clockwise direction. Posterior carpal turns on right side and anterior carpal turns on left side.
- Multilocular ovary is formed in tomatoes and Datura due to formation of false septum.
- Unilocular is present in Henoonia.
- The ovary is bilocular at the base and unilocular on the upper side in Capsicum (chilli).

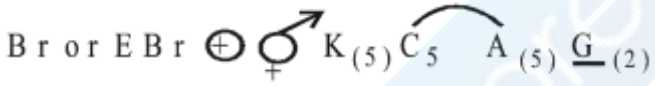
FRUIT

- Fleshy fruits - berry sometimes capsule which is simple fleshy and indehiscent such as tomato, brinjal, chilli, Physalis etc.
- The seeds are released by the degeneration of pericarp.
- All the parts of the fruit are edible.
- The fruit of the Datura is septifragal capsule in which dehiscence takes place through the septa.

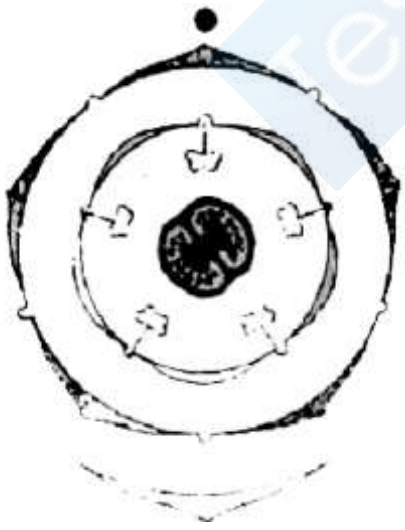
SEED

Endospermic

FLORAL FORMULA



FLORAL DIAGRAM



ECONOMIC IMPORTANCE

FOOD

- Potato (Solanum tuberosum) - Edible part = underground stem- tuber
- Tomato (Lycopersicon esculentum/Solanum lycoperscium)

- Brinjal (Egg plant) = Solanum melongena
- Makoi = Solanum nigrum
- Chilli = Capsicum annuum
- Shimla mirch = Capsicum frutescens
- Rasbhari (Gooseberry) = Physalis peruviana (fruit are eaten)
- Physalis ixocarpa
- Cyphomandra betacea [tree tomato]

MEDICINES

- Atropa belladonna (Deadly nightshade) -The roots are used in the manufacture of belladonna. Atropine alkaloids is obtained from the roots. It is used to dilate the pupil of the eye.
- Stramonium is obtained from the seeds of Datura (Thorn apple) in which Scopolamine alkaloid is present. It is a pain reliever and sedative.
- Henbane medicine (containing hyoscyamine alkaloid) obtained from the leaves of Hyoscyamus niger. It is used in the treatment of asthma and whooping cough.
- Nicotine & anabasin alkaloid are obtained from the leaves of Nicotiana tabacum (Tobacco) & N. rustica. It is a nerve stimulant and are also used as an insecticide.
- Solanum xanthocarpum (Nelee Kanteli) – Its juice is used in rheumatism and cough.
- Withania somnifera (Asvagandh/Ashwagandha) - Its roots are used as a nerve tonic and leaves are used in fever.
- Solanum nigrum (Makoi) - The fruits are laxative.

ORNAMENTAL PLANTS

Many plants of the family are cultivated for their beautiful flowers and fragrance as follows :

- Petunia alba and Petunia hybrida.
- Cestrum nocturnum
- Cestrum diurnum
- Schizanthus
- Brunfelsia hopeana
- Salpiglossis sinuata
- Solanum dulcamara
- Solanum grandiflorum
- Nicandra physalodes

LEGUMINOSAE OR FABACEAE

SYSTEMATIC POSITION

Class - Dicotyledonae
Sub class - Polypetalae
Series - Calyciflorae (Flower perigynous or Epigynous)
Order - Rosales - Gynoecium - monocarpellary or polycarpellary and carpels are free. (Apocarpous)
Family - Leguminosae (Fabaceae)

