Semester	Course	Hours	Credit	Sub. Code	Marks
V	CC 7	7	6	18K5B07	25 + 75 = 100

MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

UNIT-I : MORPHOLOGY

Parts of plants -Types of leaves, Phyllotaxy and Stipules, Inflorescence –Racemose, Cymose, Mixed Special type - Description of flower - Types of fruits.

UNIT-III :TAXONOMY

Diagnostic characters and Economic Importance of the following Families:
Polypetalae: Cruciferae, Capparidaceae, Tiliaceae, Rutaceae, Anacardiaceae, Leguminosae (Fabaceae, Caesalpiniaceae, Mimosoideae) and Cucurbitaceae.

REFERENCE

1. Vashista, P.C.,l990.Taxonomy of Angiosperms-S.Chand& Co.,New Delhi.
2. B.P.Pandey, and Anitha, 1990, Economic Botany, S.Chand& Company Ltd., New Delhi.
3. Pandey, B.P., 1997. Taxonomy of Angiosperms-S.Chand& Co., New Delhi.
4. Lawrence H.W., 1955.Taxonomy of vascular plants. Macmillan, Co., USA.

PREPARED BY

UNIT-I :
Dr. R.SAGAYA GIRI
Assistant Professor in Botany
K.N. Government Arts College for Women (Autonomous),
Thanjavur -613 007.

UNIT-III :
Dr. G.SANTHI
Assistant Professor in Botany & HOD
K.N. Government Arts College for Women (Autonomous),
Thanjavur -613 007.

PARTS OF PLANTS

Plants are one of the most essential living organisms on earth. They are immensely beneficial to both animals and human beings. They produce oxygen which is crucial for the survival of living organisms. Trees provide shelter to animals and are also known for their medicinal benefits. Overall, different parts of plants have different roles to perform. They act as a source of food and oxygen and maintain the ecological balance.

A plant has many parts. Different parts perform different functionalities. The part of the plant that appears above the ground level is called the shoot system while the part of the plant which lies underneath the soil is called the root system.

Parts of Plants

The main parts of a plant include:

- Roots
- Stem
- Leaves
- Flowers
- Fruits

Roots

Roots are the most important and underground part of a plant, which are collectively called the **root system**. They are the major part that anchors the plant firmly in the soil. They absorb water and minerals from the soil, synthesise plant growth regulators, and store reserve food material. The apical part of the root is covered by the root cap that protects the root apex.

The direct elongation of radicle leads to the formation of primary roots that grow inside the soil in dicots. It bears lateral roots that are known as secondary and tertiary roots.

In monocots, the primary root is replaced by a large number of roots because it is short-lived. In some plants such as Banyan tree, the roots arise from the parts of the plant and not from the radical. Such roots are known as adventitious roots.

Few plants that grow in swampy areas are roots growing vertically upwards to get oxygen for respiration. Such roots are known as pneumatophores.

Stem

The stem is the part of the plant which is found above the ground. The bark of trees are brown in colour and younger stems are green in colour. It forms the basis of the shoot system and bears leaves, fruits and flowers. The region where the leaves arise is known as the node and the region between the nodes is known as the internodes.

Stems arise from the plumule, vertically upwards to the ground. Initially, stems are usually weak and cannot stand straight. It eventually grows to become the toughest part of the plant called the trunk. The trunk is covered by a thick outer covering known as the bark. Overall stem provides a definite framework and structure to a plant, which later develops into a tree.

The stem provides support to the plant. They also protect the plant and help in **vegetative propagation**. A few underground stems such as potato and ginger are modified to store food.

The important functions of a stem include:

- A stem carries out a number of functions essential for various processes such as photosynthesis.
- Provides a definite framework and structure to a plant which later develops into a tree.
- **Support:** Primary function of the stem is to hold up buds, flowers, leaves, and fruits to the plant. Along with the roots, a stem anchors the plants and helps them to stand upright and perpendicular to the ground.
- **Transportation:** It is the part which transports water and minerals from the root and prepared food from leaves to other parts of the plant.
- **Storage:** Stems are one of the storerooms of plants where the prepared food is stored in the form of starch. The stems of a few plants in the desert areas, such as Opuntia, get modified into thick, fleshy structures that store food and prevent excessive water loss due to transpiration.
- **Reproduction:** Few stems help in reproduction through vegetative propagation and also help to bear flowers and to produce fruits.
- **Guards**: Protects Xylem and phloem allowing them to perform their functions. The stem tendrils are spirally coiled and help the plant to climb support. The axillary buds also get modified into thorns that protect the plant from grazing animals.
- The stems of a few plants in the desert areas, such as Opuntia, get modified into thick, fleshy structures that store food and prevent excessive water loss due to transpiration.

Leaves

Leaves are the most important part of a plant. They contain chlorophyll that helps the plants to prepare their food using sunlight, carbon dioxide and water. A leaf consists of three main parts- petiole, leaf base and lamina.

1. The petiole keeps the leaf blade exposed to wind and cools the leaf.
2. The leaf base is a protruding part of a leaf**.**
3. The lamina of the leaf contains veins and veinlets that provide rigidity to the leaf blade and help in the transport of mineral nutrients.

Primarily, leaves have three main functions:

- **Photosynthesis:** Green leaves prepare food for plants by using water and carbon dioxide in the presence of sunlight. This process is called photosynthesis.
- **Transpiration:** Other than photosynthesis, leaves play a crucial role in the removal of excess of water from plants through tiny pores called stomata. This is the process of transpiration.
- **Reproduction:** Leaves of some plants helps in reproduction also. For e.g. leaves of Bryophyllum give rise to a new Bryophyllum plant.

Flowers

Flowers are the most beautiful and colourful part of a plant. They are the reproductive part of a plant. A flower has four major parts, namely,

- **Petals:** It is the colourful part of a flower which attracts insects and birds.

- **Sepals:** Sepals are green leafy parts present under petals and protect the flower buds from damage.
- **Stamens:** This is the male part of the flower consisting of anther and filament.
- **Pistil:** This is the female part of the flower consisting of stigma, style, and ovary.

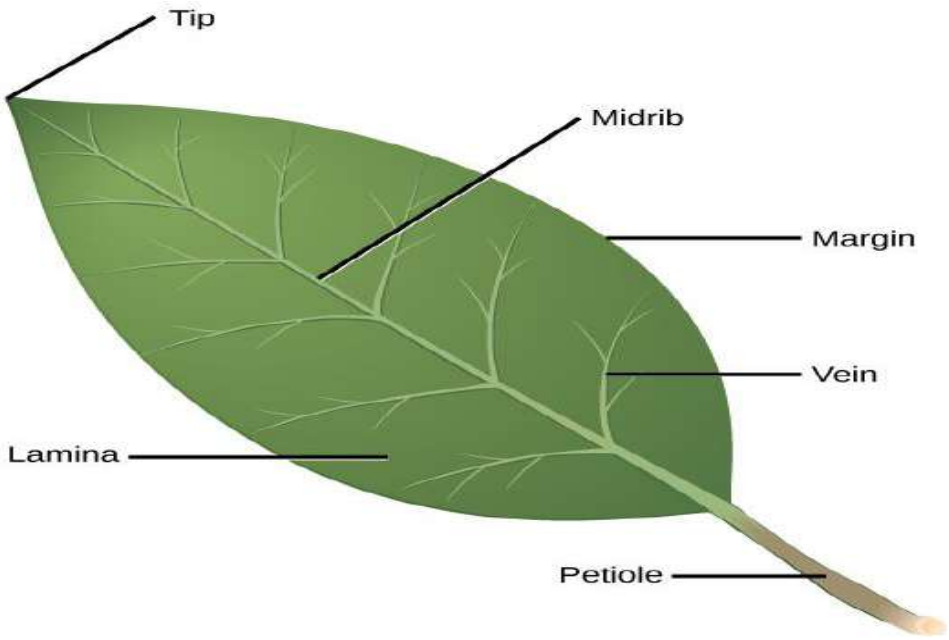
Fruits

Fruits are the main features of a flowering plant. It is a matured ovary that develops after fertilisation. Some fruits are developed without fertilization and are known as parthenocarpic fruits and the process is known as **Parthenocarpy**.

Thus, different parts of a plant help in the growth and development of a plant. All the plant parts are beneficial and work in coordination with each other.

STRUCTURE OF A TYPICAL LEAF

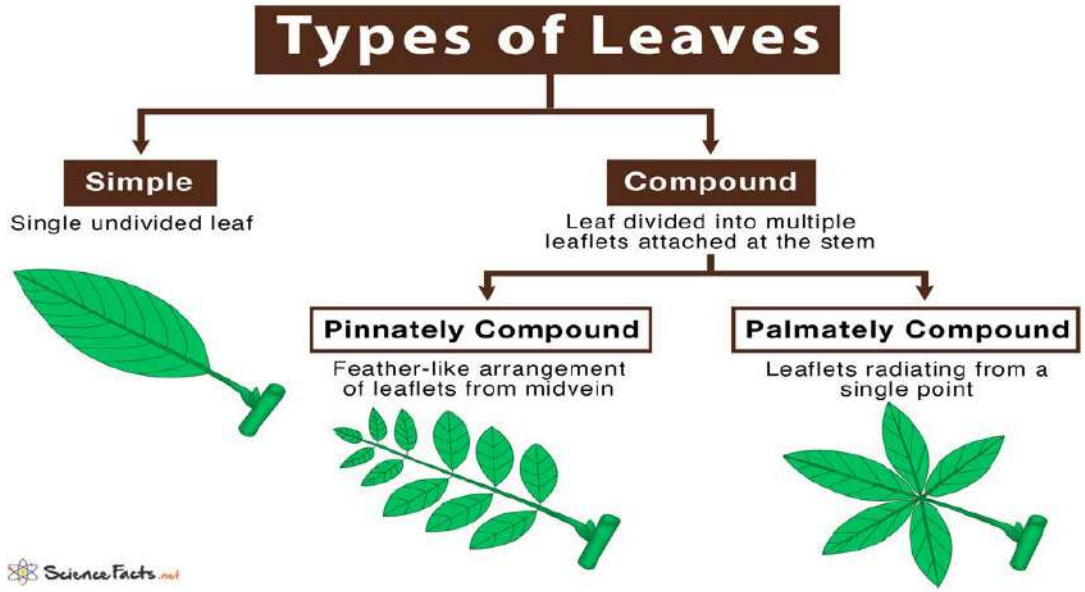
Each leaf typically has a leaf blade called the lamina, which is also the widest part of the leaf. Some leaves are attached to the plant stem by a petiole. Leaves that do not have a petiole and are directly attached to the plant stem are called sessile leaves. Leaves also have stipules, small green appendages usually found at the base of the petiole. Most leaves have a midrib, which travels the length of the leaf and branches to each side to produce veins of vascular tissue. The edge of the leaf is called the margin.



Parts of a leaf: A leaf may seem simple in appearance, but it is a highly-efficient structure. Petioles, stipules, veins, and a midrib are all essential structures of a leaf.

TYPES OF LEAVES

There are two broad categories of leaves – simple and compound, which are further classified into different groups based on their shape, size, their arrangements on the stem, leaves of flowering and non-flowering plants, and various other physical attributes.



The two different types of leaves found in a plant are:

Simple Leaf

A leaf which may be entire or incised to any depth, but not down to the midrib or petiole.When a single lamina is connected to the main stem by a petiole, the leaf is said to be simple. A simple leaf may be incised to any depth but not down to the midrib or petiole. Eg., Guava leaves

Compound Leaf

A compound leaf is a leaf made up of two or more leaflets. In a compound leaf, the midrib of the leaf is branched into different leaflets and is connected by a single petiole. For eg., Pea, palm leaves.

The compound leaves may be of several types.

They are as follows:

A. Palmately compound Leaf

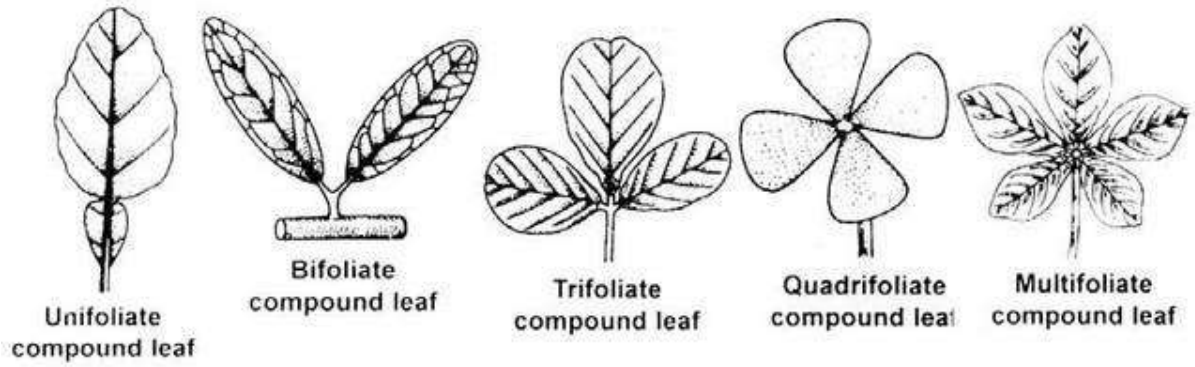
(i) Unifoliate: Having one leaflet only, e.g., Citrus.

(ii) Bifoliate: Palmate compound leaf with two leaflets, e.g., Prinsepia, Balanites.

(iii)Trifoliate: Such palmate compound leaf having three leaflets growing from same point, e.g., Oxalis, Vigna, Trifolium, Melilotus, etc.

(iv)Quadrifoliate: Compound palmate leaf with four leaflets arising at a common point, e.g., Marsilea (a pteridophyte).

(v)Muitifoliate: Compound palmate leaf with five or more leaflets arising at a common point, e.g., Gynandropsis pentaphylla, Bombax ceiba.



B. Pinnately Compound Leaf:

(a) Pinnate: A compound leaf having leaflets on each side on an axis or midrib.

(b) Unipinnate: Having leaflets on each side of an axis, e.g., Cassia.

(c) Bipinnate: The entral axis produces secondary axis which bears the leaflets, e.g., Acacia.

(d)Tripinnate: The secondary axes produce the tertiary axis which bear the leaflets, e.g., Moringa.

(e)Decompound: More than thrice pinnate, e.g., old leaves of coriander.

(f) Paripinnate: Pinnately compound without a terminal leaflet, e.g., Cassia.

(g) Imparipinnate: Pinnately compound leaf with an odd terminal leaflet, e.g., pea.

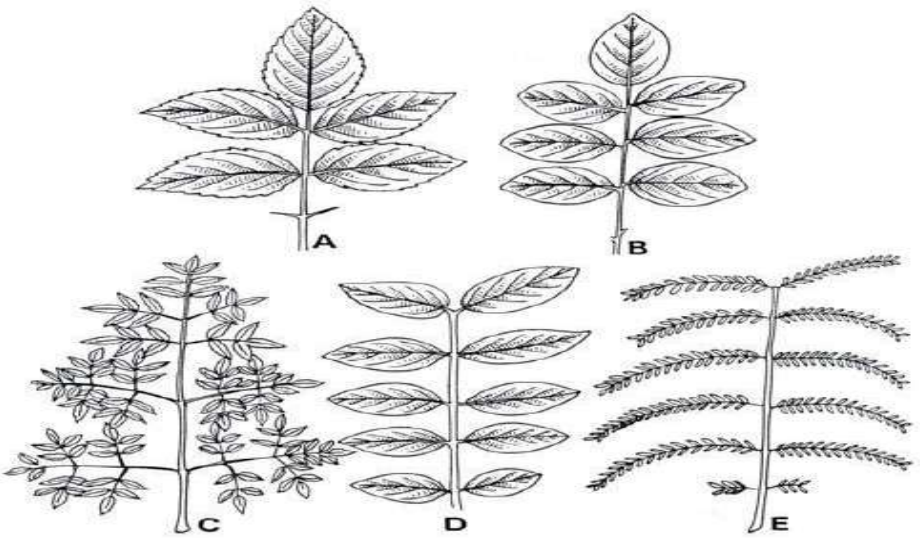


Fig. 34.41. Compound leaves. A, imparipinnate compound leaf of rose; B, imparipinnate compound leaf with alternate leaflets in *Murraya*; D, paripinnate compound leaf of *Cassia fistula*; E, bipinnate compound leaf of *Acacia*; C, tripinnate compound leaf of *Melia azadarach*.

Margin of Lamina:

Entire: With continuous margin, e.g., Psidium, mango, madar.
Dentate: With large saw like teeth on the margin, e.g., Nympluiea, watermelon.

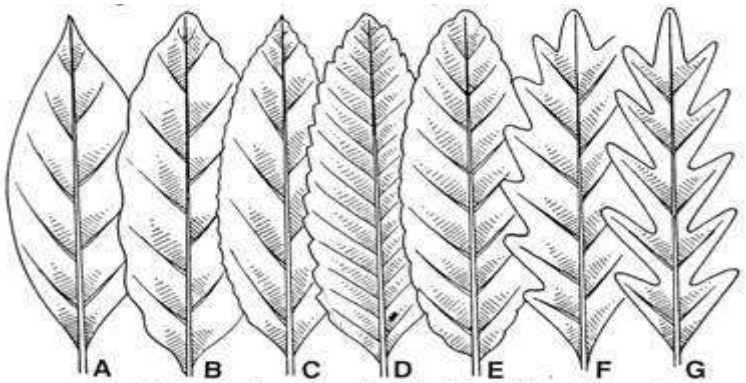


Fig. 34.42. Leaf margins. A, entire; B, undulate; C, serrate; D, dentate; E, crenate; F, lobed; G, parted.

