3. Plant Taxonomy:

Biological concept of species. General Characters, with Floral formula and floral diagram citing Examples and Economic importance of following: (classification as per B&H)

Dicotyledonae : Polypetlae: Annonaceae, Brassicaceae, Meliaceae, Leguminosae, Myrtaceae. Gamopetalae : Rubiaceae, Asteraceae, Lamiaceae, Apetalae: Euphorbiaceae, and

Monocotyledonae : Liliacaeae.

Biological concept of species. A **biological species** is a group of individuals that can breed together. However, they cannot breed with other groups. In other words, the group is reproductively isolated from other groups. "The words 'reproductively isolated' are the key words of the **biological species definition**".

Many systems of classification of angiosperms have been proposed by many taxonomists from time to time.

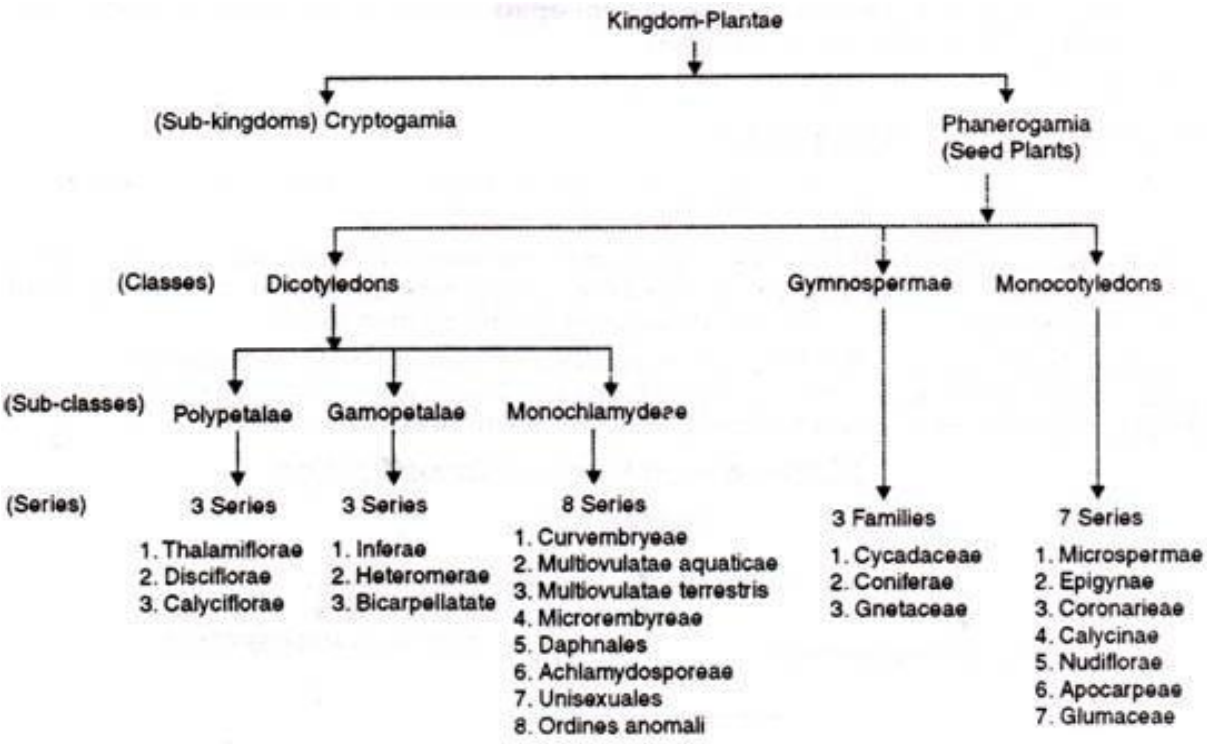
It can be divided into three broad categories:

i. Artificial Systems based on superficial features.
ii. Natural systems based on form relationships.
iii. Phylogenetic systems based on evolutionary and genetic relationships.

Natural Systems: In these systems the organisms are classified on the basis of their natural affinities (i.e. the basic similarities in the morphology) rather than on a single character for determining the affinities.

Bentham and Hooker's Classification: The most important and the last of the natural systems of classification of seed plants was proposed by two British taxonomists George Bentham (1800-1884), a self trained botanist, and Joseph Dalton Hooker (1817-1911), the first director of the Royal Botanical Garden, Kew (England).

They recorded precise description of most of the plants known at that time. Their monumental work which took about quarter of a century for completion was described in three volumes of Genera Plantarum, published in Latin during July 1862 and April 1883. Bentham and Hooker's system of classification is still used and followed in several herbaria of the world. It is supposed to be the best system for the students to identify plants in the laboratory.