Main characteristics

Flower - Perigynous G- /Hypogynous G
Gynoecium - Monocarpellary
Ovary - Unilocular
Placentation - Marginal

The ovary is superior and long in which two sutures are present - ventral suture and dorsal suture. The ovules are present in one row on the ventral suture.
Dis-similarties are found in the remaining characters. On the basis of these dissimilarities (inflorescence and floral characters), Leguminosae family is divided into 3 subfamilies –

1. **Papilionatae**
2. **Caesalpinioideae**
3. **Mimosoideae**

I. SUB - FAMILY – PAPILIONATAE / LOTOIDEAE

Sleeping movements commonly occur in this family.

ROOTS

Roots are branched and tap root system is present. Root nodules are present in which N_2-fixing bacterium, Rhizobium leguminosarum is present.

LEAVES

Stipulate, unipinnate, imparipinnate means lamina is divided into many leaflets and leaflets are in odd number.
Many modifications are found in leaves as follows –

- Some of the leaflets of compound leaves of Pea are modified into tendrils for climbing.
- All the leaflets of Lathyrus odoratus are transformed into tendrils.
- The stipules of leaves in both Pea and Lathyrus odoratus become foliaceous (which help in photosynthesis).

Inflorescence : Typical raceme or sometimes solitary axillary as Lathyrus aphaca.

GENERAL FEATURES OF FLOWER

Bracteate, bisexual, Perigynous/hypogynous, pentamerous and zygomorphic symmetry. The zygomorphic symmetry is due to presence of different (odd) petals (dissimilar petals & androecium).

CALYX
Sepals 5, gamosepalous, aestivation valvate or imbricate and anterior sepals is odd.

COROLLA
Petals 5, papilionaceous (main feature) polypetalous, one petal is odd out of 5-petals, towards the mother axis (posterior in position). It is the largest and outermost petal which is called standard or vexillum.
Below the vexillum, two small free petals present are known as wing or alae (lateral in position)
The innermost two petals are fused together to form a boat like structure called keel or carina which encloses the essential organs.
Therefore, such type of aestivation is called vexillary or descending imbricate.
Exception : Petals are absent in Lespedeza.

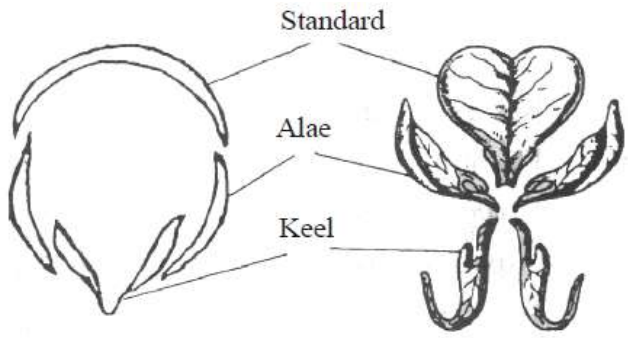


Fig. : Corolla

ANDROECIUM

This is the second main diagnostic character for the subfamilies of Leguminosae.
Stamens - 10; diadelphous - 1 + (9) ;
9 stamens fused together to form a sheath around the pistil while the tenth (posterior one) is free
Exception : 10 - stamens are free in Sophora.
10 stamens are monoadelphous in Pongamia, Crotalaria, Lupinus cymopsis (10).
The posterior stamen is absent in Arachis, Dalbergia and Abrus. 9 stamens are present in them in monoadelphous condition (9).

GYNOECIUM

Gynoecium is monocarpellary, unilocular, half inferior/ superior with marginal placentation.