Serrate: With serrate edges themselves toothed, e.g., China rose, nim.
Undulate: The margin is wavy, e.g., Polyalthia.
Convolute: Rolled together.
Crenate: With obtusely toothed margin, e.g., Bryophyllum, Centella.
Lacerate: Having margin or apex deeply cut into irregular lobes, e.g., many members of Ranunculaceae.
Laciniate: Irregularly incise, fringed.
Laciniolate: Minutely incised or fringed.
Ciliate: Bearing fine hairs on the margin, e.g., Cleome viscosa.
Crispate: Curled or extremely undulate margin.
Spinous: Bearing many spines, e.g., Argemone.
Pectinate: Comb like margin.
Lobed: Leaf margin divided into many lobes, e.g., Ranunculus.

Leaf Apex:

Acute: Ending in a sharp point forming an acute angle, e.g., mango.
Acuminate: Drawn out into long point; tapering; pointed, e.g., Ficiis religiosa.
Obtuse: With blunt or rounded end, e.g., Banyan.

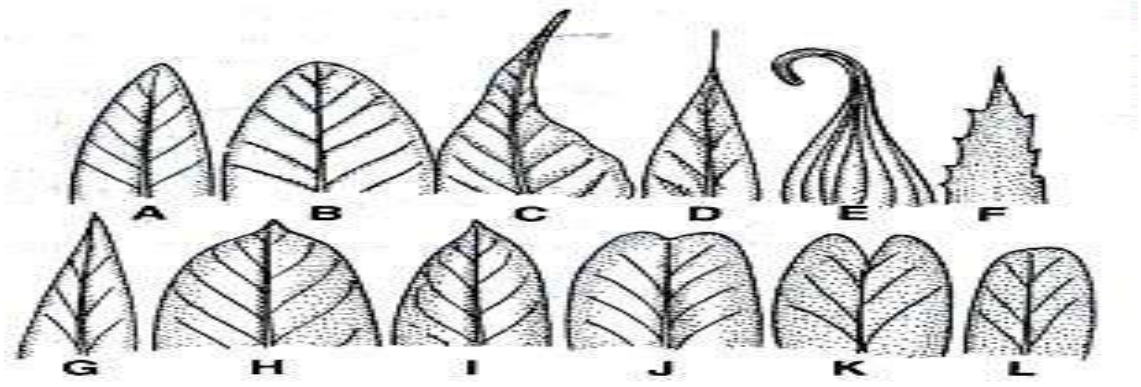


Fig. 34.43. Leaf apices. A, acute; B, obtuse; C, acuminate; D, aristate; E, cirrhose; F, spinous or cuspidate; G, caudate; H, mucronate; I, same as H; J, retuse; K, emarginate; L, truncate.

Truncate: Terminating abruptly, as if tapering end were cut off, e.g., Caryota mens,
Emarginate: Having a notch at apex, e.g., Bauhinia.
Mucronate: Abruptly terminated by a sharp spine, e.g., apex of leaflet of Cassia obtusifolia.
Cuspidate: Terminating in a point.
Aristate: Provided with awns or with a well developed bristle.

Retuse: Obtuse with a broad shallow notch in middle, e.g., Oxalis.
Cirrhose: Leaf with prolongation or mid-rib forming a tendril, e.g., Gloriosa.
Apiculate: Forming abruptly to a small tip, e.g., Dalbergia.

Leaf Venation

System or disposition of veins in the leaves.
They are of several types:

Reticulate: Like net work, e.g., in most of dicots.

Parallel: Parallel veined, e.g., most of monocots.

(a) Unicostate reticulate:
Having only one principal vein, e.g., mango, banyan, etc.
(b) Multicostate reticulate:
Having many principal veins, e.g., castor, cucumber, etc.

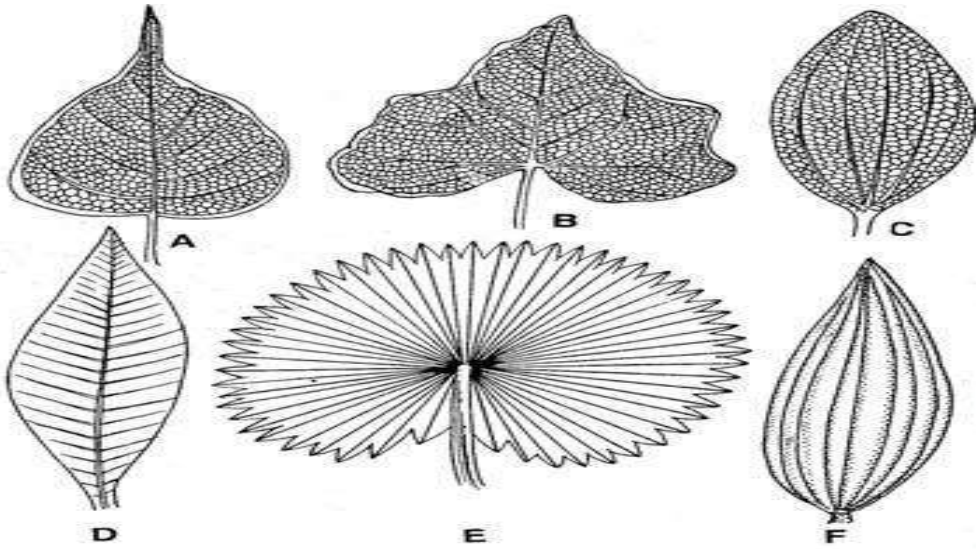


Fig. 34.44. Leaf venation. A, reticulate unicostate venation; B, reticulate multicostate—divergent venation; C, reticulate multicostate—convergent venation; D, parallel unicostate; E, parallel; F, multicostate—convergent.

Shape of Leaf Lamina:

Linear: Long and narrow leaf, e.g., many grasses.
Lanceolate: Lance-shaped leaf, e.g., bamboo, Nerium, etc.
Round or orbicular: Leaf with a circular leaf blade, e.g., lotus, garden nasturtium, etc.
Elliptical: An ellipse-shaped leaf, e.g., guava, jack, etc.
Ovate: Leaf with an egg-shaped leaf lamina, i.e., slightly broader at the base than at the apex, e.g., banyan, China rose, etc.
Spathulate: Spatula-shaped leaf, i.e., broad and round at the top and narrower towards the base, e.g., Calendula and Drosera.
Oblique: Leaf with two unequal halves, e.g., Begonia.

Oblong: Leaf with wide and long leaf lamina. Here the two margins run more or less straight up, e.g., banana.
Reniform: Kidney-shaped leaf, e.g., Indian pennywort.
Cordate: Leaf with heart shaped leaf lamina, e.g., betel.
Obcordate: Inversely heart-shaped leaf blade, e.g., wood-sorrel.
Sagittate: Leaf with an arrow shaped leaf blade, e.g., arrow-head and some aroids.
Hastate: Sagittate leaf with its two lobes directed outside, e.g., water bindweed and Typhonium.
Lyrate: Lyre-shaped leaf lamina, i.e., with a large terminal lobe and some smaller lateral lobes, e.g., radish, mustard, etc.
Acicular: Long, narrow and cylindrical leaf, i.e., needle-shaped, e.g., pine (a gymnosperm).
Cuneate: Wedge shaped leaf, e.g., water lettuce.

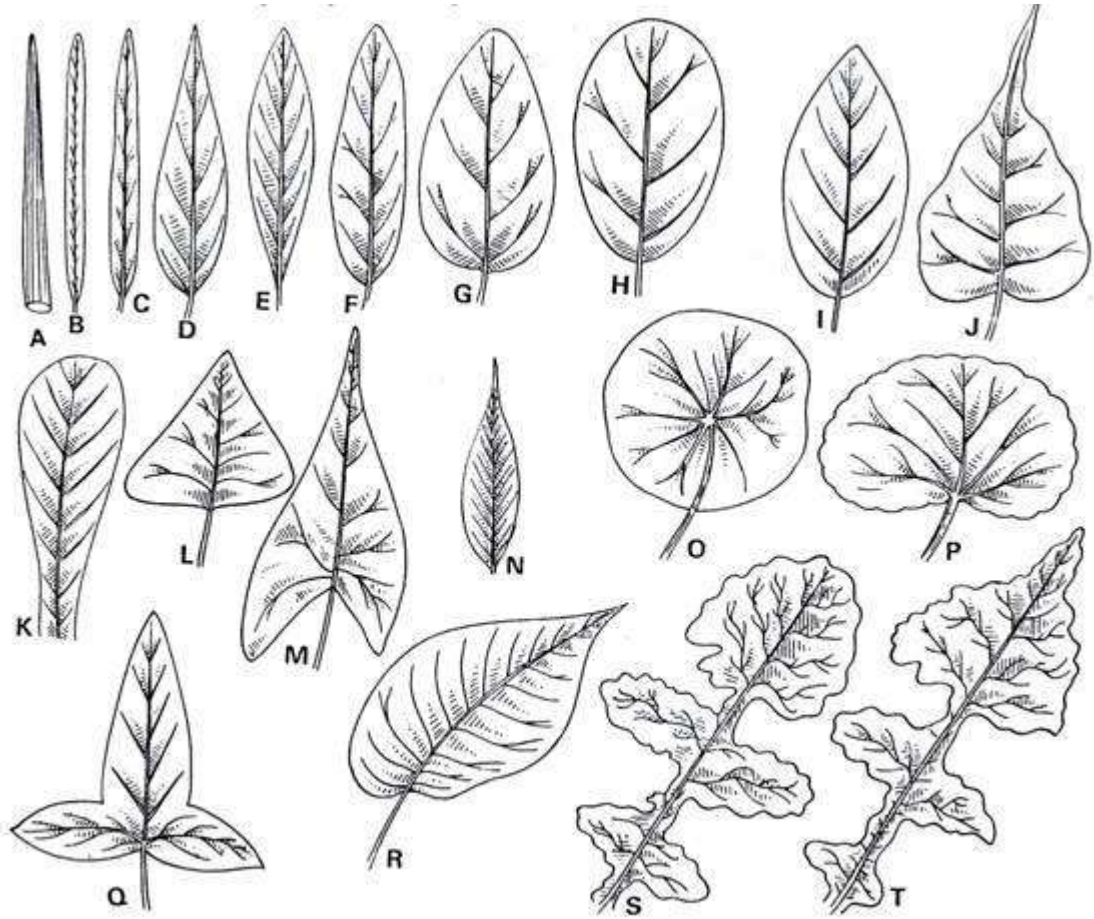


Fig. 34.45. Shape of leaf lamina. A, cylindrical; B, acicular; C, linear; D, lanceolate; E, oblanceolate; F, oblong; G, ovate; H, obovate; I, oval; J, cordate; K, spathulate; L, deltoid; M, sagittate; N, subulate; O, orbicular; P, reniform; Q, hastate; R, oblique; S, lyrate: T, runcinate.

PHYLLOTAXY AND ITS TYPES

Phyllotaxy is the arrangement or distribution of leaves on the stem or its branches, that will help them to receive maximum sunlight to perform photosynthesis.

Types of Phyllotaxy:

It is of six types alternate, opposite, and whorled

1.Alternate

a. Alternate disticus

b.b.Alternate spiral

2.Opposite

a.opposite supporposed

b.opposite decussate

3.Ternate

4.Whorled

5.Radicle

6.Mosic

1.Alternate phyllotaxy: A single leaf arises at each node in an alternate manner. Examples: **China rose**, Sun flower.

2. Opposite phyllotaxy: A pair of leaves arise at each node and lie opposite to each other. Examples: Calotropis, Guava.

a) Opposite and decussate:

When two successive pairs of leaves occur at right angle to each other, e.g., *Psidium.*

(b) Opposite and superposed:

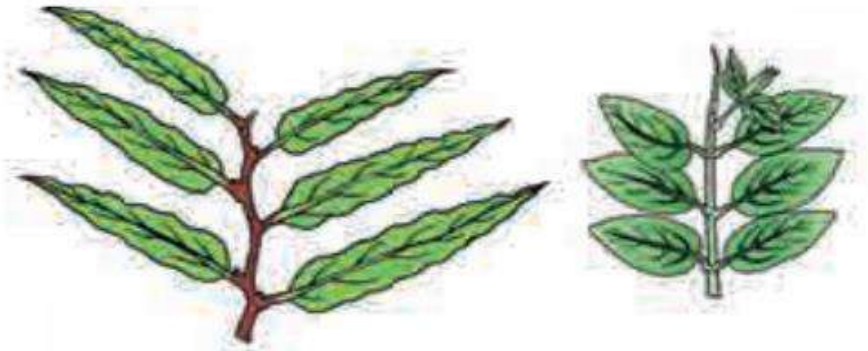
When all the pairs of leaves occur in the same plane, e.g., *Combretum.*

3.Ternate Phyllotaxy : A group of three leaves occur as a whorl at each node of the stem.Eg. *Nerium*

4. Whorled: When more than two leaves are arranged in the form of a whorl at each node the phyllotaxy is called whorled, e.g., *Hydrilla verticillata*, *Nerium*, etc.

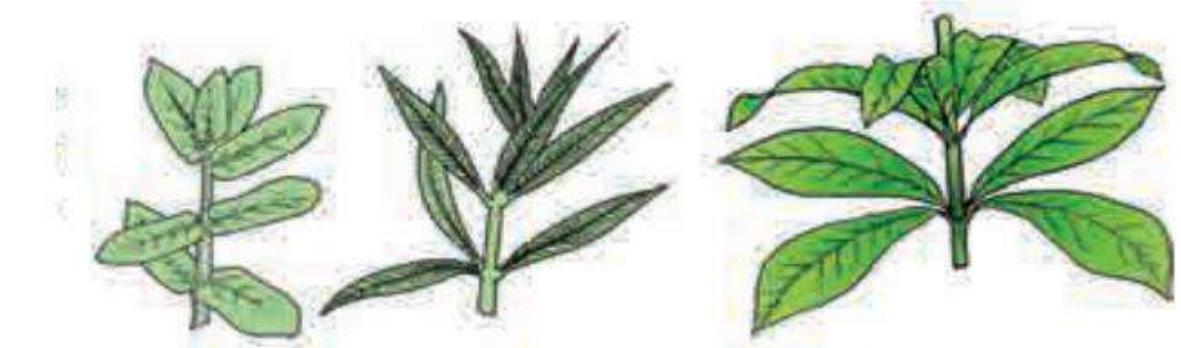
5.Mosaic Phyllotaxy: The smaller and larger leaves are arranged in a mosaic pattern, so that all the leaves are equally exposed to sunlight.Eg.*Acalypha*

6.Radical Phyllotaxy: The leaves arise in cluster, from near the ground level, looking as though they start from the root directly. The stem is highly reduced and subterranean. Eg. *Pine apple, Aloe*



Alternate *Polyalthia* Opposite Superposed *Guava*

Figure 3.14: Phyllotaxy



Opposite Decussate *Calotropis* Ternate *Nerium* Whorled *Allamanda*

STIPULES

Stipule is an outgrowth borne on either side (sometimes just one side) of the base of a leafstalk (the petiole). A pair of stipules is considered part of the anatomy of the leaf of a typical flowering plant, although in many species the stipules are inconspicuous or entirely absent (and the leaf is then termed ***exstipulate***). In some older botanical writing, the term "stipule" was used more generally to refer to any small leaves or leaf-parts, notably prophylls.[1] The word *stipule* was coined by Linnaeus[2] from Latin *stipula*, straw, stalk.

Types of stipules

The position of stipules on a plant varies widely from species to species, though they are often located near the base of a leaf. Stipules are most common on dicotyledons, where

they appear in pairs alongside each leaf. Some monocotyledon plants display stipule-like structures, but only display one per leaf.

According to shape, size and position**Stipules can be considered**

1.Free lateral stipules- In this type, there are two stipules one on either side, at the base of the petiole. Eg. *Hibiscus* .

2. **Adnate stipules**- - In this type, two stipules are fused to the stem or to the rachises. *Rosa*

3.Interpetiolar stipules-,A stipule is "interpetiolar" if it is located in between the petioles, as opposed to being attached to the petioles, and generally one stipule from each leaf is fused together, so it appears that there's just one stipule between each leaf. Eg.*Ixora*

4. **Intrapetiolar stipules**- A stipule is "intrapetiolar" if it is located in the angle that's between a stem and a petiole. In this case, the two stipules generally form together and appear to be one stipule Eg. Gardenia

5.Ochreate stipules- A stipule is "ochreate" if a single stipule appears to be a solid tube that goes all the way around the stem**.** Eg. *Polygonum*

6.Auriculate stipules: The stipules are ear-lobe like at the base of the leaves around the node. Eg.*Cassia*

6.**Foliaceous stipules**- A stipule is "foliaceous" if it is leaf-like. Eg *Lathyrus.* These are generally used to photosynthesize.

7.bud scales- A stipule is considered a "bud scale" if it is hard or scaly and protects leaf buds as they form.

8. tendrillar- A stipule is considered "tendrillar" if they are long thin tendrils, and are generally used by climbing plants

9.**spiny.** -A stipule is considered "spiny" if they are long and pointy. These are generally used to deter animals.