Merits of Bentham and Hooker's System:

1. Each plant has been described either from the actual specimen or preserved herbarium sheets so that the descriptions are detailed as well as quite accurate.
2. The system is highly practical and is useful to students of systematic botany for easy identification of species.
3. The flora describes geographical distribution of species and genera.
4. The generic descriptions are complete, accurate and based on direct observations.
5. Larger genera have been divided into sub genera, each with specific number of species.
6. Dicots begin with the order Ranales which are now universally considered as to be the most primitive angiosperms.
7. Placing of monocots after the dicot is again a natural one and according to evolutionary trends.
8. The placing of series disciflorae in between thalami florae and calyciflorae is quite natural.
9. The placing of gamopetalae after polypetalae is justified since union of petalsis considered to be an advanced feature over the free condition.

Demerits of Bentham and Hooker's System:

1. Keeping gymnosperms in between dicots and monocots is anomalous.
2. Subclass monochlamydeae is quite artificial.
3. Placing of monochlamydeae after gamopetalae does not seem to be natural.
4. Some of the closely related species are placed distantly while distant species are placed close to each other.
5. Certain families of monochlamydeae are closely related to families in polypetalae, e.g. Chenopodiaceae and Caryophyllaceae.
6. Advanced families, such as Orchiadaceae have been considered primitive in this system by placing them in the beginning. Placing of Orchidaceae in the beginning of monocotyledons is unnatural as it is one of the most advanced families of monocots. Similarly, Compositae (Asteraceae) has been placed near the beginning of gamopetalae which is quite unnatural.

7. Liliaceae and Amaryllidaceae were kept apart merely on the basis of characters of ovary though they are very closely related.
8. There were no phylogenetic considerations

General Characters, with Floral formula and floral diagram citing Examples and Economicimportance of following: (classification as per B&H)

Dicotyledonae : Polypetlae : Annonaceae,

Classification :

Kingdom :

Sub. Kingdon :

Class :

Sub. Class :

Series :

Genus :

Species :

Distribution of Annonaceae:

The family Annonaceae is commonly called Custard-apple family. Rendle included 62 genera and 820 species in this family. Lawrence recognised 80 genera and 850 species.

Vegetative characters:

Habit and habitat: Trees, shrubs or lianas. Artabotrys climbs by means of hooks. Oil ducts present in the bark, leaves and perianth leaves. Terrestrial and perennial. Evergreen, deciduous, cultivated as well as wild.

Root: Tap, deep and extensively branched.

Stem: Erect, branched, solid, woody, sometimes woody climbers. Leaves – Simple, entire, alternate, exstipulate, distichous, gland dotted.

B. Floral characters:

Inflorescence : Often solitary, axillary, sometimes cauliflourous in groups.

Flower : Actinomorphic but zygomorphic in Monodora due to difference in size of petals, hermaphrodite, unisexual in Stelechocarpus, complete, trimerous, hypogynous, perigynous (Eupomatia) spirocyclic, often aromatic.

Calyx: Sepals 3, sepaloid, polysepalous, connate at the base,valvate.

Corolla: Petals 6 in two whorls of 3 each, valvate or slightly imbricate. Sometimes no distinction into sepals and petals so perianth in 3 or more whorls of 3 each.

Androecium: Stamens numerous spirally arranged on the axis which forms a large convex receptacle, filament short and thick, anthers long, extrorse, truncate connective, bithecous.

Gynoecium : Carpels numerous or a few, usually free, spirally arranged on the raised receptacle, apocarpous, superior, unicarpellary, unilocular; ovules one to many, anatropous; style short or none, stigma small, Monodora (Africa) with syncarpous ovary and parietal placentation.

Fruit : An aggregate of berries, united to form a single compound fruit (Annona squamosa).

Seed: Large, numerous, often embedded in a copious, white fleshy pulp, endospermic.

Pollination: Entomophilous, due to gaudy and scented flowers.

Floral formula: $\oplus \, ☿ \, K_3 \, C_{3+3} \, A_{\alpha} \, \underline{G_{\alpha}}$ or $(\underline{\alpha})$

Economic Importance of Annonaceae:

1. Food: The fleshy fruits of various Annona specifics are juicy and edible, and also used in preparation of soft drinks and jellies. Recent analysis shows that they contain about 18 per cent sugar.

Edible fruits are also obtained from various species of Annona and Asimina.

2. Timber : Bocagea virgata, B. laurifolia, Cyathocalyx zeylanicus, Duguetia quitarensis, Oxandra lanceolata and Eupomatia laurina yield useful timber.

3. Oil: The flowers of Desmos chinensis furnish 'Macassar oil' a perfume. The perfume is also obtained from Mkilua fragrans and specially liked by Arab women.

4. Fibre: The bark of Goniothalamus wightii produces strong fibres.

5. Ornamental: Artabotrys odoratissimus and Annona discolor are grown in garden for their scented flowers. Desmes chinensis is an ornamental tree.