FRUIT

Legume or pod, dry, dehiscent, one chambered fruit. It has two sutures and opens along both (dorsal and ventral) sutures.
Sometimes, lomentum is also found as in Arachis (mungphali)

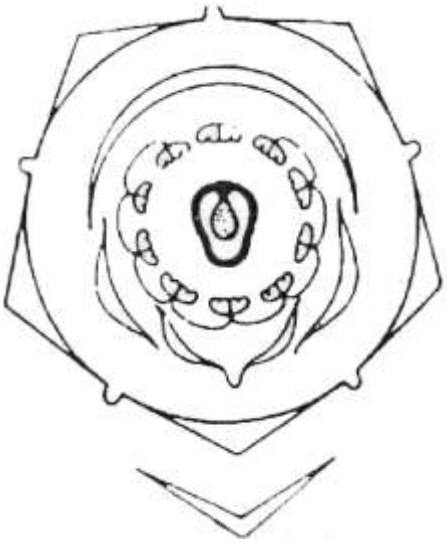
SEED

Non-endospermic.

FLORAL FORMULA

Br $K_{(5)}\ C_{1+2+(2)}\ A_{1+(9)}\ G_1$

FLORAL DIAGRAM



ECONOMIC IMPORTANCE

FOOD PLANT

- Arhar (Pigeon pea)= Cajanus cajan (lndicus)
- Chana (Gram) = Cicer arietinum
- Mattar (Pea) = Pisum sativum
- Urad (Black gram) = Phaseolus mungo or Vigna mungo
- Mung (green gram) = Phaseolus radiatus (esculentus) or Vigna radiatus
- Masoor = Lens esculenta or L. culinaris or Ervum lens
- French bean or Kidney bean (Rajma) = Vigna/Phaseolus vulgaris
- Soyabean = Glycine max (G. soja)
- Gwar (cluster bean) = Cymopsis tetragonoloba
- Methi = Trigonella foenum graecum
- Mungphali (Ground nut) = Arachis hypogea.
- Sem = Dolichos lablab
- Horse gram = Dolichos bifolras
- Agast tree = Sesbania grandiflora. Its flowers are edible
- Kasoori Methi = Medicago flacata
- Mothh = Phaseolus aconitifolia or vigna aconitifolia
- Cowpea (chowla) = Vigna sinensis
- Asparagus bean = Vigna catiang
- Khaseri dal = Lathyrus sativus (The lathyrism disease is produced by the use of this dal.)
- Lima bean (Lobia) = Phaseolus lunatus

FODDER

- Alfalfa = Medicago sativa
- Van Methi (Sweet clover) = Melilotus indicus
- Sejni (Indian clover) = Meliotus alba
- Berseem = Trifoloium alexandrium
- Bankla = Vicia faba

FIBERS

- Sunnhemp = Crotalaria juncia - bast fibres
- Dhanicha = Sesbania cannabinus - Hard fibres
- Ratthi = Arbus precatorius - Hard fibres
- Ougenia delbegiodes
- Erythrina suberosa

TIMBER

- Shisham = Dalbergia sissoo [Indian Red wood]
- Kala shisham = Dalbergia latifolia
- African black wood = Dalbergia melanoxylon
- Red sandalwood = Pterocarpus santalinus
- Indian kino tree = Pterocarpus marsupium
- Hard sola = Aeschynomeni aspara

DYES

- Red colour is obtained from red sandal = Pterocarpus santalinus
- Neel (Blue dye) = Indigofera tinctoria (dye is obtained from leaves).
- Fire of forest = Butea monosperma - orange, yellow dye is obtained from the flower.
- Crotalaria striata = Black dye
- Psoralia plicata = Yellow dye

MEDICAL PLANTS

- Muliathi (Liquoric) = Glycyrrhiza glabra - Its roots are used in coughs and cold.
- Krameria triandra - The medicine is used for diarrhoea.
- Inacna prurita (rainch) - Antithelminitc.
- Pongamia pinnata - Oil of seed is used for rheumatism.