Purpose of stipules

Stipules have various functions. Some stipules are not well understood or may be vestigial.It is known that foliaceous stipules are used like leaves to make energy for the plants. Sometimes stipules protect the next leaf or bud as it grows in then falls off after the leaf unfolds. Stipules can be used as climbing tendrils by climbing plants. Spiny stipules can be used to help protect the plant from animals

INFLORESCENCE

An **inflorescence** is a group or cluster of flowers arranged on a stem that is composed of a main branch or a complicated arrangement of branches. .**Inflorescences** may be simple (single) or complex (panicle). The rachis may be one of several **types**, including single, composite, umbel, spike or raceme.

Types of Inflorescence

In a plant, flowers may grow either as a single flower or as a group. The inflorescence is defined as the arrangement of a cluster of flowers on a floral axis. The inflorescence is of two types, they are: Racemose and Cymose

1.Racemose or Indefinite or Indeterminate Type of Inflorescence:

The arrangement in which the youngest flower is present near the apex and older towards the base, i.e., in acropetal succession. So, in this case the growing point does not stop the growth and forms continuously the lateral flowers.It is of following types:

1. Raceme:

When peduncle bears many pedicellate flowers in an acropetal manner, e.g., Delphiniumajacis, Veronica, etc.

2. Spike:

A raceme with sessile flowers, e.g., Adhatoda vasica, Callistemon, etc.

3. Spikelet:

Small spikes arranged in a spike, raceme or panicle manner. Each flower consists of an awned bract, three stamens and an ovary with two feathery stigmas, e.g., Triticum.

4. Panicle:

Branched raceme, e.g., Delonix regia.

5. Catkin:

Pendant spike with unisexual flowers, e.g., Morus alba, Salix, etc.

6. Spadix:

Spike with a fleshy axis, enclosed by one or more large bracts called spathes, e.g., Musa, Pistia, etc.

7. Corymb:

Raceme, in which all the flowers reach the same level due to more elongation of the pedicel of older flowers, e.g., Iberis amara.

8. Umbel:

When pedicellate flowers arise from a common point as in members of Umbelliferae or Apiaceae.

9. Capitulum or Head:

When numerous, small, sessile flowers are aggregated to form a dense inflorescence as in members of Compositae or Asteraceae.

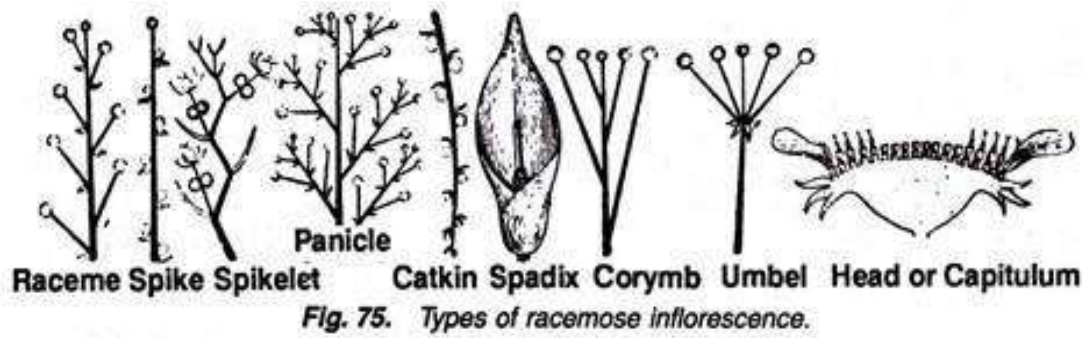


Fig. 75. Types of racemose inflorescence.

II.Cymose or Definite or Determinate Type of Inflorescence:

When the apical growth of the floral axis is checked by the formation of a flower, it is called cymose inflorescence. Flowers are arranged in basipetalous manner, i.e., the terminal flower is oldest and young flowers are present on lower side. It is of following types:

1. Monochasial or Uniparous Cyme:

When peduncle bears a single terminal flower, and a single lateral branch which also bears a single terminal flower.It is of following three types:

(a) Helicoid or Bostryx:

A monochasial cyme in which successive lateral branches develop only towards one side of the main axis, e.g.. Hamelia patens, Juncus, etc.

(b) Scorpioid or Cincinnus:

When successive lateral branches develop on both the sides of main axis in alternate manner, e.g.. Heliotropium.

(c) Rhipidium:

A flat scorpioid cyme in which all the flowers are present at the same level, e.g., Solanum nigrum.

2. Dichasial or Biparous Cyme:

When peduncle bears a terminal flower and a pair of opposite lateral branches which also bear terminal flowers, e.g., Stellaria media.

3. Polychasium or Pleiochasium or Multiparous Cyme:

When the peduncle bears a single terminal flower and just below it are present more than two lateral branches bearing terminal flowers, e.g., Calotropis procera.

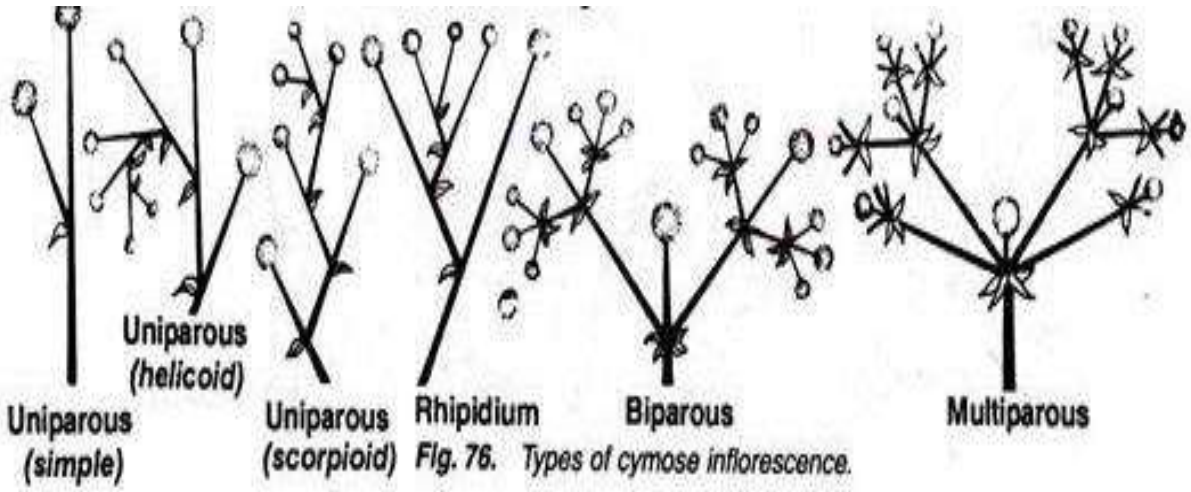


Fig. 76. Types of cymose inflorescence.

III.Mixed Inflorescence

In this type of inflorescence, the axis starts as a racemose inflorescence and shows branching in a cymose fashion. There are different types under this.

1.Thyrsus

The main axis of the inflorescence shows a number of simple dichasial cymes arranged in a racemose manner eg. *Ocimum*.

2.Verticillaster

A pair of dichasial cymes arise from the axils of opposite flowers. Later these grow as monochasial scorpioid cymes around the stem eg. *Leucas*.

3.Mixed Spadix

In *Musa*, several cymose clusters are arranged on the swollen inflorescence axis from base to apex. Each cymose cluster is surrounded by a large bract called **spathe**.

IV.Special types of inflorescence

The type of inflorescence which cannot be included in racemose type or cymose type is called special type. There are several kinds of special type inflorescence.

1. Cyathium:

A cup-shaped involucre having nectar-secreting glands, a centrally placed single large female flower which is reduced to pistil, and many male flowers present in the form of stamens, e.g., Euphorbia.

2. Verticillaster:

When flowers arise in the axil of bracts arranged opposite to each other. Each cluster of flowers in this type of inflorescence represents dichasial cyme, as in members of Labiatae.

3. Hypanthodium or Syconium:

It consists of a hollow, flask – shaped, fleshy axis opening by a small ostiole at the apex. Many reduced flowers are arranged closely along its inner surface. Male flowers are situatednear the periphery and female flowers in the centre, e.g., Ficus.

4.Coenanthium

Here the receptacle is fleshy and appears like a circular disc like structure. The centre of the disc contains female flowers and around these are present the male flowers
eg. *Dorstenia*.

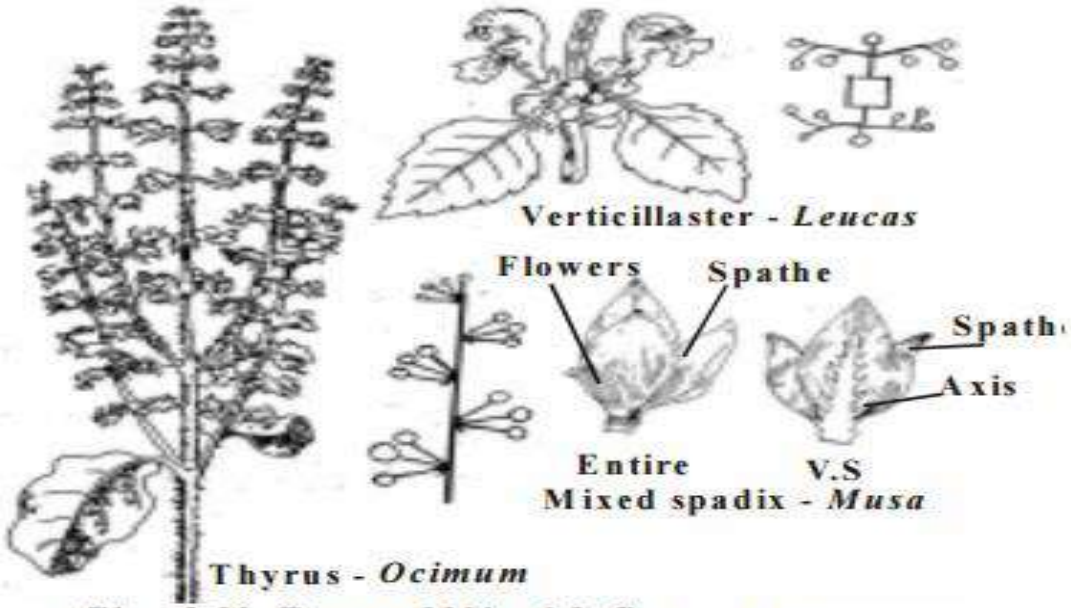


Fig : 3.30. Types of Mixed Inflorescence

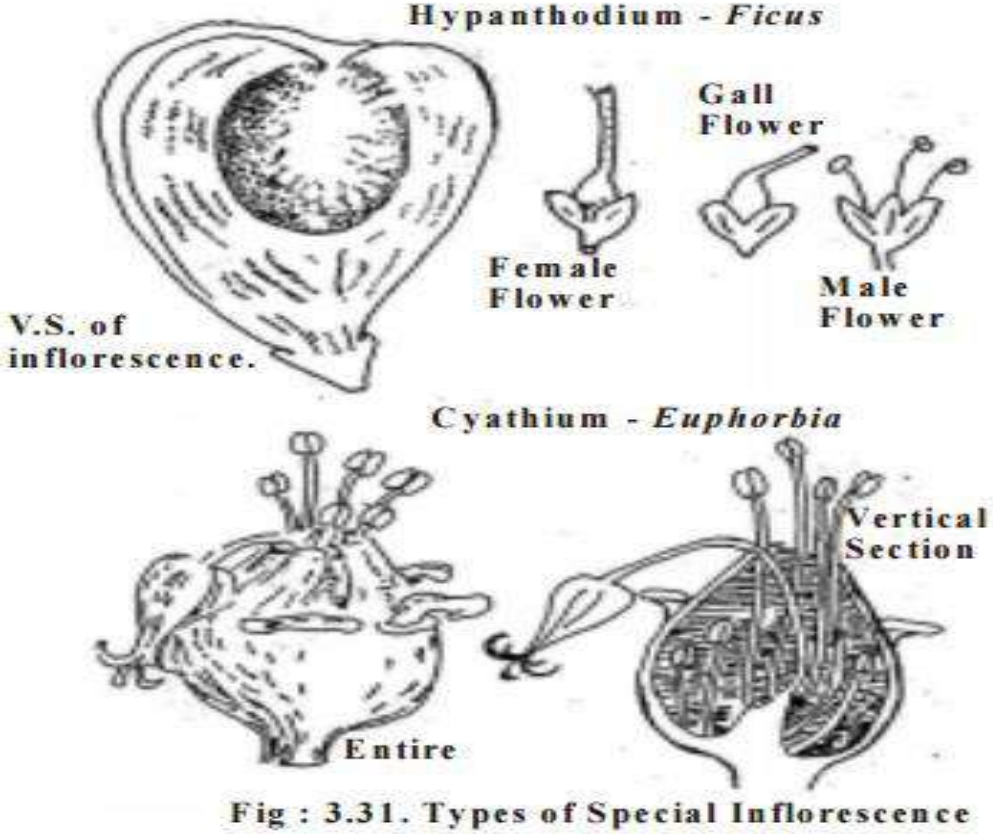
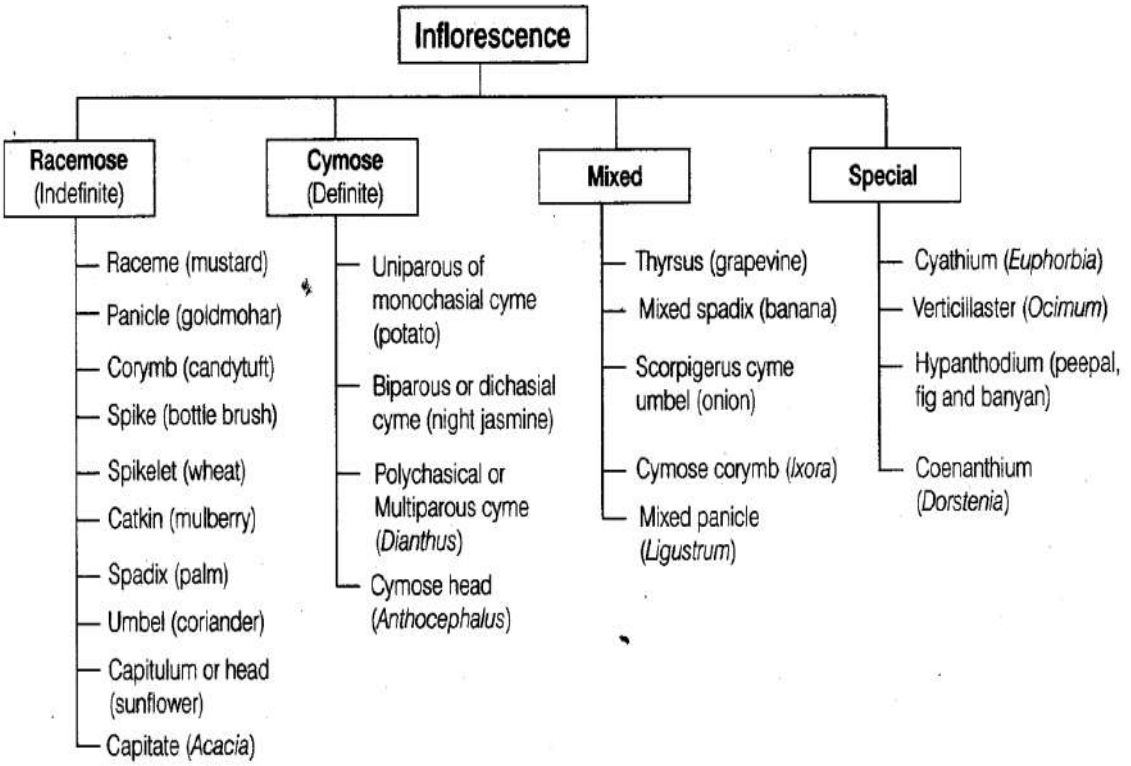


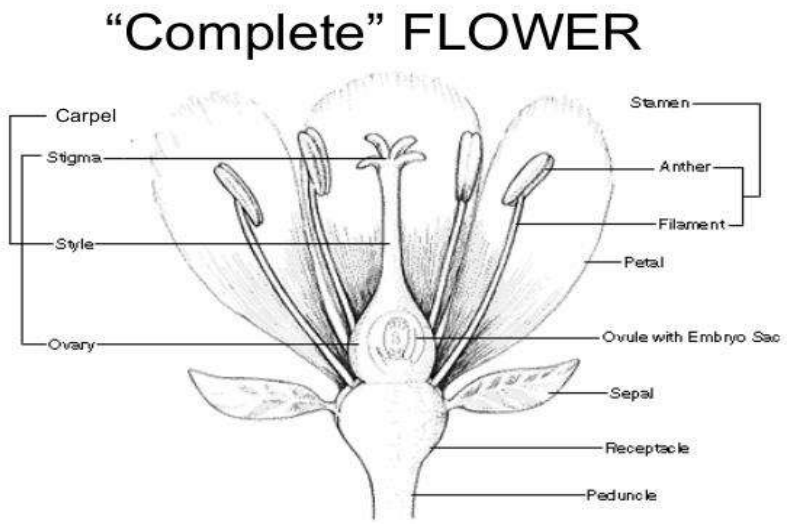
Fig : 3.31. Types of Special Inflorescence



Differences between Racemose and Cymose Inflorescence

Character	Racemose	Cymose
• **Peduncle**	It does not end in a single flower instead grows continuously.	It ends up into a single flower.
• **Number of flowers**	Indefinite or indeterminate number of flowers are formed.	A definite or determinate number of flowers are formed.
• **Position of flowers on peduncle**	Flowers are arised laterally in all sided on the peduncle.	Flowers actually arise terminally in one side only.
• **Bract**	The bracteate flowers are borned in the axile of the bracts.	In uniparous cyme, the bracts when exist, are formed on the side opposite the origin of flowers.
• **Arrangement of flowers**	The flowers are arranged in an acropetal manner.	The flowers are arranged in a basipetal manner.
• **Grouping of flowers**	It is a less common occurrence.	It is a more common occurrence.
• **Flowering period**	Flowers open at short intervals.	Flowers open at long intervals and the total flowering period is much larger.
• **Pollination**	A single visit by a pollinator can pollinate a large number of flowers.	A pollinator cannot pollinate many flowers in one visit though flowers are grouped more frequently.
• **Flowers arrangement in a group**	In a floral group, flowers are arranged in a centripetal manner, i.e. younger flowers occupy central position, while older flowers towards the periphery.	In a group of flowers, the flowers are arranged in a centrifugal manner, which is opposite situation to centripetal.
• **Fruit protection by flowers**	Newly formed fruits are not protected by flowers because these fruits are formed towards the periphery of grouping of flowers.	Newly formed fruits are protected by new flowers, because fruits formed towards the centre of grouping of flowers.