Common plants of the family:

1. Annona squamosa L. – (H. Sarifa or sitafal) custard apple or sugar apple – well known fruit tree.
2. Annona reticulata L.– Bastard apple or Bullock's heart–a fruit tree.
3. Artabotrys uncinatas – A small climbing shrub with hooked peduncles – and glabarous leaves.
4. Cyathocalyx zeylanicus (H. Hari Champa) – A tall tree with deflexed or horizontal branches.
5. Polyalthia longifolia – The. "Ashok" An ornamental tree.
6. Uvaria cordata (Dunal) – Alston is a climber noted for its cordate leaves and red flowers.

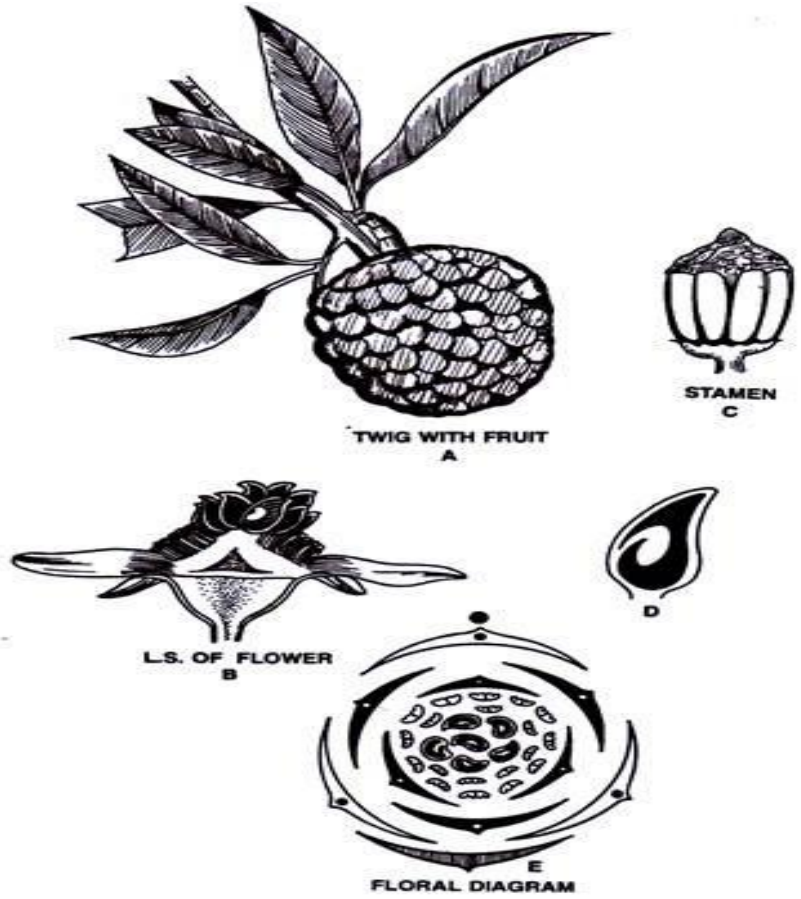


Fig. 26.1. *Annona squamosa*. A–Twig with fruit; B–L.S. of flower; C–Stamen; D–Carpel; E–Floral diagram.

Brassicaceae,

Distribution : 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.

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

Economic Importance of Brassicaceae:
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.

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.