ORNAMENTAL

- Butterfly pea = Clitoria ternatea
- Sword bean = Cannavalia gladiata
- Indian Coral tree = Erythrina indica
- Indian telegraph plant = Desmodium gyrans
- Glory pea = Clianthus
- Phool matar (Sweet pea) = Lathyrus odoratus
- Japanese pagoda tree Sophora japonica
- Lupinus albus
- Pongamia pinnata

INSECTICIDES

- Deris elliptica = Rotenone insecticide - rotenone is obtained.

GUM

- Bengal kino - It is obtained from the butea (dhak)
- Balsam of perue = Myroxylon balsemum
- Gwar gum = Edible gum is obtained from the Gwar.

OTHER USES

- Arbus precatorius = Crab's eye = Ratti = Jeweller's weight- Jewellers use it's seeds as weight.
- Aeschynomeni indica - Omfosm pith plant - Its wood is spongy, toys are made from this.
- Dalbergia latifolia - (Indian Rose wood) - Its bark is used in tanning.
- Aeschynomeni aspara = Indian cork plant - It is used as cork.
- Silk worm lives on the stem of Butea.
- Alhagi pseudoalhagi = Camel's fodder. From twigs screens (chiks) are manufactured.

II. SUB-FAMILY - CAESALPINOIDEAE

ROOT

Tap root system.

LEAVES

Usually compound, unipinnate, paripinnate. But, bipinnate in Delonix.
Phyllode is found in Parkinsonia – means lamina falls and petiole is transformed into a leaf like structure.
Such type of modification is meant for reducing of transpiration.
Inflorescence : Panicle or raceme of racemes or compound raceme. “Raceme of racemes.”

GENERAL CHARACTER OF FLOWER

Bracteate, bisexual, perigynous/hypogynous, pentamerous and zygomorphic symmetry of the flower is due to the presence of sterile stamens.

CALYX
Sepals 5, polysepalous, imbricate aestivation, odd sepal is anterior one.

COROLLA
Petals 5, polypetalous, ascending imbricate aestivation (posterior petal is the innermost.)
Exception : Petals are absent in Ashok (Saraca), only 3 - petals are present in Imli (Tamaritidus)

ANDROECIUM
Stamens 10, free, arranged in two whorls/(Circles) 5 + 5, some of them are sterile called staminodes.
Most of the genera have 3 staminodes.
7 Stamens are present in Tamarindus, monadelphous, out of them 4 are staminodes.
5 - 8 normal stamens are present in Saraca (Ashok)
5-normal stamens are found in Bauhinia variegata (Kachnar)

GYNOECIUM
Monocarpellary, ovary half inferior/superior, unilocular, style long, stigma is simple and marginal placentation.

FRUIT

Legume or pod is present. Lomentum is present in Tamarindus.

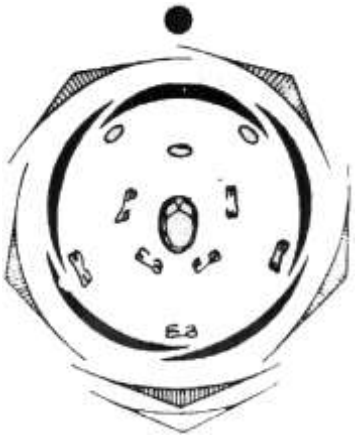
SEED

Non-endospermic or endospermic

FLORAL FORMULA

Br K_5 C_5 A_{5+5} or A_{7+3} (Staminodes) G_1

FLORAL DIAGRAM



ECONOMIC IMPORTANCE

FOOD

- Imli = Tamarindus indica
- Kachnar = Bauhinia variegata
- Rawal = Bauhinia purpurea
- Ceratonia siliqua = Seeds are rich in protein

ORNAMENTAL

- Amaltas = Cassia fistula
- Gulmohar = Delonix regia
- Nagput (Snake climber) = Bauhinia anguinia
- Ashok = Saraca indica
- Peacock flower = Caesalpinia pulcherima
- Kachnar = Bauhinia varigata
- Vilayati kikar (Jeruselam Thorn) = Parkinsonia aculeata
- Amberstia nobilis