THE DESCRIPTION OF FLOWERS



A flower is the reproductive unit of an angiosperm plant. There is an enormous variety of flowers, but all have some characteristics in common. The definitive characteristic of the angiosperms is the enclosed ovary, which contains and protects the developing seeds. Floral reproduction is bisexual, and flowers have "male" and "female" parts. The "male" or pollen-bearing part is called the stamen, and is composed of the filament and the anther. The "female" or seed-bearing part is called the pistil, and is composed of the ovary, the stigma, and the style. A flower may have exclusively male parts, exclusively female parts, or commonly, both. When there are separate flower types, both may occur on the same plant; occasionally a plant may bear only male or female flowers.

Surrounding the reproductive parts is the perianth, a double envelope consisting of an outer portion, the calyx, which forms the sepals, and an inner portion, the corolla, which forms the familiar petals. There may also be leafy elements, termed bracts, surrounding a flower. Individual flowers are often organized into a larger group or cluster, termed an inflorescence. The stalk supporting a single flower is called a pedicel, that supporting an inflorescence, or an isolated flower, a peduncle.

Peduncle:
The stalk supporting an inflorescence or solitary flower.
Pedicel:
The footstalk supporting a single flower in an inflorescence.
Involucre:
A circle or cup of bracts that surrounds and supports the multiple florets of the head in the composite flowers of the family *asteraceae*. The shape and arrangement of the *involucral bracts* is important in describing the members of this family.
Bract:

A leaf-like element below a flower or on an inflorescence. Bracts are typically shaped differently than other leaves on the plant. They are usually green, but occasionally are brightly colored and petal-like.

Calyx:

The outer perianth of a flower. The calyx surrounds the corolla, and is typically divided into lobes called sepals. These are frequently green, and reduced relative to the petals, but they can also be large, and brightly colored, resembling petals. In many flowers, the sepals enclose and protect the flower bud prior to opening.

Corolla:

The inner perianth of a flower. The corolla typically surrounds the reproductive parts of the flower. It may be continuous as in a petunia, lobed, or divided into distinct petals. In some cases, especially in cultivated varieties, the corolla may be doubled or even further multiplied, producing multiple layers of petals. In other cases, it may be lacking entirely.

Filament:

The usually narrow and often threadlike part of the stamen which supports the pollen-bearing anther.

Anther:

The pollen-bearing body of the stamen, usually relatively compact, and supported at the end of the narrow filament. Under a lens, anthers exhibit a wide variety of forms and means of attachment. These characteristics are often important in technical keys for flower identification.

Ovary:

The part of the pistil that encloses the unfertilized seeds or ovules, and that typically develops into a dry or fleshy fruit once pollination takes place. The ovary is generally central to the flower, and supports the other principle parts. Whether they are attached at the top (ovary inferior) or the bottom (ovary superior) is an important anatomical characteristic for classification. Not all "fruits" are mature ovaries; some form from supporting parts of the flower, for example, strawberries develop from the receptacle - the enlarged top of the flower stalk.

Perianth:

The technical term for the envelope that surrounds the reproductive parts of a flower. This enclosure is composed of two concentric units, the outer perianth, or calyx which may be divided into sepals, and the inner perianth, or corolla, which may be divided into petals. Either the calyx or the corolla (or both) may be much reduced or lacking.

Petal:

A division or lobe of the corolla or inner perianth of a flower.

Pistil:

The seed-bearing or "female" reproductive part of a flower. The pistil is composed of the ovary, the style, and the stigma. The ovary contains the developing seeds, and is connected to the pollen-receiving stigma by the style. Flowers often contain a single pistil, but may contain several. Staminate or "male" flowers contain only stamens and lack pistils entirely.

Receptacle:

The generally enlarged top of the footstalk, which supports the other parts of the flower. Some "fruits" are enlarged receptacles rather than ovaries.

Sepal:

A division or lobe of the calyx or outer perianth of a flower. Sepals are often green, and/or reduced in size, but they can be colorful and petal-like as well.

Stamen:

The pollen-bearing or "male" reproductive part of a flower. The pollen is borne on a more or less compact body termed the anther, which is supported by the filament. A flower may have hundreds of stamens, or only a few. Pistillate or "female" flowers have pistils but no stamens.

Stigma:

The upper part of the pistil which receives the pollen. The stigma is often sticky, or covered with fine hairs or grooves, or other anatomical features that help the pollen to adhere. It may be cleft into several parts.

Style:

The usually elongated part of the pistil that connects the ovary to the stigma.

FRUITS

Fruit, the fleshy or dry ripened ovary of a flowering plant, enclosing the seed or seeds. Thus, apricots, bananas, and grapes, as well as bean pods, corn grains, tomatoes, cucumbers, and (in their shells) acorns and almonds, are all technically fruits. Popularly, however, the term is restricted to the ripened ovaries, a fruit is a mature ovary and its associated parts. It usually contains seeds, which have developed from the enclosed ovule after fertilization, although development without fertilization, called parthenocarpy, is known, for example, in bananas.

Fertilization induces various changes in a flower: the anthers and stigma wither, the petals drop off, and the sepals may be shed or undergo modifications; the ovary enlarges, and the ovules develop into seeds, each containing an embryo plant. The principal purpose of the fruit is the protection and dissemination of the seed.

True Fruit

A true fruit is one that develops only from the ovary. Examples are Mango, Coconut, Zizyphus, etc.

False Fruit or Pseudocarp

In some fruits, it is not the ovary that forms the fruit. In fact, some other parts of the flower, like the thalamus, inflorescence, calyx are modified to become a part of the fruit. These types of fruit are called false fruits. Examples are Apple, Strawberry, etc.

Geocarpic Fruit

These are underground fruits. Examples include Arachis.

TYPES OF FRUITS

1. Simple
2. Aggregate
3. Composite

1.Simple fruit

These fruits develop from the monocarpellary ovary or multicarpellary syncarpous ovary. Only one fruit is formed by the gynaecium. Simple fruits are of two types

Fleshy Fruits: In fleshy fruits, the fruit wall is differentiated into epicarp, mesocarp, and endocarp. These fruits develop from superior or inferior syncarpous gynoecium.

1.Berry - a fleshy, indehiscent simple fruit derived from a simple or compound ovary, having one to many seeds, with a soft and fleshy pericarp or most of it. (e.g. tomato, guava, grape, lanzones, eggplant, individual fruit of pineapple). In some literature, the avocado and banana are described as **baccate** or berry-like fruits. Two specialized berry fruit types are the *pepo* and *hesperidium*.

2.Hesperidium - a special type of berry with a leathery rind and is segmented, typical of the citrus family.

3.Pepo - a special type of berry with a hard, thick rind and is not segmented, the ovary partially or entirely enclosed by the receptacle, typical of the family *Cucurbitaceae* (e.g. squash, cucumber, muskmelon, watermelon, pumpkin). Some cucurbits produce a dehiscent capsule and not a pepo.

4.Pome - an accessory fruit in which the seed-bearing ovary or core is surrounded by a fleshy tissue called *hypanthium* or floral tube, which is not a part of the pericarp. The hypanthium develops from the fused bases of perianth segments. e.g. apple (*Malus*), pear (*Pyrus*), quince, *Cydonia*, and *Chaenomeles*).

5.Drupe or stone - a fleshy indehiscent simple fruit that develops from a simple ovary, with the layers of the pericarp distinctly separated. The endocarp which encloses the seed is hard and woody or stone-like. In most fruits, the mesocarp is fleshy when ripe (e.g. mango). The coconut is considered a dry drupe, with a mesocarp (the husk) that is fibrous when mature.

Dry Fruits: The pericarp of simple dry fruits is usually quite dry and hard. It is not differentiated into the three layers of epicarp, mesocarp and endocarp. In some dry fruits, this pericarp is broken down and the seeds are scattered or dispersed. These fruits are dehiscent fruits. In some fruits, the pericarp is further arranged into one or more seeded segments. Such fruits are schizocarpic fruits. In some fruits, the pericarp is not observed to be dehisced even after maturing/ripening. Such fruits are indehiscent Fruits.

Types of dry simple fruits are: a. Dehiscent fruits b. Indehiscent fruits

a. Dry Dehiscent fruits

Dry Fruits, pericarp dry at maturity a. Dehiscent fruits, those which dehisce or split open when fully mature (1) Follicle, composed of one carpel and splitting along a single suture (2) Legume, composed of a single carpel and splitting along two sutures (3) Capsule, composed of several carpels and opening at maturity in one of four ways: (a) Along the line of carpel union (septicidal dehiscence) (b) Along the middle of each carpel (loculicidal dehiscence) (c) By pores at the top of each carpel (poricidal dehiscence) (d) Along a circular, horizontal line (circumscissle dehiscence) (4) Silique, composed of two carpels which separate at maturity, leaving a persistent partition between them

b.Dry Indehiscent fruits

Indehiscent fruits, those which do not split open at maturity (1) Achene or akene, a one-seeded fruit with the seed attached to the fruit at one point only (2) Caryopsis or grain, a one-seeded fruit in which the seed is firmly attached to the fruit at all possible points (3) Samara, a one- or two-seeded fruit with the pericarp bearing a wing like outgrowth. A modified achene (4) Schizocarp, consisting of two carpels which at maturity separate along the midline into two one-seeded halves, each of which is indehiscent (5) Loment, having several seeds, breaking into one-seeded segments at maturity (6) Nut, a hard, one-seeded fruit, generally formed from a compound ovary, with the pericarp hard throughout B. Aggregate Fruits. Aggregate fruits consist of a number of matured ovaries formed achene (e.g. buttercup)

2.Aggregate Fruits

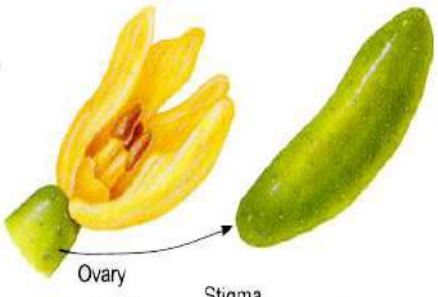
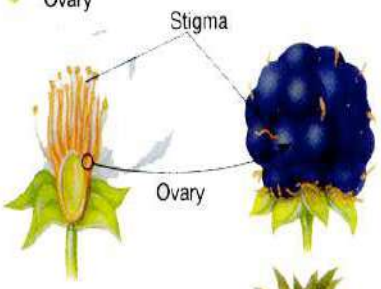
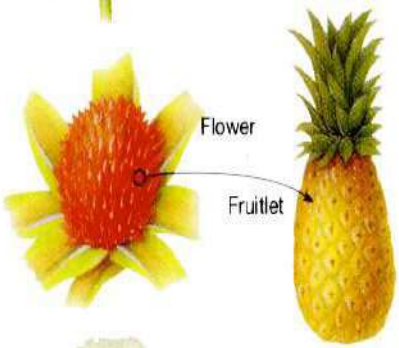
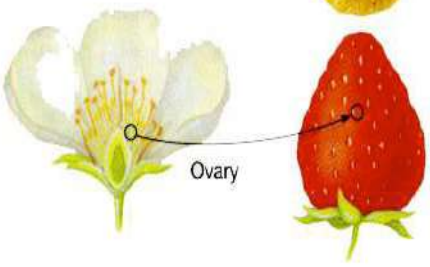
These are the fruits that develop from the multicarpellary apocarpous ovary. It becomes a fruitlet because each carpel is separated from one another in the apocarpous ovary. These fruits make a bunch of fruitlets which is known as etaerio.

- **Etaerio of follicles:** Each fruit or etaerio is a follicle. Eg. Calotropis, Catharanthus, Magnolia -e. In calotropis, the stigma is fused or joined in carpellary ovary and ovaries of ovules are separated. It means only two follicles are present in etaerio.
- **Etaerio of achenes:** In this aggregate fruit, each fruit is an achene. Eg. Ranunculus, Strawberry, Rose, Lotus. In lotus, the thalamus becomes spongy and some achenes are embedded in it. In strawberry, the thalamus is fleshy and we can find small achenes on its surface.
- **Etaerio of berries:** It is an aggregate of small berries. Eg. Polyalthia, Annona squamosa (Custard-apple). In the etaerio of Annona, all the berries are arranged densely on the thalamus.
- **Etaerio of drupes:** In this type of fruit, many small drupes develop from different carpels. Eg. Raspberry. In this type carpel of apocarpous ovary form drupe fruit.

3.Multiple or Composite Fruits

All composite fruits are false fruits. In these fruits, generally, there are many ovaries and other floral parts combining to form the fruit. These are of two types:

- **Sorosis:** These fruits develop from spike, spadix or catkin inflorescence. Examples inJackfruit fruit, Kevda (screwpine). In jackfruit (Kathal) pistillate flowers are developed around the peduncle. In fruit formation, the pericarp becomes spongy and fused.
- **Sycosis:** These fruits develop from hypanthodium inflorescence. Receptacle becomes hollow and has a pore. Numerous small scales surround the pore. Eg. Ficus species Peepal

Type	Characteristics	Example	Flower	Fruit
Simple	Develops from a single ovary, formed from a single carpel or from two or more fused carpels (= compound pistil)	Cucumber		
Aggregate	Develops from fusion of many separate carpels in a single flower	Raspberry		
Multiple	Develops from ovaries of many flowers grouped on same stalk	Pineapple		
Accessory	Develops from ovaries plus nearby tissue	Strawberry		

UNIT III

CURUCIFERAE

Characters of Brassicaceae:

Flowers actinomorphic rarely zygomorphic, hermaphrodite; sepals four in two whorls of two each, petals four, diagonally arranged-cruciform; stamens six, tetradynamous; gynoecium bicarpellary, syncarpous, parietal placentation, bilocular due to the formation of flase septum (replum); fruit siliqua or silicula.

A. Vegetative characters:

Habit:
Generally herbs, annual (Brassica, Capsella) or biennial or shrubs. Common Indian herbs are Eruca, Alyssum, Nasturtium, Lepidium, Coronopus etc. Vegetative reproduction is by bulbils (Dentaria bulbifera) or by coral roots.

Roots:
Tap root, swollen on account of stored food materials. It may be conical (Radish), fusiform or napiform (Turnip).

Stem:
Herbaceous, erect, cylindrical (Iberis, Brassica) rarely woody or some times reduced (Raphanus & Brassica species), glabrous or hairy, solid and branched.

Leaves:
Alternate or sub-opposite, simple, exstipulate (Brassica campestris). May be cauline or radical (Raphanus), generally sessile, hairy, entire and with unicostate reticulate venation.

B. Floral characters:

Inflorescence:
Raceme (Brassica campestris) corymbose raceme (Iberis) or corymb.

Flower:
Pedicellate, ebracteate, hermaphrodite, actinomorphic rarely zygomorphic (Iberis and Teesdalia), hypogynous, complete or incomplete (Lepidium) and tetramerous.

Calyx:
Sepals 4 arranged in two whorls of two each, polysepalous (2 antero-posterior and 2 lateral), 2 lateral sepals may be saccate, imbricate aestivation, inferior.

Corolla:
Petals 4, alternate with sepals, polypetalous, petals arranged in the form of across known as cruciform. This arrangement is characteristic of the family Petals usually clawed, petals generally equal rarely unequal (Iberis, Teesdalia) or sometimes petals may be replaced by stamens (Capsella bursa pastoris).

Androecium:
Stamens 6, arranged in two whorls, outer two stamens short and inner four long (2+4), tetradynamous, polyandrous, anthers dithecous basifixed, introrse. Disc like nectaries, variable in number, present at the base of stamens. In some cases the number of stamens is variable – 16 (Megacarpaea), 4 (Cardamine hirsuta), 2 (Coronopus) etc.

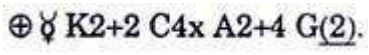
Gynoecium:
Bicarpellary rarely tricarpellary (Lepidium sativum), syncarpous, ovary superior, unilocular, becomes bilocular due to the development of false septum called replum: parietal placentation, ovules many, style short, stigma simple or bifid. The crucifer carpel has been a puzzling subject for the morphologists and their attention attracted towards its for a long time. According to some there are only two carpels while others hold that there are four carpels.

Fruit:
Siliqua or silicula, sometimes lomentum (Raphanus); when the valves separate in a siliqua the seeds remain attached to the replum.