1. Brassica campestris, Linn. (Fig. 31.1):

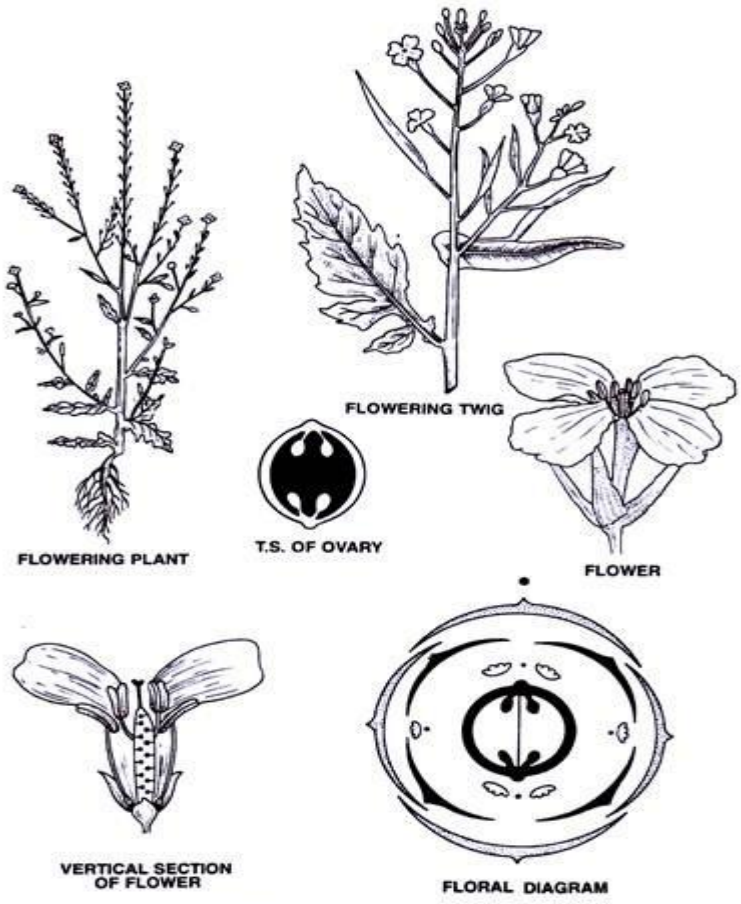


Fig. 31.1. *Brassica campestris.*

Meliaceae

Distribution : This family is also called Mahogany family. It includes 50 genera and 1400 species according to Willis. In India it is represented by 20 genera and 70 species. It is widely distributed in tropics of both the hemispheres.

Characters : Plants woody trees, leaves pinnately compound exstipulate; leaflets asymmetrical, margin serrate, inflorescence cymose panicles, flowers actinomorphic, hermaphrodite, calyx and corolla sometimes united, stamens 8 to 10, monadelphous, obdiplostemonous: annular necticiferous disc between petals and stamens, gynoecium pentacarpellary, syncarpous, superior, fewer or multilocular with 1-2 rarely more ovules in each locule; single style; fruits various – capsular or drupaceous.

A. Vegetative characters:

Habit: Mostly woody trees rarely shrubs, often with a characteristic smell.

Roots: Much branched tap root.

Stem: Woody much branched, erect, solid.

Leaves: Alternate, exstipulate, pinnately compound rarely simple, without transparent dots or glandular dots, serrate margin.

B. Floral characters:

Inflorescence: Cymose panicles often axillary.

Flower: Pedicellate, bracteate, complete, hermaphrodite or polygamous, actinomorphic, hypogynous, pentamerous, with a necticiferous disc.

Calyx: Sepals 4-5, small poly- or gamoseplaous (connate at the base), imbricate rarely valvate aestivation, inferior.

Corolla: Petals 4-5 rarely 3 to 8, polypetalous rarely connate at the base or adnate to the staminal tube, imbricate or twisted aestivation, inferior.

Androecium: Stamens 8-10, inserted outside the base of hypogynous disc, filaments united to form a columnar tube (monadelphous; Cedrela), anthers bithecous, erect, introrse, longitudinal dehiscence, necticiferous disc present or absent.

Gynoecium: Carpels 2-5, syncarpous, superior, 2-5 locular, axile placentation, with 1-2 ovules in each loculus, single style, stigma capitate, discoid or lobed.

Fruit: Berry, capsule or drupe.

Seed: Winged, albuminous or exalbuminous.

Pollination: Entomophilous, due to the presence of nectaries.

Floral formula: $\oplus, \varnothing\, \mathrm{K}_{4-5}$ or $(4-5)\, \mathrm{C}_{4-5}\, \mathrm{A}_{(8-10)}\, \mathrm{G}\, \underline{(2-5)}$.

Economic Importance of Meliaceae:

The family is not of great economic importance.

1. Oil: The seeds of Melia azadirachta (H. Neem) yield the ‘margossa’ oil of commerce. The oil is used in soap industry and medicinally in rheumatism and skin diseases. The oil of Carapa guianensis is used as an illuminant. The oil of Cedrela i.e., cedar oil is used in microscopy.

2. Medicines: Almost every part of Melia azadirachta possesses some medicinal properties. The bark is a bitter tonic, astringent and antiperiodic. The bark, root bark and young fruits are used as a tonic antiperiodic and alterative. Leaves are used as poultice and applied to boils, the twigs as tooth brushes.

Decoction of leaves is antiseptic and used to wash ulcers and eczema. The oil is used in rheumatism and skin diseases. Dry flowers are used as a tonic and stomachic. It is blood purifier.

The bark of Cedrela tonna is used as astringent, tonic and antiperiodic in chronic dysentery.

3. Timber: The wood of Cedrela toona (H. Tun), is used for furniture, carving and also for cigar boxes. The Swietenia mahoganii, Khaya senegalensis produce cabinet wood.
4. Ornamentals: Some of the plants viz., Melia, Amoora, Swietenia are grown in gardens.

Primitive characters:
1. Plants are mostly trees or shrubs.
2. Leaves alternate.
3. Presence of secretary cells.
4. Wood rays heterogenous.
5. Flowers hermaphrodite and hypogynous.
6. Flowers actinomorphic.
7. Calyx and corolla free.
8. Stamens free.
9. Pollination by insects.