TIMBER

- Log wood = Heamatoxylon campachianum - It yields a dye, haematoxylin.
- Purple heart wood = Copaifera pubiflora
- West Indian locust wood = Hymaenia carbaryl
- Hardest and heaviest wood = Hardwickia binata

- Used in agricultural implements = Kingodendron pinnatum

MEDICINES

- The raw fruits of amaltas (Cassia fistula) are used as a laxative.
- Ashokarist is obtained from the bark of ashoka tree (ayurvedic medicine).
- The leaves and seeds of Cassia occidentalis and Cassia obtusifolia are used in skin diseases.
- The bark and leaves of Cassia glauca are used in diabetes and gonorrhoea.
- A tonic is prepared from the bark of Bauhinia variegata.

OTHER USES

- Phanera vahlii - It yields a commercial gum and bark fibres are used for making ropes and baskets.
- Caesalpinia sappan - 'Gulal' is obtained from its heart wood.
- Bauhinia purpurea and Ceratonia siliqua are used as fodder.
- The oil of Kingiodendron pinnatum is used for making soaps and paints.

III. SUB-FAMILY - MIMOSOIDEAE

ROOT

Tap root system and branched.

LEAVES

Usually bipinnate. The stipule is modified into thorn as in Acacia. Phyllode is found in Australian Acacia. Most of the plants are xerophytes.

INFLORESCENCE

Two types of inflorescences are found in Mimosoideae family –

- **Capitate or cymose capitulum** : The apical region of floral axis, becomes suppressed and swells up and bears sessile flowers, e.g., Acacia.
- **Spike** : This is a type of raceme inflorescence, but in which flowers are sessile.

GENERAL FLORAL CHARACTER

Bracteate, bisexual, actinomorphic symmetry, perigynous/hypogynous, tetramerous or pentamerous.

CALYX
Sepals 4 or 5 , gamosepalous, valvate aestivation.

COROLLA
Petals 4 or 5, polypetalous or gamopetalous, valvate aestivation.

ANDROECIUM
Many stamens, free, polyandrous.
Monadelphous stamens are present in Albizia.
4 stamens which are free - found in Mimosa.
In Prosopis, 10 stamens are free

GYNOECIUM
Monocarpellary, unilocular, half inferior/superior, marginal placentation.

FRUIT

Lomentum which is a type of schizocarpic fruit, pericarp contract in between the seeds. It is divided into single seeded pieces during dehiscence. Each piece is known as mericarp. Single piece or unit is indehiscent.

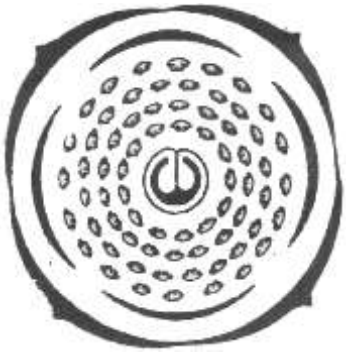
SEED

Non endospermic

FLORAL FORMULA

Br ♂ $K_{(4-5)}\ C_{4-5}\ A_{\infty}\ G_1$

FLORAL DIAGRAM



ECONOMIC IMPORTANCE

TIMBER AND FUEL

- Acacia arabica = Desi Babool. (Black wood)
- Prosopis juliflora = Australian babool.
- Xylia dolbhihiformis = Iron wood (Jamboo)
- Prosopis cineraria -Khejari (state tree of Rajasthan)
- Albizzia lebbek = Siris
- Acacia sundra = Heaviest wood in India
- Acacia julibrissin = Mimosa tree

FOOD & FODDER

- Pithecolobium dulce - Jungle Jalebi (Aril)
- Albizzia lebbek- Siris-Pods are edible and used as fodder.
- Neptunia oleracea = Lajalu – Fruits are edible.
- Parkia roxburghii = Khurail
- Entada phaseliodes