Seed:
Ex-albuminous. The germination of seed is epigeal.

Pollination:
Self or cross pollinated; flowers are visited by insects due to the presence of nectaries. Cleistogamy is found in Cardamine chenopodifolia. Anemophilous pollination is found in Pringlea.

Floral formula:



Distribution of Brassicaceae:
This family is also called Brassica family. The family includes 375 genera and 3200 species according to Willis. It is distributed all over the world but mainly confined to the Mediterranean region and north temperature regions.

Economic Importance of Brassicaceae:
This family is of considerable economic importance.

1. Food:
The plants of this family which are cultivated as vegetable crops are:

Brassica oleracea var. botrytis (H. Phul gobhi), B. oleracea var. capitata (H. Band gobhi), B. oleracea var. caulorapa (H. Gand-gobhi), Brassica campestris var. sarson (white mustard), Brassica rapa (H. Shalgam), Raphanus satiuus (H. Muli), are edible and cooked as vegetables.

2. Oil:
The seed of B. campestris (or white mustard) yield mustard oil or Karwa-tel which is widely used as a cooking medium. B. nigra (H. Kalirai) and B. juncea (H. rai) also produce oil.

After extracting oil the cake is left behind which is highly nutritious as a cattle feed; the oil cake is also used as soil fertilizer. Raphanus seeds also produce a pungent oil which is often used in adulteration of sarson oil; this oil has digestive properties.

3. Medicines:
The leaves and tender shoots of Lepidium sativum are used in liver complaints, asthma, cough and bleeding piles. Rorippa montana is an appetizer and a stimulant. The seeds of Cheiranthus cheiri are used in bronchitis and fever. The flowers are used in paralysis and impotency. Lobularia is used for gonorrhoea. Iberis amara is used in rheumatism and gout.

4. Ornamentals:
Some plants are grown in gardens for their beautiful flowers viz. Cheiran thus cheiri (wall flower), Iberis amara (candituft) Lobularia, Matthiola (stock), Hesperis (rocket), Alyssum, Lunaria (honesty) etc.

Primitive characters:
1. Leaves simple and alternate.

2. Flowers hermaphrodite, hypogynous and actinomorphic.

3. Calyx and corolla free.

4. Stamens polyandrous.

5. Ovules anatropous.

Advanced characters:
1. Plants are generally herbs-annual or biennials.

2. Leaves exstipulate.

3. Flowers ebracteate and sometimes zygomorphic (Iberis).

4. Gynoecium bicarpellary and syncarpous.

5. Fruit simple.

Affinities of Brassicaceae:
Rendle placed this family under the order Rhoedales; Bentham-Hooker placed it under the cohort Parietales. The family is related to the Papaveraceae on one hand and to the Capparidaceae on the other. Bentham & Hooker and Hutchinson (1948, 1964) hold the view that Brassicaceae is derived from the Papaveraceous ancestors whereas Eames, Arber, Hayek and Puri believe it to have a Capparidaceous alliance.

The three families, Capparidaceae, Brassicaceae (Cruciferae) and Papaveraceae have in common the features of tetramerous perianth, bicarpellary syncarpous gynoecium and parietal placentation. These characters gave problematic issues as to whether the Brassicaceae (Cruciferae) originated from the Capparidaceae or descended from the Papaveraceae.

The anatomy and morphology of stamens and carpels of cruciferous flower bears testimony to a papaverous ancestory. But in Brassicaceae the stamens are tetradynamous and not in Papaveraceae.

Comparison of floral diagram indicates that Brassicaceae is closely allied to Capparidaceae. But in Brassicaceae gynophore and variable number of stamens are absent where as these are the prominent characters of Capparidean flowers.

Within the Rhoedales reduction seems to have taken place in the number of stamens. In the Papaveraceae there are numerous stamens but in its two subfamilies reduction has occurred. In the Hypecoideae there are only four stamens; in the Fumarioideae the stamens are arranged in two bundles each with one dithecous and two monothecous anthers.

In the Capparidaceae the number of stamens range between several (as in Capparis) to six (as in Gynandropsis). Finally in Cleome there are only four stamens. The floral diagram of Cleome spinosa with six stamens is remarkably similar to that of the Brassicaceae (Cruciferae).

In this family the general condition is tetradynamous but may be reduced to only two (as in Coronopus). Celakovasky considers the above view as most satisfactory.

Cronquist (1968) too considers that the Brassicaceae (Cruciferae) evolved from the Capparidaceae.

Common plants of the family:

1. Brassica campestris (Sarson) – a cultivated herb.

2. Iberis amara (Chandni) – annual, ornamental, herb cultivated in winter.

3. Cherianthus cheiri (Wall flower) – ornamental annual herb.

4. Rorippa monatna (Water cress) – semi wild.

5. Capsella bursa – pastoris (Shepherd's purse) – common weed.

6. Farsetia jaquemontii – common weed.

7. Coronopus didymus (= Senebiera didyma) – wild in waste places.

8. Eruca sativa (Tara mira) – cultivated for seeds that yield an oil.

Division of the family and chief genera:

Types of Brassicaceae: *Brassica campestris*

Habit and habitat:

An annual herb, cultivated for seeds which yield oil.

Root:
Tap and branched.

Stem:
Herbaceous erect, cylindrical, solid, glabrous or hairy.

Leaf:
Simple, alternate, exstipulate, lower ones lyrate and upper oblong or lanceolate, unicostate reticulate venation, hairy, sessile.

Inflorescence:
A corymbose-raceme.

Flower:
Ebracteate, pedicellate, complete, actinomorphic, hermaphrodite, cruciform, tetramerous, hypogynous, and yellow.

Calyx:
Sepals 4 (2 + 2) in two whorls, outer whorl antero-posterior, the two lateral one saccate, green, polysepalous, inferior.

Corolla:
Petals four, polypetalous, cruciform, valvate, inferior, yellow.

Androecium:
Stamens six, tetradynamous, in two whorls, the outer with two short lateral stamens and inner with four long stamens arranged in two median pairs. Basifixed, polyandrous, introrse. Four green nectaries are present, on the inner side of each short stamen and a similar one at the base but outside each pair of long median stamens, inferior.

Gynoecium:
Bicarpellary, syncarpous, superior, unilocular becoming bilocular by the development of false septum called – replum; parietal placentation, style short, stigma bilobed.

Fruit:
Siliqua.

Seed:
Non-endospermic.

Floral formula:
⊕ ♀ K2+2 C4x A2+4 G (2).

.

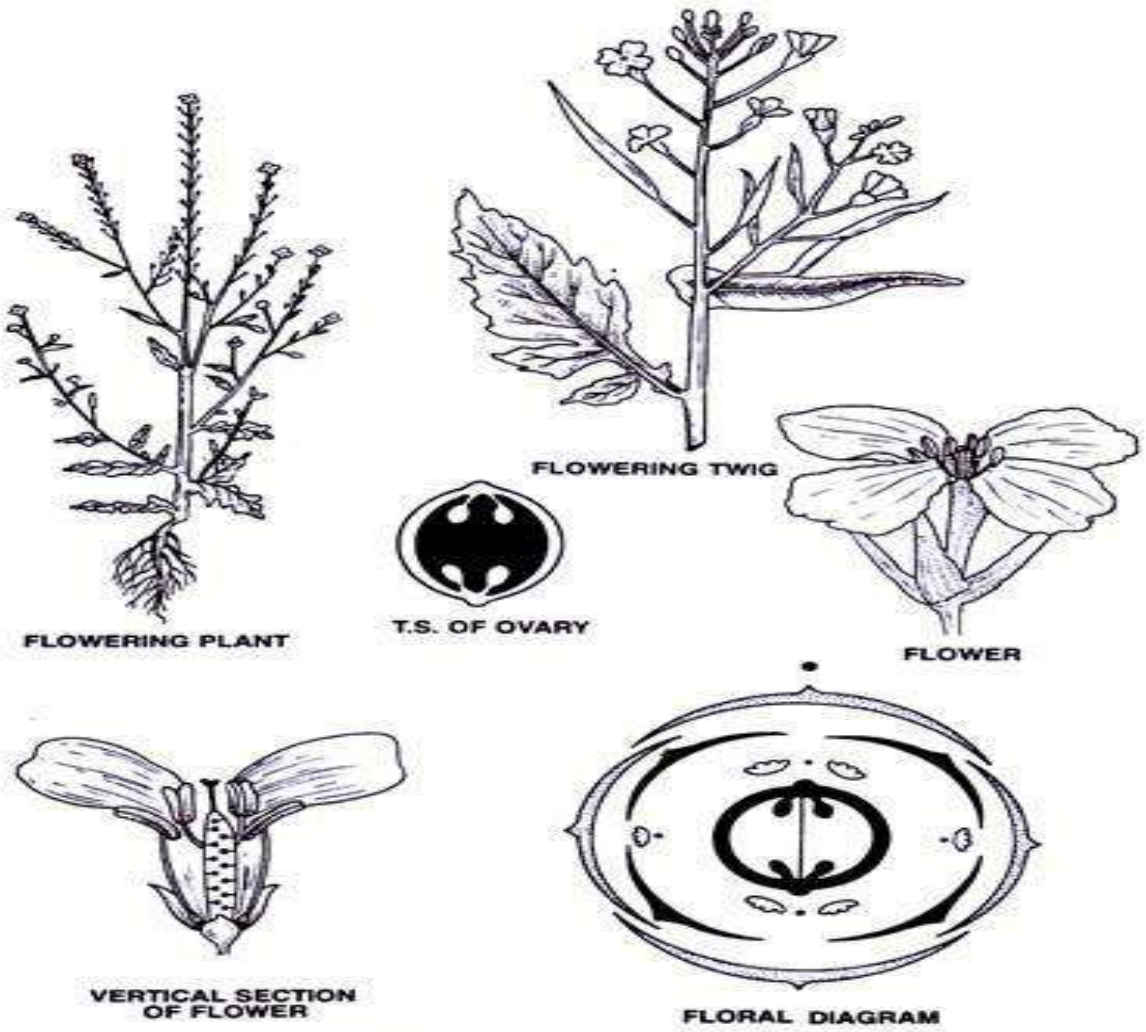


Fig. 31.1. *Brassica campestris.*

CAPPARIDACEAE

Characters of Capparidaceae:

Stipules spiny, flowers actinomorphic rarely zygomorphic, hermaphrodite, hypogynous, gynophore present; calyx polysepalous, corolla polypetalous; stamens 4 to numerous; carpels two, ovary superior, parietal placentation.

A. Vegetative characters:

Habit:

There is a great variation in habit of the plants, may be herbs (Cleome), shrubs (Capparis) or trees (Crataeva). Several plants are extreme xerophytes with reduced leaves or leaves entirely absent in adult plant (Capparis aphylla). Unlike the Papaveraceae there is no latex in the stem.

Root:

Branched tap root.

Stem:

Herbaceous or woody, solid, branched, spinous and cylindrical.

Leaves:

Alternate, simple or palmately compound, with stipules, the latter may be modified into spines or glands. In some cases e.g., Capparis aphylla, the leaves are suppressed and adult plant may be without leaves.

Inflorescence:

Raceme (Cleome), corymb (Maerua, Capparis aphylla), solitary (Niebuhria).

B. Floral characters:

Flower:

Bracteate, actinomorphic sometimes zygomorphic (Capparis aphylla), hermaphrodite, bracteoles absent; hypogynous, pedicellate, tetramerous. The internode between the petals and stamens is elongated to form androphore or that between the stamens and carpels elongated of form gynophore.

Calyx:

Sepals 4, usually arranged in two whorls (2 + 2); polysepalous imbricate aestivation and inferior. In Capparis aphylla the sepals are unequal and the hinder sepals forms a hood-like structure.

Corolla:

Petals 4, polypetalous with long claws; imbricate (Cleome) or valvate (Crataeva) aestivation, inferior. In the Australian genus Emblingia the petals are fused.

Androecium:
Stamens numerous to four. In Capparis and Crataeva there are numerous stamens. In Cleome gynandra only six stamens are present; in Cleome tetrandra there are only four stamens. Cleome spinosa has six stamens and its floral structure is remarkably similar to that of the Brassicaceae excepting that they are not tetradynamous.
In Cleome gynandra (Gynandropsis) both androphore and gynophore are present. In Capparis there is only gynophore. In Cleome the gynophore is very small or reduced.

Gynoecium:
Carpels 2 or sometimes four, syncarpous, seated on a long gynophore or sessile; ovary superior, unilocular with parietal placentation; ovules many on each placentum; style short or absent, stigma capitate or depressed.

Fruit:
A siliqua (Cleome) or berry (Capparis) or drupe (Roydsia).

Seed:
Usually kidney shaped, ex-albuminous and embryo curved.

Pollination:
Usually entomophilous; dichogamy in some cases.

Floral formula:
⊕ ☿ K2+2 C4 A4–6 or α G(2)

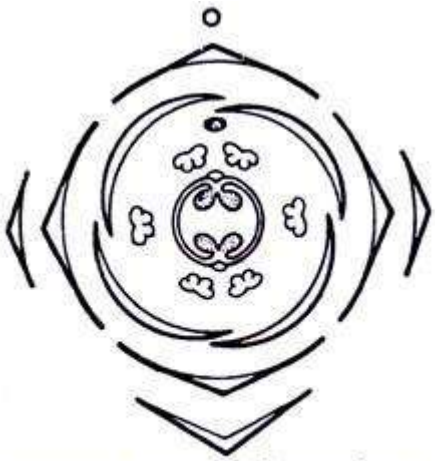


Fig. 32.1. Floral diagram of *Cleome spinosa* with six stamens and a nectary on the posterior side (after Eichler).

Distribution of Capparidaceae:
It is commonly called Caper family. The family consists of 45 genera and 700 species according to Pax and Hoffman. In India it is represented by 65 species. The plants are distributed in tropical, subtropical and warm temperate zones of both the hemispheres.

Economic Importance of Capparidaceae:
The family is not of great economic importance.

1. Food:
The fruits of Capparis aphylla, Capparis spinosa are preserved as pickle.
2. Medicine:
The top shoots and young leaves of Capparis aphylla are powdered and used to raise blisters and relieve tooth-ache. The burned and powdered wood of Capparis aphylla is a sure shot for leucorrhoea.
The root bark of Capparis spinosa is used as carminative and stimulant. The bark of Crataeva religiosa is used in medicine as a remedy for gall-bladder stone.
According to Campbell the crushed roots of Cleome monophylla when kept on the lips of a fainted person restores his conciousness.
3. Ornamental:
The ornamental plants are Maerua, Roydsia suaveolens; Crataeva religiosa is also considered a holy plant by some sects of Hindus.

Affinities of Capparidaceae:
Engler and Prantl placed the family under Rhoedales just before the Brassicaceae (Cruciferae) and intermediate between Papaveraceae and Cruciferae. Many botanists agree that Capparidaceae and Brassicaceae are closely related in bicarpellary ovary and parietal placentation. It seems that either these families have been derived from a common ancestor or Brassicaceae might have evolved from a primitive member of the Capparidaceae.
Puri (1945) was of the opinion that bicarpellary ovary and parietal placentation has been derived from a 4-loculed and 4-carpelled ovary with axile placentation.

Primitive characters:
1. Plants are mostly shrubs and some tree (Crataeva).
2. Laves alternate, stipulate and simple in some species (Cleome, Maerua).
3. Flowers hermaphrodite, hypogynous and actinomorphic.
4. Calyx and corolla free.
5. Presence of androphore or gynophore.

Advanced characters:
1. Leaves deciduous and exstipulate (Capparis decidua).
2. Calyx fused to form a tube (Maerua).
3. Gynoecium bicarpellary and syncarpous.
4. Fruit simple and seeds exalbuminous.

Common plants of the family:
1. Capparis decidua – A leafless shrub and its fruits make good pickle.
2. Cleome gynandra – A common weed with medicinally important seed.
3. Crataeua religiosa – A medium sized tree.
4. Maerua – A climbing shrubs.
5. Polanisia viscosa – A weed with yellow flowers and unstalked ovary.

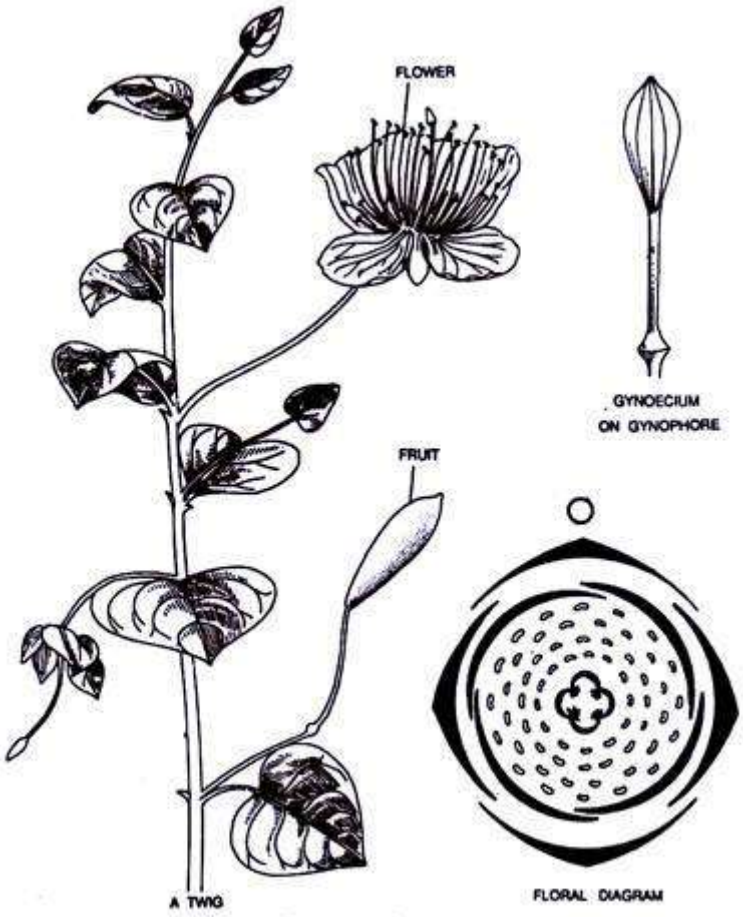


Fig. 32.2. *Capparis decidua.*

TILIACEAE:

Characters of Tiliaceae:
Leaves simple, stipulate; flower hermaphrodite, hypogynous, actinomorphic, stamens indefinite sometimes 5 to 10; carpels 2 to indefinite, syncarpous, axile placentation; fruit capsule or drupe.