Advance characters:
1. Leaves mostly compound.
2. Leaves exstipulate.
3. Unisexual flowers in Amoora, Lansium.
4. Flowers are small in size.
5. Inflorescence cymose or racemose.
6. Reduction in number of sepals and petals e.g. Amoora (3 sepals and 3 petals).
7. Androecium is monadelphous.
8. Reduction in number of stamens (Melia 10-12, in Heynea 8-10, Cedrela 4-6, Amoora 3).
9. Gynoecium syncarpous.
10. Placentation axile.
11. Fruit simple.
12. Seed non-endospermic in many genera.

The family is regarded as one of the advance among Geraniales.

Common plants of the family:
1. Melia azadirachta (H. Neem, Margosa tree) – contains margosic acid.
2. Cedrela toona (H. Tun., Indian Mahogany) – cultivated for wood; flowers yield dye called “Vasanti”.
3. Chloroxylon (stain wood) – valuable timber tree.
4. Carapa obovata – Small tree of Sundarbans.
5. Swietenia maliogani – beautiful tree with shining wood.

Important Type of Meliaceae : Melia azadirachta .

Habit: A perennial tree.

Root: Tap, well branched, with deep feeders.

Stem: Woody, erect, aerial, cylindrical, solid, branched, lower stem covered by bark.

Leaves: Alternate, exstipulate, compound imparipinnate.
Leaflet: Petiolate, ovate, serrate margin, acute apex, unicostate reticulate.
Inflorescence: Axillary panicle.
Flower: Pedicellate, complete, hermaphrodite, hypogynous, actinomorphic, pentamerous, white, scented.
Calyx: Sepals 5, gamosepalous, green, valvate, inferior.
Corolla: Petals 5, polypetalous, imbricate, white, inferior.
Androecium:
Stamens 10, monadelphous, forming a tube, with anthers at the top, on the inside, opposite the teeth of the staminal tube, basifixed, bithecous, inferior.

Gynoecium: Tricarpellary to multicarpellary, syncarpous, superior, number of locules is equal to number of carpels, one or two ovules per locules, axile placentation; style long, stigma capitate, nectar disc below the ovary.
Fruit: Drupe.
Seed: Non-endospermic

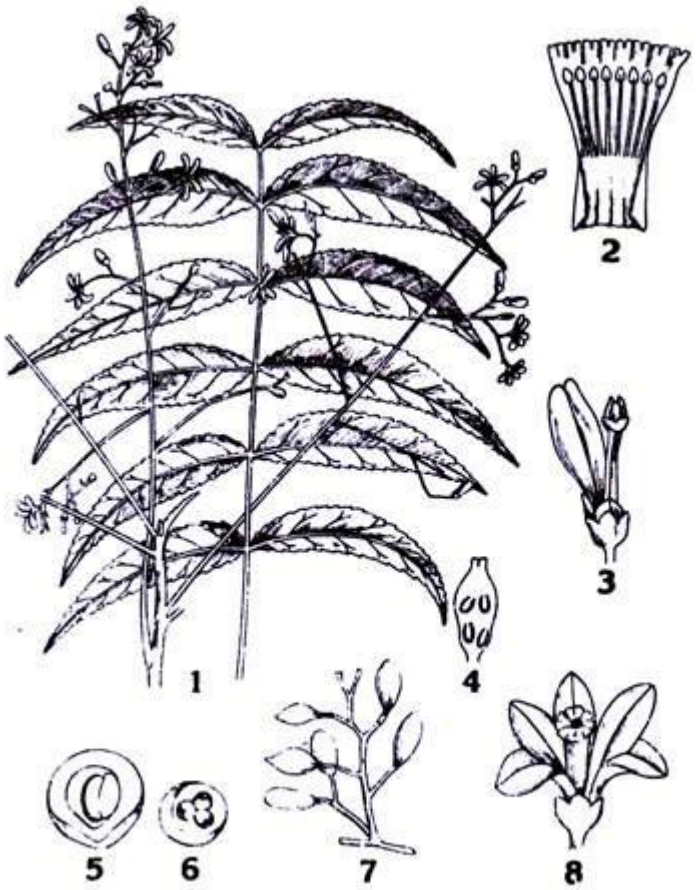


Fig. 46.1. *Melia azadirachta* Linn.
1. Flowering twig and Leaf. 2. Flower open to show. 3 & 8. Flower. 4, 5, & 6. Gynoecium. 7. Fruits.

.

Floral formula: $\oplus \, \varnothing \, K_{(5)} \, C_5 \, A_{(10)} \, \underline{G_{(3-\alpha)}}$

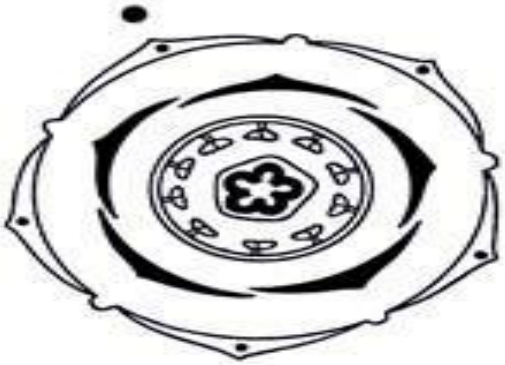


Fig. 46.2. Floral digram of *Melia*.