ORNAMENTAL

- Mimosa pudica = Sensitive plant – Touch me not.
- Neptunia oleracea = Lajwanti "Kiss me quick"
- Pithecolobium dulce - Hedge plant
- Leucaena leucophloea

OTHER USES

- Adanathera pavonia = Seed – "Goldsmith's weight"
- Acacia farnesiana - Cassie perfume is obtained from the flowers.
- Acacia catechu = Kathha is obtained from its heart wood
- Acacia concinna = Shikakai - Its pods are used for head bath.
- Prosopis spicigera - It is grown in Rajasthan as wind breaker.
- Many species of Acacia yield gum.
- Albizzia (Siris) produces a special type of gum called "Sresh".
- The pods of shikakai are also used as insecticides.
- Gum arabic is obtained from Acacia senegal.

FAMILY - LILIACEAE

SYSTEMATIC POSITION

Class - Monocotyledonae
Series - Coronarieae
Family - Liliaceae

- Perianth is present in this family. It means there is no difference in between calyx and corolla. If perianth is green in colour then it is called sepaloid as in onion.
- If perianth is coloured other than green then it is known as petaloid as in Lily.

HABIT

- Mostly herbs, some climbers.
- Sometimes abnormal secondary growth is found in trees such as - Dracaena, Yucca.

ROOT

Usually adventitious/fibrous. Fasciculated root is found in Asparagus (satawar). The base of roots swell. These are the modifications of adventitious roots.

STEM

The aerial stem is present in few plants.
Majority of the plants have underground stem. It is of two types – bulbs and corm.

- **Bulbs** : Their stem is small, dry and disc like (reduced) which possess tunicated leaves. The underground portion of the leaves store food material and becomes fleshy E.g., Onion, Garlic.
- **Corm** : Such type of stem grows vertically in the soil. [If it grows horizontally then it is said to be rhizome (Aloe).] E.g., Colchicum.

Modification of aerial stem

- Phylloclade - In Ruscus
- Cladode - In Asparagus

LEAVES

- Some of the plants bear cauline leaves (present on aerial stem.)
- Radical leaves are present in few plants such as in Asphodelus.
- The leaves of monocotyledons are sessile with sheathing leaf bases i.e. clasping round the stem.
- **Venation** : Parallel venation. Reticulate venation is found in Smilax, Paris. The stipule of Smilax and leaf tip of Gloriosa are modified into tendrils.

INFLORESCENCE

- Compound raceme, e.g., Yucca and Dracaena.
- **Scorpioid cyme** : e.g., Haemorocallis.
- **Spadix** : e.g., Aloe
- **Cymose umbel** : E.g., Onion and Garlic

GENERAL CHARACTERS OF FLOWER

- Bracteate, bisexual, complete, actinomorphic symmetry. Hypogynous and trimerous, epiphyllous and in some plants may be epipetalous
- The flowers in Ruscus and Smilax are unisexual and incomplete.
- Zygomorphic flower is present in Lilium.
- Aspidistra, Paris and Mianthimum contain tetramerous flowers.

PERIANTH

- Tepals 6 (perianth), polyphyllous, arranged in two whorls 3 + 3, Valvate or imbricate aestivation, tepal of outer whorl - anterior.
- May be polytepalous & gamotepalous.
- Eight (8) tepals are present in Paris and Mianthimum and arranged in two whorls 4 + 4.

ANDROECIUM

- 6 stamens, arranged in two whorls 3 + 3, free, polyandrous, basifixed or versatile and introrse.
- Only 3 stamens are present in Ruscus in the innermost whorl.
- Eight stamens are found in Paris arranged in two whorls 4 + 4.

GYNOECIUM

Tricarpellary, syncarpous, trilocular, stigma trifid, axile placentation, superior ovary.