A. Vegetative characters:

Habit:
Shrubs or trees rarely herbs (Corchorus) with mucilagenous juice.

Root:
Tap and branched.

Stem:
Erect, cylindrical or angular, woody, solid and branched.

Leaves:

Alternate rarely opposite, simple, margin entire, dentate or lobed-, stipulate, stipule caducous (Tilia).

B. Floral characters:

Inflorescence:
Cymose and often very complex (Tilia, Triumfetta).

Flower:
Pedicellate, actinomorphic, hypogynous, hermaphrodite, rarely unisexual (Carpodiptera), tetra or pentamerous, sometimes with epicalyx.

Calyx:
Sepals 5 or 4 rarely 3, polysepalous or basally connate, valvate aestivation, inferior.

Corolla:
Petals 5 or 4 rarely absent (Prockia), polypetalous, often glandular, imbricate aestivation, usually coloured but sometimes sepaloid, inferior.

Androecium:
Stamens 10 to indefinite, free or united in groups (Grewia), inserted at the base of petals or on androphore (Grewia), anthers dithecous, extrorse, dehiscence by apical pores or longitudinal slits.

Gynoecium:
Carpels 2 to 10 or many (Apeiba), syncarpous; ovary superior, 2 to many locular with 1 to many anatropous ovules in each loculus; axile placentation; style simple; stigma capitate or lobed.

Fruit:
Capsule or schizocarpic or drupaceous.

Seed:
Endospermic, embryo curved with leafy cotyledon.

Pollination:
Entomophilous.

Floral formula:

$\oplus \, ♀ \, K5 \text{ or } (5) \, C5 \, A \, \alpha \, G \, \underline{(2-\alpha)}$

Distribution of Tiliaceae:

It is commonly called Jute family. It comprises 50 genera and 450 species. The members are mostly tropical and some inhabitants of temperate climate. It is abundant in South East Asia and Brazil.

Economic Importance of Tiliaceae:

1. Fibre:
Corchorus capsularis and C. olitorius are cultivated for their tenacious blast fibres, which yield jute of commerce. It is used in making gunny bags.

2. Medicinal:
The fruits of Grewia asiatica are astringent, cooling and digestive. The root bark is used in rheumatism.

The flowers, leaves and fruits of Triumfetta bartramia are used in gonorrhoea. Bark and fresh leaves of this plant are used in diarrhoea and dysentery.

3. Wood:
The species of Tilia yield useful timber. Tilia americana is one of the best timber plant of America.

4. Ornamental:
Some of the plants viz. Sparmannia, Microcos are grown in gardens.

Primitive characters:
1. Plant are generally shrubs or trees.
2. Leaves alternate, simple, stipulate.
3. Flowers hermaphrodite, hypogynous and actinomorphic.
4. Corolla polypetalous.
5. Gynoecium polycarpellary (Apeiba).
6. Seeds endospermic.

Advanced characters:
1. Inflorescence cymose or complex (Tilia).
2. Flowers unisexual (Carpodipetera).
3. Corolla rarely absent (Prockia).
4. Gynoecium syncarpous with axile placentation.
5. Presence of curved embryo in the seeds.

Affinities of Tiliaceae:
The family Tiliaceae is related to Sterculiaceae in habit, leaves, stipules and androphore (Grewia). It differs from Malvaceae in stellate hairs, dithecous anthers and polyadelphous stamens.

It is also allied to the family Elaeocarpaceae and hence Bentham and Hooker had included the latter in Tiliaceae. Engler has set the family Elaeocarpaceae apart from Tiliaceae due to mucilage, presence of imbricate sepals and porous dehiscence of anthers.

Common plants of the family:
1. Corchorus – The well known Jute fibre, is obtained from this plant.
2. Grewia asiatica – The fruits are acidic and syrups are made from it.
3. Telia – A big tree.
4. Triumfetta bartramia – A weed of waste places.

RUTACEAE |

Hypogynous to slightly perigynous; bisexual or unisexual; apocarpous to syncarpous with axile, basal or apical placentation; ovules mostly few; stamens definite in number, free; petals contorted to valvate; disc mostly conspicuous; leaves often gland-dotted; endosperm present.

Explanation of Family—Rutaceae:
There are about 140 genera and 1300 species in this family.

Distribution:
They are widely distributed in warm temperate regions. They are also found in tropical regions. In our country the family is represented by several important genera such as, Citrus, Aegle, Feronia, Murraya, Ruta, etc.

Habit:
Usually the plants are trees or shrubs. Herbs are rarely found. Some of the shrubs are climbing and xerophytic. Aegle marmelos (Bel) and Feronia elephantum (Kaith) are large sized trees Murraya exotica is an ornamental shrub with scented white flowers. Sometimes the shrub becomes tree-like in habit.

Species of Citrus are small trees. They are grown in the gardens for their fruits rich in vitamins. Ruta graveolens is a strong-smelling herb which is a common garden shrub. The plant of Paraminya grifithii is a woody climber. This possesses strong curved spines.

It is believed that Citrus aurantium (Narangi) probably originated in Northern India and Assam. It has been cultivated since 1500 B.C.

Root:
Tap and branched.

Stem:
Usually erect, sometimes climbing branched, woody or rarely herbaceous, cylindrical, solid, green when young, grey when becomes old.

Leaves:
The leaves may be either simple or compound. They are usually alternate and rarely opposite. They are exstipulate. The leaves are dotted with glands. These glands contain volatile oils

which give typical smell to the leaves. In most of the Citrus species the leaves possess winged petioles.

According to many authors the leaves with winged petioles are regarded as unifoliate palmate type of compound leaves. In early stages actually the leaf possesses three leaflets but on its maturity two of them fall off. In certain Australian genera such as Citrus, Feronia, etc., the leaves are reduced to spines. Such plants are extreme xerophytes.

Inflorescence:
The inflorescence consists of several variations in different species. Generally it is cymose, but sometimes it is racemose. In some cases the flowers are solitary axillary. In Murraya exotica the flowers are arranged in either axillary or terminal corymbs. In Citrus sp., the flowers are either solitary axillary or arranged in racemes.

Flower:
The flowers are pedicellate, complete, hermaphrodite, regular or occasionally slightly zygomorphic, white or yellow, hypogynous. A disc is present beneath the ovary. Usually pentamerous and rarely tetramerous, or trimerous. Sometimes the flowers are unisexual, e.g., Evodia, Zanthoxylum, etc.

Calyx:
There are usually five sepals. Sometimes only four sepals are found. Usually polysepalous but in the genera with zygomorphic flowers the calyx becomes either tubular or united. The aestivation is either imbricate or quincuncial.

Corolla:
There are usually five petals. Sometimes only four petals are present. The corolla is polypetalous. However, in an Australian species Correa speciosa, the petals become united attaining campanulate shape. The petals are coloured-white, yellow or red. The petals are inferior. The aestivation is imbricate.

Androecium:
Usually ten or eight stamens are present in obdiplostemonous condition. Sometimes the number of stamens decreases or increases to indefinite. In Citrus sp., and Aegle marmelos the stamens are indefinite. In such cases they are arranged in irregular bundles, i.e., polyadelphous condition. In Murraya exotica there are ten stamens arranged in two whorls of five each.

One whorl of stamens is alternating and the other antipetalous. The filaments are free. The anthers are bilobed, basifixed and introrse.

Gynoecium:

The gynoecium consists of 3, 4, or five carpels. Rarely it consists of a fewer number of carpels or indefinite carpels. The carpels are fused together, i.e., syncarpous. In most of cases the placentaion is axile. The ovary is tri to multilocular. Each locule contains one or more anatropous ovules. In Feronia, however, the placentation is parietal. In this a large number of ovules are arranged in several rows on the parietal placentas.

Fruit:

The fruits are of various kinds in different genera. They may be berry, drupe or capsule. In Murraya exotica the fruit is berry. The Citrus fruits are known as hespiridium (a berry). In Acronychia, the fruit may be capsule or drupe.

Seeds:

The seeds are endospermic or non-endospermic. Each seed contains a large straight very often curved embryo.

Pollination:

Usually entomophily, i.e., by means of the agency of insects. The nectar secreting disc found beneath the ovary is main source of attraction for the insects. The coloured and scented flowers also attract the insects.

Floral Formula: ⊕ ♀ K 5, or (5), C 5, A 10, G ($\underline{3-5}$).

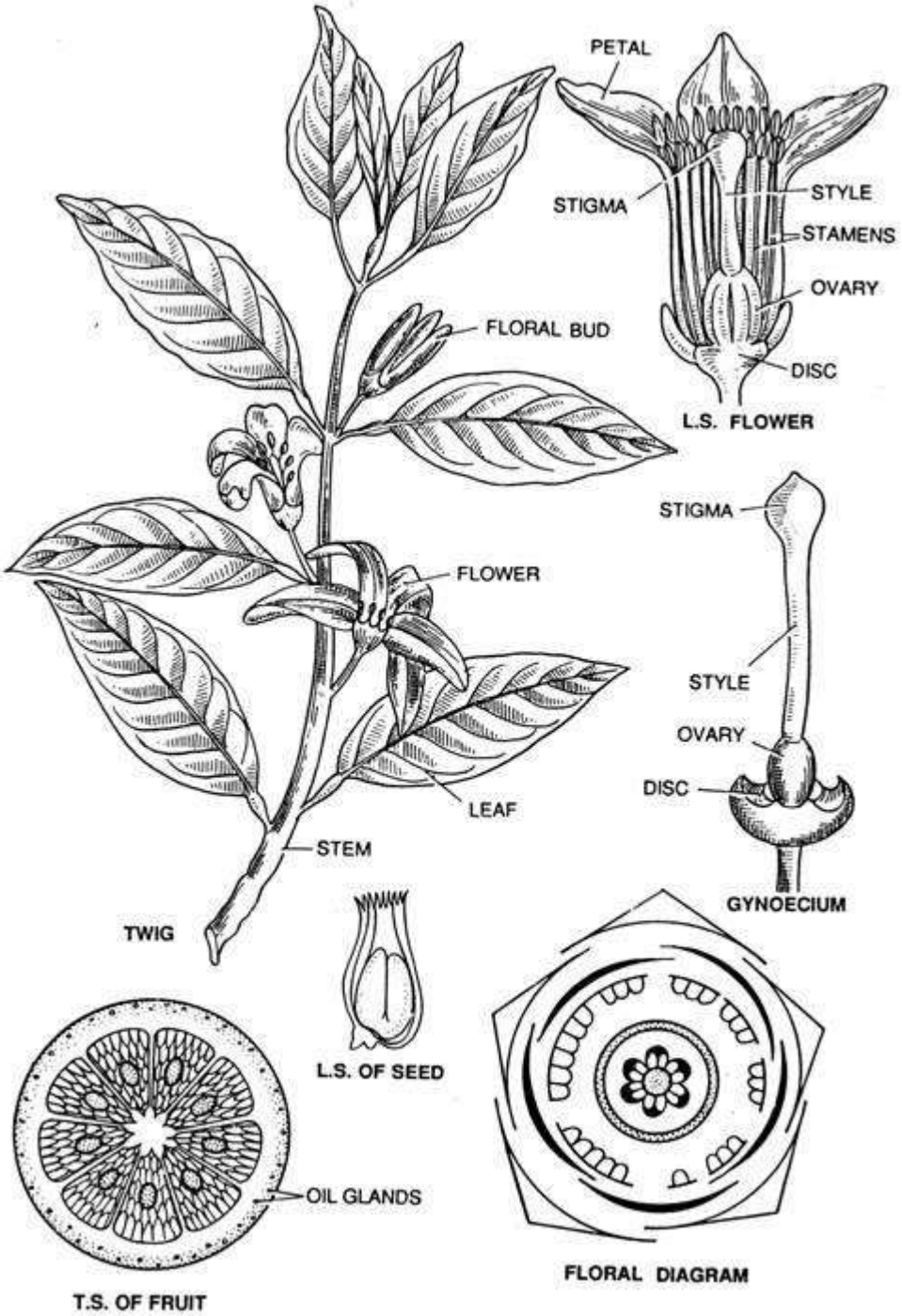


Fig. 18.1. Rutaceae, *Citrus aurantium* Linn., Orange; Verna, **Narangi.**

ANACARDIACEAE

Characters of Anacardiaceae:

Leaves alternate, exstipulate, simple or pinnately compound; auxiliary panicle inflorescence; flower pentamerous, hermaphrodite, actinomorphic, stamens 10 inserted at the base of an annular disc (intrastaminal disc); Carpels 1-2, Ovary superior with one pendulous or ascending ovule; fruit a drupe.

A. Vegetative characters:

Habit:

Generally trees and shrubs and rarely woody vines containing resin passages with gum or acrid juice.

Root:

Tap, root, deep.

Stem:

Erect, woody, hard, with resinous bark.

Leaves:

Alternate, (opposite in Dobinea) simple (Mangifera) or pinnately compound (Rhus, Odina), exstipulate.

B. Floral characters:

Inflorescence:

A terminal or axillary panicle.

Flower:

Small, complete, usually actinomorphic rarely zygomorphic, pentamerous, hermaphrodite but often unisexual (Rhus, Pistacia, Odina) by reduction of androecium or gynoecium, a nectar secreting disc or gynophore present; hypogynous.

Calyx:

Usually 5 sepals, sometimes 3 to 7, free, or basally connate or semi-connate, imbricate.

Corolla:

Petals 5-3 or absent (Pistacia) polypetalous rarely connate, imbricate, sometimes fused with the receptacle to form a hypanthium.

Androecium:
Stamens ten in two whorls of 5 each all fertile (Buchanania), in Anacardium, 10-7 of which only one is functional and the rest are staminodes; filaments free, basally connate, stamens arise from the base of on intrastaminal disc, this disc may sometimes be modified into a gynophore, anther bithecous, introrse.

Gynoecium:
Tricarpellary rarely pentacarpellary, syncarpous, unilocular, superior, one pendulous ovule; in Bauchanania – ovary pentacarpellary and pentalocular with only one ovule; styles 1-5, widely separated.

Fruit:
Usually drupe, mesocarp resinous, and fleshy in Mangifera, sometimes nut (Anacardium).

Seed:
Cotyledon thick with little or no endosperm and curved embryo.

Pollination:
Entomophilous.

Floral formula:
$\mathrm{Br,\ \oplus\ \varnothing\ K_{(4-5)\ or\ 5}\ C_5\ A_{1-10}\ \underline{G_{(1-5)}}}$

Distribution of Anacardiaceae:
The family is also called Mango or Cashew family. It includes 80 genera and over 600 species according to Jones and Liechsinger (1987). Chiefly tropical but occurs in S. Europe, temperate Asia and also America. Mangifera extends from India to Malaya and the Philippines.

Economic Importance of Anacardiaceae:

1. Food:
Many plants yield edible fruits such as Mangifera indica (mango), Anacardium occidentale (Cashew-nut), Buchanania lanzan (Chironji), Harpephyllum caffrum (Kaffir plum), Spondias pinnata (Hog plum), Pistacia vera (pistachio-nuts).

Pistacia lentiscus (mastic tree) yields a mastic resin used in chewing gums, alcoholic beverages etc.

2. Varnish:

Many species of Rhus and Semecarpus yield resins and varnishes.

3. Gum:
Lannea coromandelica bark provide gum.

Schinopsis lorentzii and bark of Lannea coromandelica are used in tanning industry.

4. Ink:
Insect galls on the branches and leaves of various species of Rhus, Pistacia are used in manufacture of ink.

Semecarpus anacardium (Dhobis-nut) fruits provide black ink used for dyeing textiles and marking cotton clothes.

5. Skin irritants:
Rhus toxicodendron, R. quercifolia etc. are skin irritants.

6. Ornamentals:
Continus coggyria, Rhus typhina and Spondias pinnata are ornamental plants.

Primitive characters:
1. Plants mostly trees and shrubs.

2. Leaves alternate and simple in most genera.

3. Flowers hypogynous, hermaphrodite and Actinomorphic.

4. Sepals and petals free.

5. Stamens free and bithecous.

Advance characters:
1. Leaves compound in some species.