Leguminosae,

The family Leguminosae is divided into 3 sub-families as : Sub-family 1. Papilionaceae .2 Caesalpiniaceae 3 Mimoseae

The family is also known as Fabaceae. It includes 600 genera and 1200 spices. It is regarded as the second largest family of dicotyledons. In India the family is represented by 1100 species and 100 genea. The family divided into 3 sub-families based upon the floral characters.

The 3 sub-families are considered as 3 separate families e.g. Papilionaceae, Caesalpiniaceae and Mimoseae by many botanists. Senn (1943) on the basis of comparative wood anatomy suggests that there is not much reason and sharp differences between these sub-families to separate them.

1. Fabaceae – Papilionaceae :

Distribution of Fabaceae – Papilionaceae : It is commonly called pea family. It includes 375 genera. The family is represented in India by 70 genera and 754 species. The members of this family are xerophytes, mesophytes, hydrophytes and halophytes (Desmodium lattifolium).

Diagnostic features: Herbs, shrubs or trees, generally climbers; leaves alternate, stipulate, simple or compound; flower zygomorphic, hermaphrodite, corolla papilionaceous, stamens 10 or 9 diadelphous or monadelphous; carpel one, fruit legume

Characters of Fabaceae-Papilionaceae:

A. Vegetative Characters:

Habit : The plants show great variation in habit. The plants may be herbs (Melilotus, Medicago, Trifolium), shrub, (Butea, Flemingia), climbers (Lathyrus, Pisum, Vicia), twinners (.Dolichos, Vigna) and trees (Dalbergia, Sesbania, Erythrina). Aeschynomene is an aquatic plant-

Root : A much branched tap root system, bearing bacterial nodules.

Stem : Herbaceous or woody, erect or twinner, branched, angular or cylindrical, solid or fistular.

Leaves : Cauline or ramal; alternate, stipulate, compound mostly trifoliate sometimes simple as in Alysicarpus; modified partly or wholly into tendril (Lathyrus, Pisum, Vicia) leaf base may be pulvinate. In Lathyrus aphaca the entire leaf becomes modified into a tendril; in Pisum and Lathyrus the stipules are foliaceous and highly developed, in Pisum and Vicia the leaflets are modified into tendrils.

B. Floral characters:

Inflorescence : Racemose raceme, rarely solitary axillary.

Flowers : Medianly zygomorphic, hermaphrodite, pedicellate, slightly perigynous, complete and pentamerous. The papilionaceous corolla is typical. The floral characters are rather uniform.

Calyx: Sepals 5, gamosepalous odd sepal anterior, sepaloid, ascending imbricate aestivation.

Corolla : Petals 5, polypetalous, papilionaceous, posterior petal outermost large – the vexillium or standard; next two lateral ones-the wings or alae; and the two anterior and innermost united to form a boat-shaped structure – the keel or carina; descending imbricate or vexillary aestivation.

Androecium : Stamens 10 or rarely nine (Abrus, Dalbergia), diadelphous or monadelphous (Crotalaria), posterior stamen is free and filaments of nine are fused to form a sheath around the ovary; in Arachis ten stamens are monadelphous and in Sophora all ten stamens are free.

Gynoecium : Monocarpellary; ovary superior, unilocular, marginal placentation, numerous ovules on the ventral suture; style long slightly bent at the apex, flattened, hairy or without hair (Mucuna): stigma simple or capitate (Mucana).

Fruit: Legume or pod, indehiscent (Dalbergia), lomentum (Alysicarpus).

Seed: Non-endospermic.

Pollination: Entomophilous.

Floral formula: ♁ ☿ K (5) C1+2 + (2) A(9)+1or (10) G1.

Economic Importance of Fabaceae - Papilionaceae:

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.

Peru balsam and Tolu balsam are obtained from Mysoxylon. Gum tragacinth is obtained from Astragalus gummifer. Gum is also obtained from Butea monosperma and Pterocarpus. Because of root nodules many plants of this family can enrich the soil with fixed nitrogen. Hence they are often used in crop rotation.