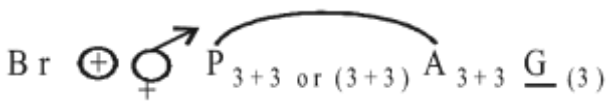
FRUIT

Some have berry as in Lily and normally it is capsule as in onion.

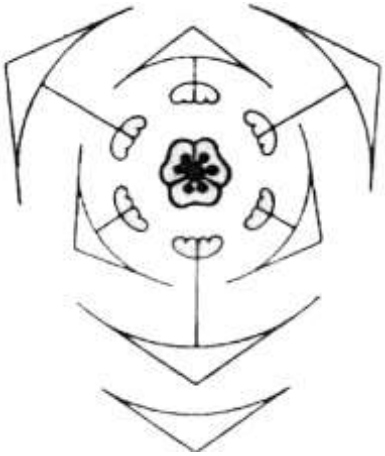
SEED

Endospermic

FLORAL FORMULA



FLORAL DIAGRAM



ECONOMIC IMPORTANCE

FOOD

- Onion (Allium cepa) - Foul odour is due to an oil like organic compound of sulphur - allyl sulphide formed in fleshy leaves of bulb.
- Garlic (A. sativum) - Anti-diabetic property is due to sulphur containing S-allyl-cysteine sulphoxide (SACS) in fleshy leaves of bulb.
- Satawar (Asparagus) - Fasciculated roots
- Leprogeria rosea - Fruits are eaten as vegetables
- Allium schoenoprasum

ORNAMENTAL PLANTS

- Lily – Lilium bulbiferum
- Tulip – The flowers are attractive due to infection of virus.
- Convalaria majlis – Lily of the valley
- Sendiviera trifasiata – "Mother in Law's tongue"
- Ruscus aculeatus – "Butcher's boom"
- Frittilaria tenella ; F. Melagris – Snake's head
- Agapanthus americanus – African lily

MEDICINAL USES

- Sarasaprilla (Smilax zeylamicum) - Its seeds are used in urinary troubles.
- Sudarshan (Crinum asiaticum) – The juice of leaves is used in rheumatism and ear pain.
- Gvar patha (Aloe vera) - The juice of the leaves is used as a skin tonic and increases the eye sight.
- Asphodelus tennuifolious - Its seeds are used in peptic ulcer.
- Urginea (wild onion) and Scilla- A rat killer medicine is prepared from their bulb.
- Lahasun (Allium sativum) - It is very useful in heart disease, rheumatism & diabetes.
- Glorioso superba - It is used in leprosy and piles, it is also very useful in biting of snake or scorpion.

OTHER USES

- Dragon plant (Dracaena draco) - Red colour resin is obtained from the stem, that's why it is known as "Dragon's blood".
- Dragger plant (Yucca aloifolia, Y. filamentosa) -Fibres are obtained from the stem.
- Colchicum autumnale - Colchicine is obtained this plant which is used to induce polyploidy in plants. C. luteum = Corm is laxative.
- Iphigenia indica - Red colour is obtained from the flowers.
- Phormium tenax - It is used for preparing oil paints and varnishes.
- Sansevieria roxburghiana = "Indian Bowstring hemp" and Sansevieria trifasciata = "African Bowstring hemp" - Fibres are obtained which are used for making ropes and nets.
- Veratrum album - Moth killer is prepared

SPECIAL POINTS

- Fabaceae is the alternative name of the Leguminosae.
- Compositae = Asteraceae is the largest family of angiosperms.
- Desmodium latifolium is the member of papilionacea family which is a halophyte.
- J.C. Bose conducted experiment of plant movements on Desmodium gyrans.
- Pollen grains in Mimosoideae are usually present in the form of packets.
- Soyabean contains more protein than meat.
- Aloin alkaloids are obtained from Aloe plant of liliaceae.
- Smilax is a monocot, having reticulate venation.
- The flowers enter into the soil after fertilization in groundnut.
- Pulses are a rich source of proteins.