2. Flowers small inconspicuous and arranged in distinct inflorescence.

3. Flowers unisexual in Rhus, Pistacia.

4. Petals absent in Pistacia.

5. Gynoecium monocarpellary in many genera Mangifera, Anacardium.

6. Fruit drupe or nut.

Common plants of the family:

1. Anacardium occidentale L; Cashew nut, "Kaju" a small tree extensively cultivated in Madras, Kerala, Mysore and Andhra Pradesh.

2. Mangifera indica L. Mango "Aam" "Amra" grown extensively in Uttar Pradesh, Madhya Pradesh, the Punjab, West Bengal, Maharashtra and Madras.

3. Buchanania lanzen streng. (B. latifolia Roxb); Cuddapah-almond, "Chironji", occurs throughout the country except in the dry North-West.

4. Pistacia vera L; pistachio nut "Pista", cultivated in N. India.

5. Rhus vernicifera DC (Toxicocendron vernicifera DC); varnish tree.

Division of the family and chief genera:

The Anacardiaceae is divided into five tribes:

Tribe (i). Dobineae:

Female flowers naked, Carpel 1. Example: Dobinea.

Tribe (ii). Mangifereae:

leaves simple and entire. Carpels 1-5. Example: Buchanania, Mangifera etc.

Tribe (iii). Rhoideae:

Carpels 4-5 ovary free from floral axis with a solitary ovule. Examples: Pistacia and Rhus.

Tribe (iv). Semecarpeae:

ovary adnate to and sunken in thalamus. Example: Semecarpous.

Tribe (v). Spondieae:

Leaves pinnately compound. Carpels 4-5, connate; ovules as many as carpels. Example: Spondias.

Important Type of Anacardiaceae:

Mangifera indica (The mango, "Aam" Fig. 50.1):

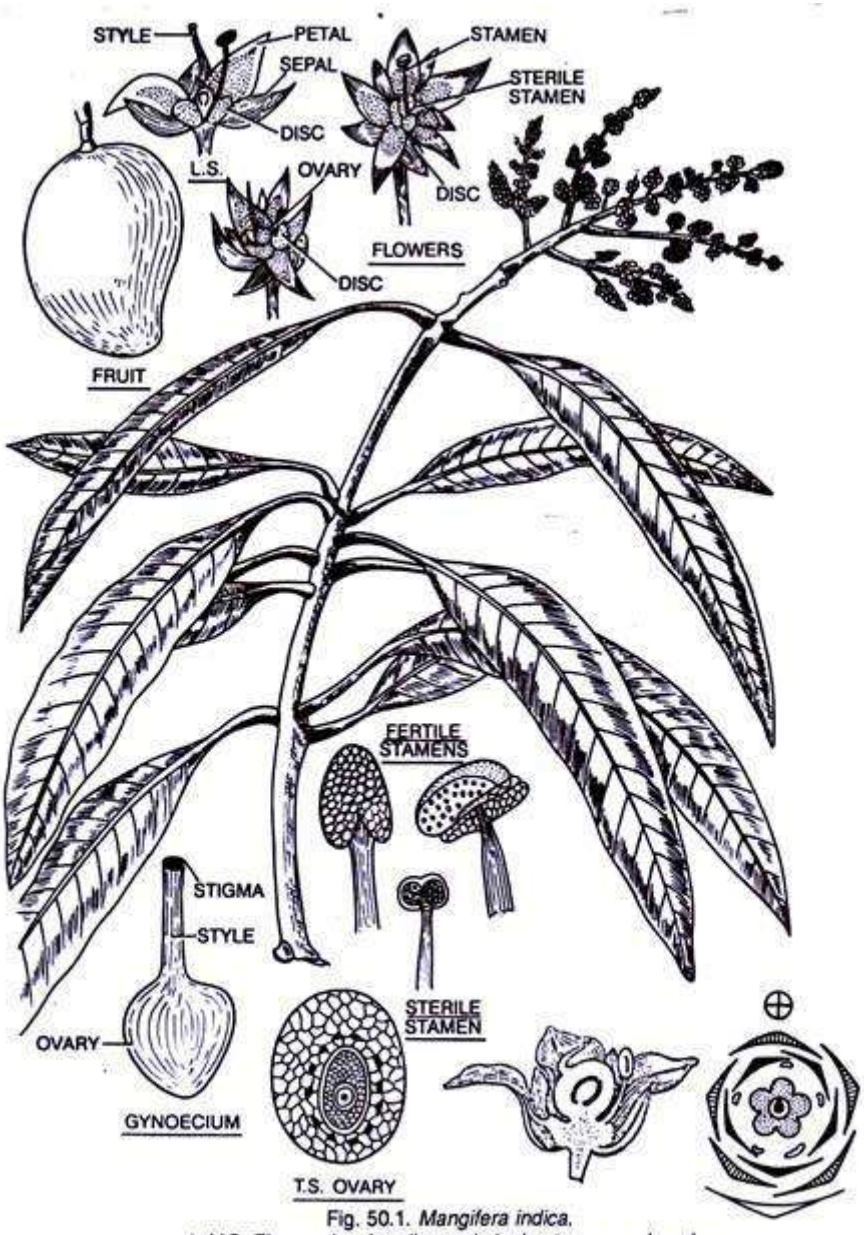


Fig. 50.1. *Mangifera indica.*
1. V.S. Flower showing disc and single stamen and ovule.
2. Floral diagram.

FABACEAE

Systematic position

Class **:** Dicotyledons

Sub class **:** Polypetalae

Series **:** Calyciflorae

Order **:** Leguminales

Family **:** Fabaceae

Common plant

Pisum sativum

Cicer arietinum

Glycine max

Lathyrus odoratus

Crotolaria guncea

Arachis hypogea

Clitoria ternatea

Distribution

- It includes 600 genera and 1200 spices.
- It is recorded as the second largest family of dicotyledons.
- In India the family is represented by 1100 species and 100 genera.
- The family divided into 3 sub-families
    - Faboideae
    - Caesalpinoideae
    - Mimosoidceae

Habit

- Fabaceae a wide variety of habits
- Generally the plants are herbs or shrubs (often climbing), very rarely trees.
- Sometimes they are hydrophytes and xerophytes.
- Most of the members are cultivated in the fields which yield pulses.

Stem

- The stem is erect or climbing (it climbs by means of tendrils), branched, angular or cylindrical herbaceous or woody.

Leaves

- The leaves are alternate, opposite or whorled, usually compound (digitate or pinnate), rarely even pinnate, sometimes simple, stipulate, stipules occur at the base of the petiole (foliaceous and large), sometimes secondary stipules arise at the base of individual leaflets.

Inflorescence

- The inflorescence is racemose, the spike, and the contracted raceme or head.

Flower

- The flowers are usually pedicellate, zygomorphic, irregular, hermaphrodite (bisexual), complete, perigynous and papilionaceous.

Calyx

- It consists of sepals, gamosepalous (united sepals), equal or unequal, below the disc united in a tubular calyx, 5 toothed or five lobed or bi-labiate (the two upper and three lower may unite). Aestivation ascending imbricate.

Corolla

- The corolla consists of 5 petals (unequal), the uppermost and the largest petal is known as standard or vexillum; the two free lateral petals are known as wings or alae; the anterior pair of united petals is termed keel or carnia, this encloses stamens and pistil. They are of various colours. Venation is conspicuous. Aestivation descending imbricate.

Androecium

- The stamens are usually 10, inserted on a disc below the calyx, they may be in two bundles (diadelphous) of 9+1 or 5+5, or in one bundle (monadelphous), rarely free. Anthers bi-celled, dorsifixed, dehiscence by longitudinal slits.

Fruit

- Legume or pod, splitting along both dorsal and ventral sutures. In some species it is indehiscent lomentum.

Seeds

- Many, exalbuminous, usually flattened.

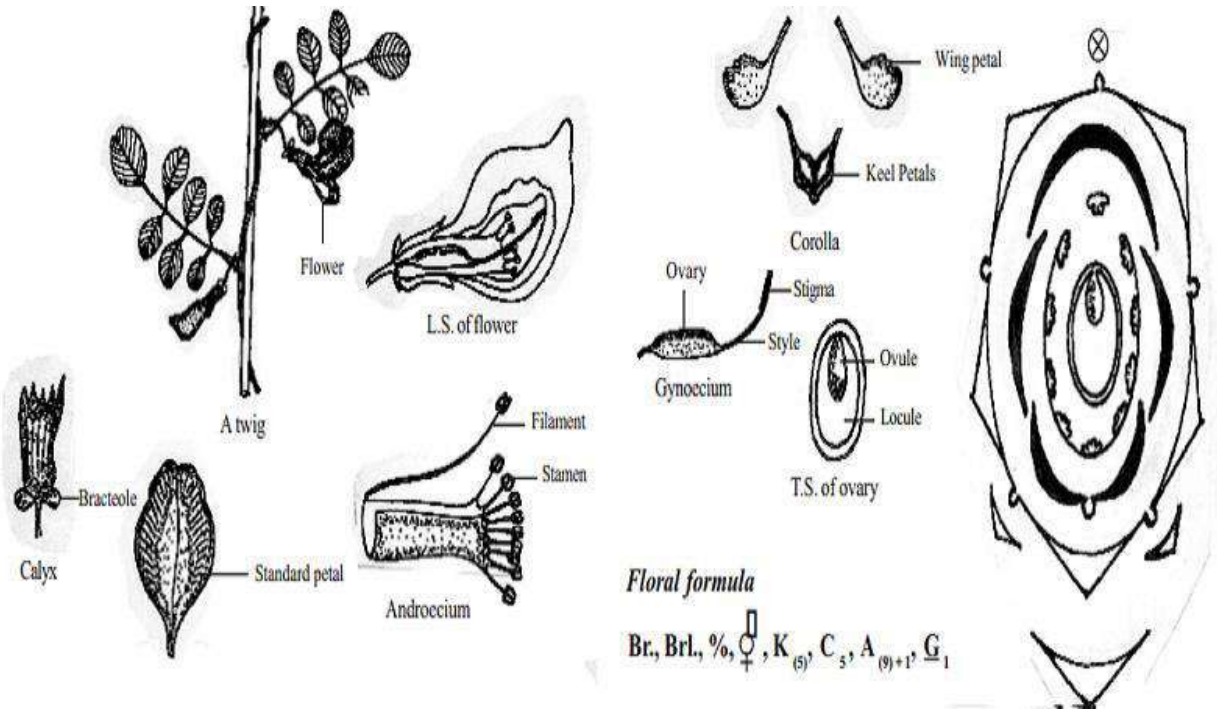
Pollination

- Entomophilous(insect pollinated)

Floral formula

-|- ♂ K(5), C 1+2+ (2), A(9)+1, G1.

Floral diagram



Economic important

- **1. Food**
  - The fruits and seeds of *Pisum sativum (H. Matar), Cicer arietinum, (H. Chana), Cajanus cajan (H. Arhar), Dolichos lablab (H. Sem), Vigna aconitifolius (H. Moth), Phaseolus radiatus (H. Moong), P. mungo (H. Urd), Lens esculenta (H. Masur), Glycine max* (Soyabean) are used as vegetable and pulse. Soya-bean is supposed to contain very high percentage of proteins comparable to meat.
- **2. Oil**
  - The seeds of *Arachis hypogea* are pressed to obtain an oil. It is converted into vegetable ghee after hydrogenation and largely used as substitute for pure ghee. The oil cake is used for cattle feeding. Mungfali is also eaten after roasting.
- **3. Medicine**
  - *Glycyrrhiza glabra (H. Mulathi)* is used in throat pain and cough. *Physostigma venenosum* has several alkaloids and sometimes used as an eye ointment. The

fresh juice of the leaves of *Abrus precatorius (H. Ratti)* is said to remove spots of leucoderma. Its seeds have constant weight to an astonishing degree and traditionally used by goldsmiths.

- *Cyamopsis tetragonoloba* (syn. *Psoralea tetragonolaea*) seeds are laxative, stimulant and produce a colourless essential oil. The juice of *Sesbania grandiflora* flowers is said to improve eye sight.

- **4. Fibre**
  - *Crotalaria juncea* (Sunn Hemp or H-Swun) yields fibres, which are used for making rope, mat, coarse canvas, sacks, nets etc. It is a blast fibre.
- **5. Timber**
  - *Dalbergia sissoo* (*H. Shismam*), *D. latifalia* (Indian rose wood) yield timber.
- **6. Dye**
  - *Indigofera tinctoria* yields a dye–the indigo (*H. Neel*).
- **7. Ornamental and miscellaneous**
  - Many plants viz., *Lathyrus odoratus, Clitoria, Sesbania, Lupinus, Genista, Robinia*, etc. are used as ornamental plants in gardens.
  - *Erythrina* – (Indian Coral tree) is bird pollinated and produces beautiful red flowers.

MIMOSACEAE

Class **:** Dicotyledons

Sub class **:** Rosidae

Order **:** Fabales

Family **:** Fabaceae

Common plants Mimosaceae

1. *Acacia*

- Tree or shrub, with yellow flowers in rounded head.

2. *Albizzia lebbek* (Siris)

- Silk flower, flowers in round heads, flower fragrant.

3. *Mimosa – H. Chuimui*

- Leaves are highly sensitive, showing sleep movements.

4. *Neptunia oleracea*

- An aquatic, common water weed.

5. *Parkia roxburghii*

- A handsome avenue tree.

6. *Prosopis*

- Prickly tree or shrub. Prosopis spicigera- tree of arid regions; it is water indicator.

7. *Entada*

- A woody climber.

8. *Xylia*

- Iron wood tree.

Characters of Mimosaceae

- Trees or shrubs; leaves bipinnate and stipulate, stipule may be modified into spines; inflorescence cymose head or head; flowers actinomorphic, hermaphrodite, small, tetra or pentamerous; calyx and corolla valvate; petals connate below, stamens number varies from 4 (*Mimosa*) to many (*Acacia, Albizzia*); carpel one; fruit legume.

Distribution of Mimosaceae

- It is commonly called Acacia family. It includes 40 genera and 2000 species. The members are mostly distributed in tropical and sub-tropical regions. In India it is represented by 12 genera and 90 species.

Vegetative characters

Habit

- Herbs (*Mimosa*), climbers (*Entada*) and trees (*Acacia, Albizzia*) and hydrophytic (*Neptunia oleracea*). Many members are xerophytic (*Acacia, Prosopis*).

Root

- Tap, much branched and deep.

Stem

- Erect or climbing woody, branched angular or cylindrical, solid, covered with bark, some species yield gum, sometimes spiny.

Leaf

- Cauline, ramal, alternate, pinnate or bipinnate compound, stipulate, stipules may be modified into spines, petiolate; in some species of Acacia the petiole becomes flattened into a phyllode and leaflets fall down; leaflets show movements (*Mimosa, Neptunia*).

Floral characters

Inflorescence

- Cymose head (*Acacia*), spike or racemose (*Dichrostachys* and *Prosopis*).

Flower

- Pedicellate or sub-sessile (*Acacia)* or sessile (*Prosopis*), bracteate, actinomorphic, hermaphrodite, hypogynous, complete, tetra or pentamerous, small.

Calyx

- Sepals 5, gamosepalous, valvate or imbricate (*Parkia*), green or petaloid (*Acacia nilotica*), inferior.

Corolla

- Petals 5, polypetalous or gamopetalous (*Acacia, Albizzia*) valvate, inferior.

Androecium

- 4 free in Mimosa, 10 free in *Prosopis*, indefinite and monadelphous in *Albizzia*, filaments long, anthers dithecous, pollen grains often in packets; often gland dotted to attract the insects.

Gynoecium

- Monocarpellary, ovary superior, unilocular, marginal placentation, one or many ovules in a carpel; style long and filiform; stigma minute and simple

Fruit

- A legume or lomentum.

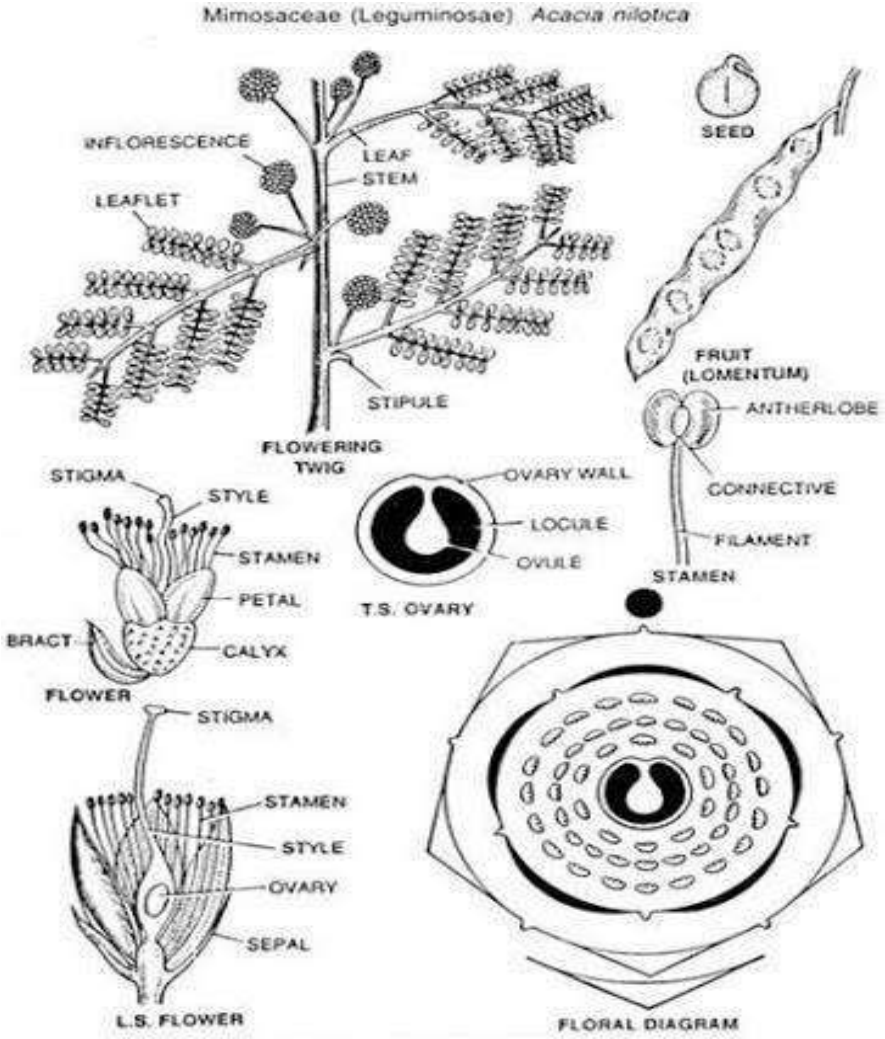
Seed

- Non-endospermic.