Primitive characters:
1. Leaves alternate, stipulate and simple in some species (Indigofera cordifolia, Heylandia).
2. Flowers hermaphrodite, large and showy.
3. Corolla polypetalous.
4. Androecium polyandrous in Ormosia, Baphia, Sophora.
5. Ovules anatropus.
Advanced characters:
1. Plants herbaceous, annual.
2. Leaves compound and in many genera leaflets are modified into tendrils (Pisum, Lathyrus)
3. Flowers zygomorphic.
4. Calyx gamosepalous.
5. Corolla papilionaceous.
6. Stamens diadelphous.
7. Gynoecium monocarpellary.
8. Fruit simple legume.
9. Ovules campylotropous.
10. Seeds non-endospermic.
Important Types of Fabaceae-Papilionaceae:Lathyrus odoratus

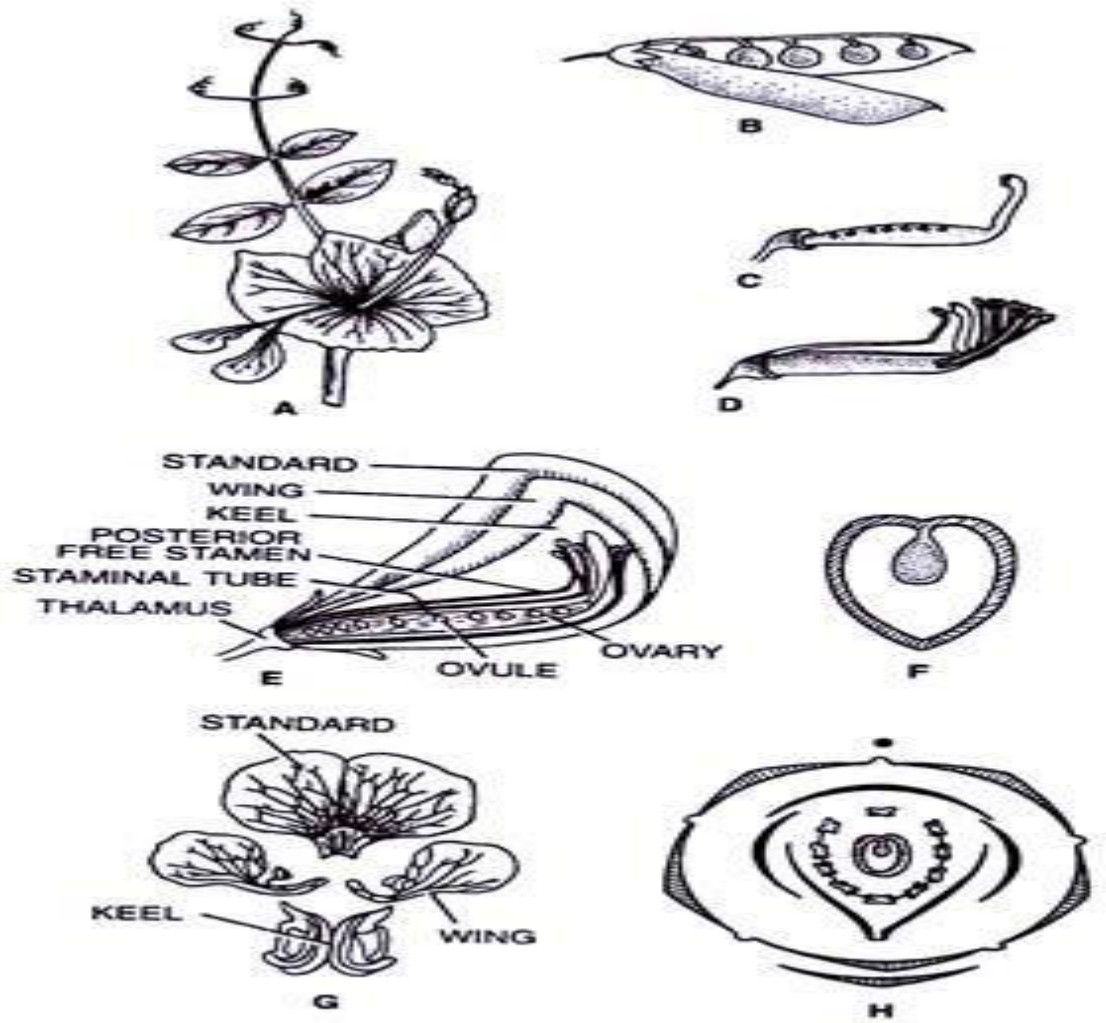


Fig. 52.1. *Lathyrus odoratus* – A. twig with flowers; B. dehisced pod; C. ovary with style and stigma; D. diadelphous stamens with staminal tube covering the ovary; E. V.S. flower; F. T.S. ovary; G. corolla; H. Floral diagram.

Habit:A cultivated, climbing herb.

Root: Tap, branched.

Stem: Herbaceous, weak, fistular, branched, hairy.

Leaf: Alternate, petiolate, stipulate, stipules leafy, pinnately compound, imparipinnate, upper leaflets are modified into tendrils and help in climbing.

Leaflets: Opposite, ovate-elliptical, wavy margin, acute apex unicostate, reticulate venation.

Inflorescence: Racemose or solitary axillary.

Flower: Bracteate, pedicellate, complete, hermaphrodite, zygomorphic pentamerous, hypogynous.