Floral formula

$$\mathrm{Br} \oplus \mathrm{K}\,(4) \text{ or } (5)\ \mathrm{C}_{4 \text{ or } 5},\ \mathrm{A}10 \text{ or } \alpha\ \underline{\mathrm{G}_1}.$$

Floral diagram



Economic Importance of Mimosaceae

- The sub-family is not of much economic importance. A few members are however useful.
- 1. Acacia catechu serves as a host for the lac insects. From this plant Katha is also obtained. Gum arabic is obtained from the barks of *A. nilotica* (syn. *A. arabica*) and *A. Senegal*. Saresh- a type of gum – is obtained from *Albizzia le*bbek.
- The flowers of *A. decurrens* var. dealbata yield a perfume.
- The bark of *Acacia* yields tannin which is used in leather tanning.
- 2. The wood of *Adenanthera pavonina* is powdered and yields a red dye.
- 3. *Prosopis spicigera* is grown as a hedge plant and also as a wind breaker in Rajasthan to check spreading desert, acts as water indicator.
- 4. Durable timber is obtained from *Acacia melanoxylon, Lysistoma sabicu, Xylia dolabriformis* (Iron wood).

CAESALPINIACEAE

Class **:** Dicotyledons

Sub class **:** Rosidae

Order **:** Fabales

Family **:** Fabaceae

Characters of Caesalpiniaceae

- Leaves paripinnate; flowers zygomorphic; calyx and corolla 5, ascending imbricate; stamens 10 or less, free, gynoecium monocarpellary with marginal placentation.

Vegetative characters

Habit

- It shows great variation in habit i.e. may be trees (*Delonix regia, Tamarindus, Caesalpinia, Saraca indica, Cassia fistula, Bauhinia* etc.), shrub, under shrubs or herbs. Besides this sometimes all types of plants occur in same genus e.g. *Cassia fistula* – tree; *C: sophera*-shrub; *C. occidentalis* – undershrub and *C. tora* – annual herb. *Bauhinia vahlii* is a woody climber.

Root

- Tap and branched.

Stem

- Erect, woody, herbaceous or climbing, branched, glabrous or covered with prickles and spines (Parkinsonia).

Leaf

- Alternate, leaf base pulvinate, compound unipinnate (Cassia, Tamarindus), bipinnate (Delonix, Caesalpinia) or rarely simple; stipulate. In Bauhinia the leaf is deeply emarginate – perhaps due to the fusion of two leaflets.

Floral characters

Inflorescence

- Racemose.

Flower

- Pedicellate, bracteate, zygomorphic, complete, hermaphrodite, slightly perigynous, pentamerous.

Calyx

- Sepals 5, free, or connate, odd sepal anterior, imbricate aestivation. In *Tamarindus* the two posterior sepals are united.

Corolla

- Petals 5, in *Tamarindus* there are only three posterior petals; in *Copaifera saraca* the petals are totally reduced; free, ascending imbricate aestivation, posterior petal is innermost.

Androecium

- Stamens 10, free, reduction in number of stamens by the formation of staminodes. In Cassia there are 3 posterior staminodes; Saraca 3-8 stamens; in *Tamarindus* only 3 stamens and monadelphous; dithecous, introrse.

Gynoecium

- Monocarpellary, ovary superior or slightly inferior, unilocular with marginal placentation, straight or curved, hairy; style long; stigma simple.

Fruit

- Legume and never breaks up into one seeded parts.

Seed

- Non-endospermic.

Pollination

- Entomophilous.

Floral formula:

Br, o|o ⚥ K5 C5 A 10 or 7 + 3std, $\underline{G}_1$.

Floral diagram

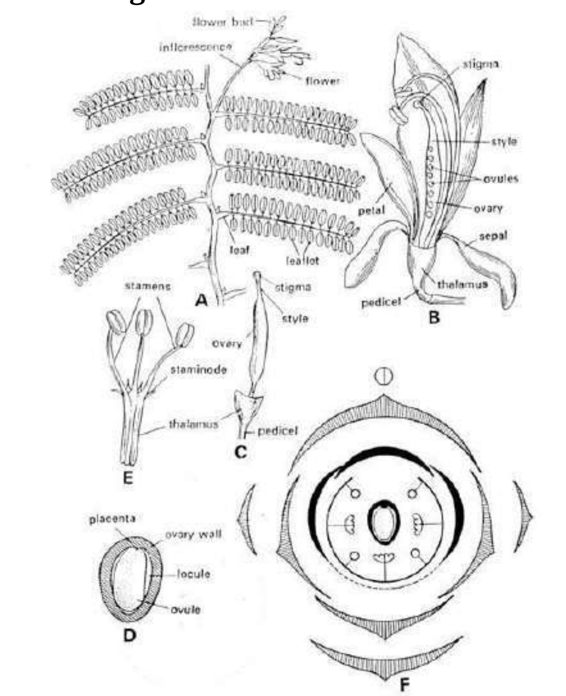


Fig. 15.3. Caesalpiniacean–*Tamarindus indica* L. (**Imli**). A, flowering twig; B, L.S. of flower, C, gynoecium; D, T.S. of ovary; E, stamens; F, floral diagram.

Economic important

1. Food

- The flower buds of *Bauhinia variegata* (*H. Kachnar*) are used as vegetable. The fruits of *Tamarindus indica* (H. Imli) are spicy and used as condiment.
- The seeds of *Tamarindus indica* yield starch.

2. Medicine

- The pulp of the pods of Cassia fistula (*H. Amaltas*) is utilised as a purgative. The bark-decoction of *Saraca indica* (*H. Ashoka*) is used as a remedy for menstrual disorders.

3. Fibre

- The bark of Bauhinia vahlli yields fibres which are used in rope making.

4. Dye

- The wood of *Haematoxylon campechianum* yields a dye called haematoxylin. This is an anatomical stain.

5. Tanning

- The pods of *Caesalpinia coriaria, C. sappan* and *C. digyna* are used in tanning leather.

6. Ornamentals

- *Delonix regia* (syn. *Poinciana regia*) *H – Gulmohar, Bauhinia sp., Caesalpinia pulcherrima, Colvillea racemosa, Parkinsonia aculeata, Saraca indica* etc., are grown in gardens and along the road side. *Delonix* and *Saraca a*re liked for their deep shade giving quality.

CUCURBITACEAE

Systematic position

- Class :Dicotyledons
- Subclass:Dilleniidae
- Order :Violales
- Family :Cucurbitaceae
- Genus :Coccinia
- Species :indica

Characters of Cucurbitaceae

- Prostrate herb bearing tendrils; leaves palmately lobed, surface hispid; flowers pentamerous, unisexual, monoecious or less commonly dioecious; stamens five, usually less, anthers free or connate, ovary inferior, trilocular, parietal placentation, fruit fleshy, pepo. Vascular bundles bicollateral and in two alternating rows.

Common plant of the family:

1. Cucurbita

- Cultivated for vegetables.

2. Trichosanthes

- Scandent herb cultivated for delicious vegetable.

3. Lagenaria (H. Lauki)

- Cultivated for common man vegetable.

4. Luffa aegyptcia (H. Tori)

- Cultivated for vegetable.

5. Momordica charantia (H. Karela)

- Fruits are slightly bitter in taste.

6. Ecballium elaterium

- It has a special method for the dispersal of seeds.

Distribution of Cucurbitaceae

- It is commonly called gourd family. The family has 110 genera and 850 species out of which 86 species are found in India. The members are chiefly inhabitants of tropical regions; a few in temperate regions. The members are wanting in the colder regions.

Vegetative characters

Habit

- Mostly annual or perennial herbs, rarely shrubs (Acanthosicyos) or small trees (Dendrosicyos), usually trailing, climbing by means of tendrils.

Root

- Tap root, branched may be thickened due to storage of food and water.

Stem

- Herbaceous,
  climbing,
  angular,
  fistular, branched.

Leaves

- Alternate, petiolate- petiole long and hollow; simple, lobed, exstipulate, palmately veined; tendrils present in the axil of leaf or opposite to the leaf. In Acanthosicyos the leaves are absent but thorns are present.

Morphological nature of the tendril

- Morphological nature of tendril has been a subject of great controversy. Tendrils have been considered by various authors as roots, stems, leaves, stipules, shoots, flower stalks or organs sui generis.

- According to Braun (1876) it is a modified bracteole. Engler considered it is modified stipule. Muller (1887) regarded the upper portion of the tendril as a modified leaf and lower stiff portion as the axis. This view was supported by Hagerup (1930).

- Probably the tendrils originate as stipules as shown by their lateral position to leaf-base and being rarely paired. By the work of Sensarma (1955) it appears that the tendrils is partly vascularised in the manner of a stipule in some cases.

Floral characters

Inflorescence

- There is great variation in the inflorescence. Flowers are solitary, or racemose or cymose panicles (Actinostemma).

Flower

- Regular, mostly unisexual rarely bisexual (Schizopepon), incomplete, epigynous, small or large, mostly white or yellow, pentamerous.

Male flower

- Produced in large numbers.

Calyx

Sepals 5, gamosepalous, sepals pointed rarely petaloid, campanulate, aestivation imbricate.

Corolla:

Petals 5, gamopetalous united at the base (Momordica) or throughout (Cucurbita, Coccinea), polypetalous (Luffa, Lagenaria), may be campanulate, rotate, imbricate or valvate aestivation.

Androecium

Stamens 5, sometimes free or combined to form a central column, anthers dithecous extrorse, dehiscence longitudinal or in curves; androecium may be modified in one of the following ways:

- 1. In Thaldiantha two pairs of stamens are closely approximated in the lower part of their filaments and the fifth stands apart.
- 2. In Sincydium the pairs of stamens are united below; in Momordica, Citrullus, the union of pairs of stamens is complete and apparently only three stamens are present.
- 3. In Sicyos and Sechium the filaments unite to form a central column and the anthers are very much curved.
- 4. In Cyclantliera the stamens are united into a central column with two ring like pollen chambers running round the top. (Compare with the condition found in Phyllanthus cyclanthera of the Euphorbiaceae).
- 5. In Fevillea a polyandrous condition is found with all the five stamens free and alternating to the five free petals. This is a primitive genus.

Gynoecium

- Reduced or rudimentary or absent.

Female flower

- They are fewer in number than the male flowers.

Calyx

- Sepals 5, gamosepalous, calyx tube adnate to the ovary wall; imbricate aestivation, superior.

Corolla

- Petals 5, gamopetalous, inserted on calyx tube; imbricate aestivation, superior.

Androecium

- Staminodes 0, 3, 5.

Gynoecium

- Tricarpellary, syncarpous, ovary inferior, unilocular with parietal placentation, the intruding placentae make the ovary to appear trilocular.
- In Luffa the ovary is narrow and ultimately 3-4 celled and apparently of the axile type. In Sechium the ovary is unilocular with only a single ovule; ovule bitegmic. Style stout and columnar and bears a forked stigma for each carpel.
- The stigmas are commissural i.e. stand above the dividing lines between the carpels. This is explained by assuming that each is a joint structure and composed of a branch of the stigmas of two adjacent carpels.

Fruit

- Soft, fleshy, indehiscent and either a berry or pepo. Fruits sometimes very large in size (*Citrullus* sp. *Benincasa* sp., *Cucurbita* sp.). In Ecballium the fruit is highly turgid when ripe and dispersal is by explosion.

Seed

- Exalbuminous, flattened, numerous, embryo straight, cotyledons large and oily.

Pollination

- Entomophilous.

Floral formulae

Male flower : ⊕ ♂ K(5) C5 or (5) A5 or (5) G0
Female flower : ⊕ ♀ K (5) C5 or (5) A O or 3–5 staminodes G (3).

Floral diagram

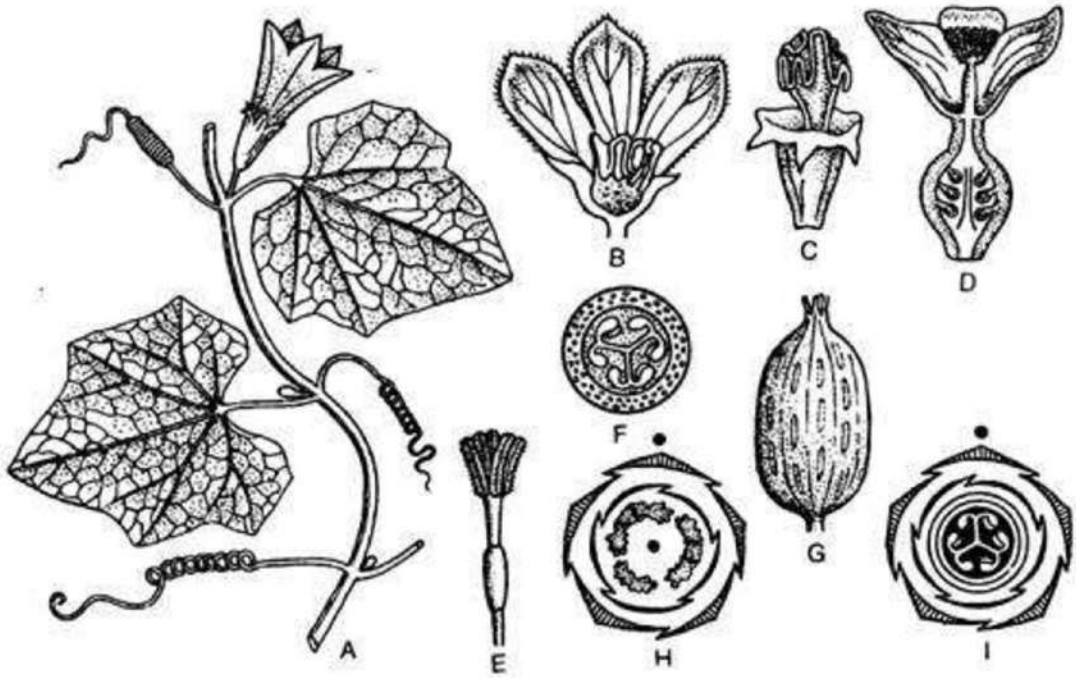


Fig. 4.80 Cucurbitaceae (*Coccinia grandis*) : A. Portion of a plant with male flower; B. V.S. of a staminate flower; C. Staminate flower after removal of corolla; D. V.S. of a pistillate flower; E. Pistil; F. T.S. of ovary; G. Fruit; H. Floral diagram of staminate flower. and I. Floral diagram of pistillate flower

Economic Importance of Cucurbitaceae

I. Vegetables and fruits

1. *Cucumis melo* (Hindi – Kharbuza)

- The fruits are edible and a number of varieties are known. *C. melo* var. momordica is Phut and *C. melo* var. utilissimus is Kakri. *Cucumis sativus* is Khira.

2. *Citrullus vulgaris* (Hindi – Tarbuz)

- The fruits are large and ripen during summers; it is cultivated on the sandy beds of rivers. *C. vulgaris* var. fistulosus is Tinda which is used as vegetable.

3. *Cucurbita maxima* is Kaddu

- *Cucurbita maxima* is Kaddu while *C. pepo* is Safed Kaddu; both are used as vegetable.

4. Benincasa heipida is Petha

- *Benincasa heipida* is Petha. It is used as vegetable; PETHE-KI-MITHAI is also prepared from the fruits.

5. Lagenaria vulgaris is Lauki

- *Lagenaria* vulgaris is Lauki; the fruit is commonly used as a vegetable. From ripe fruit-shells sitar is made.

6. Trichosanthes dioca is Parwal

- *Trichosanthes dioca* is Parwal whose fruits are also used in vegetable preparations. *T. anguina* is Chachinga which is also used as vegetable.

7. Luffa acutangula is Torai

- *Luffa acutangula* is Torai. This is also a popular vegetable.

8. Momordica charantia is Karela

- *Momordica charantia* is Karela. The fruits are bitter but used in vegetable preparations. It is said to be useful in gout and rheumatism.

II. Medicine

There are a few plants also important medicinally.

9. *Citrullus colocynthis* – produces the alkaloid colocynthin from its fruits. The fruits and roots are used against snake bite. The alkaloid is also used in other diseases.

10. *Ecballium elatarium* fruits produce elaterium of medicine which has narcotic effect and useful in hydrophobia.

III. Ornamental

- Some plants viz., *Ecballium, Sechium, Sicyos* are grown in gardens.