Calyx: Sepals 5, gamosepalous, pentapartite, companulate, odd sepal anterior, imbricate aestivation, green, hairy.

Corolla: Petals 5, polypetalous, papilionaceous, consisting of a large posterior petal – the vexillum or standard, two lateral-alae or wings and two inner fused to form a boat shaped structure the keel or carnia, vexillary aestivation.

Androecium: Stamens 10, diadelphous, nine are fused by the lower halves of their filaments to form a tube round the ovary and tenth posterior one free, anthers basifixed, introrse, dithecous, enclosed in the keel.
Gynoecium: Monocarpellary, ovary superior, unilocular, hairy, elongated, laterally compressed, marginal placentation ovules many, style long, stigma hairy.
Common plants of the family:
1. Abrus precatorius (H. Ratti) : The seeds of this plant are used by goldsmiths as small weights called “ratti”.
2. Butea monosperma (Syn. B. frondosa) : It is called Flame of the Forest or parrot tree. The flowers are sold in the market by the name of “Tesu”.
3. Desmodium gyrans : Indian Telegraph plant. It is a plant of waste places and is noted for the autonomous movements.
4. Melilotus indica (H. Ban-methi) : Annual herb with yellow flowers.
5. Pongamia pinnata (Syn. P. glabra; H. Karanja):
It is a tree, planted on avenues.

2 Caesalpiniaceae:

Distribution : It is commonly called cassia family. The sub-family contains 135 genera which are cosmopolitan in distribution. In India it is represented by 110 species and more than 21 genera
Characters : Leaves paripinnate; flowers zygomorphic; calyx and corolla 5, ascending imbricate; stamens 10 or less, free, gynoecium monocarpellary with marginal placentation.
A. 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, undershrubs 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.
B. 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, ⊕|⊕ ☿ K5 C5 A 10 or 7 + 3std, $G_{\underline{1}}$.

Economic Importance:

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 are liked for their deep shade giving quality.

Primitive characters:

1. Plants mostly trees and shrubs.
2. Leaves simple (Bauhinia).
3. Flowers hermaphrodite, large and brightly coloured.
4. Stamens polyandrous.
5. Ovules anatropous.

Advanced characters:

1. Leaves compound in most of the genera.
2. Inflorescence simple or compound raceme.

3. Flowers zygomorphic.
4. Calyx gamosepalous.
5. Reduction in number of petals or absent (Dialium, Saraca).
6. Reduction in number of stamens to five or three (Tamarindus).
7. Gynoecium monocarpellary.
8. Seeds non-endospermic.

Common plants of the sub-family:

1. Bauhinia variegata (H. Kachanar):
An ornamental plant with beautiful flowers and bilobed leavs.

2. Caesalpinia pulcherrima (Peacock flower or H. Radhachura): Cultivated in gardens.

3. Cynometra cauliflora:
It has edible fruits. Oil prepared from its seeds is applied in leprosy and skin diseases.

4. Parkinsonia aculeata (H. Vilayti kikar):
A large shrub or a small tree, with yellow scented flowers.

5. Delonix regia (syn. Poinciana regia) (H. Gulmohur or Krishnachura):A spreading roadside tree with beautiful foliage and red flowers.

6. Saraca indica (H. Ashoka):
An ornamental tree and supposed to be very sacred because according to Ramayana, Sitaji was kept in captivity in Ashoka Vana (forest of Saraca indica) by Ravana.

7. Tamarindus indica (H. Imli):A tree with 3 petals and stamens.

Important Type of Caesalpiniaceae:

Cassia fistula, Linn. (Fig. 53.1):

Habit: A perennial tree.

Root: Tap, branched and perennial.

Stem: Erect, cylindrical, woody, solid, branched.

Leaf: Cauline and ramal, alternate, petiolate, stipulate, stipules minute, caducous; paripinnately compound, leaflets 4-8 pairs.

Leaflets: Opposite, subsessile with pulvinus at the base, wavy margin, acute apex, glabrous, unicostate reticulate venation.

Inflorescence: Raceme.

Flower: Pedicellate, bracteate, complete, hermaphrodite, zygomorphic, pentamerous, hypogynous.

Calyx: Sepals 5, polysepalous, odd sepal anterior, imbricate aestivation, inferior.

Corolla: Petals 5, polypetalous, yellow, clawed, ascending imbricate aestivation, inferior.

Androecium: Stamens 10, in two whorls of 5 each, 3 posterior ones are staminodes, polyandrous, filaments unequal in length, anthers basifixed, dithecous, introrse.

Gynoecium: Monocarpellary, ovary superior, unilocular, marginal placentation, style short, stigma terminal and hairy.

Floral formula: $\mathrm{Br,\ o|o\ \varnothing\ K5\ C5\ A7 + 3\ std\ \underline{G1}.}$

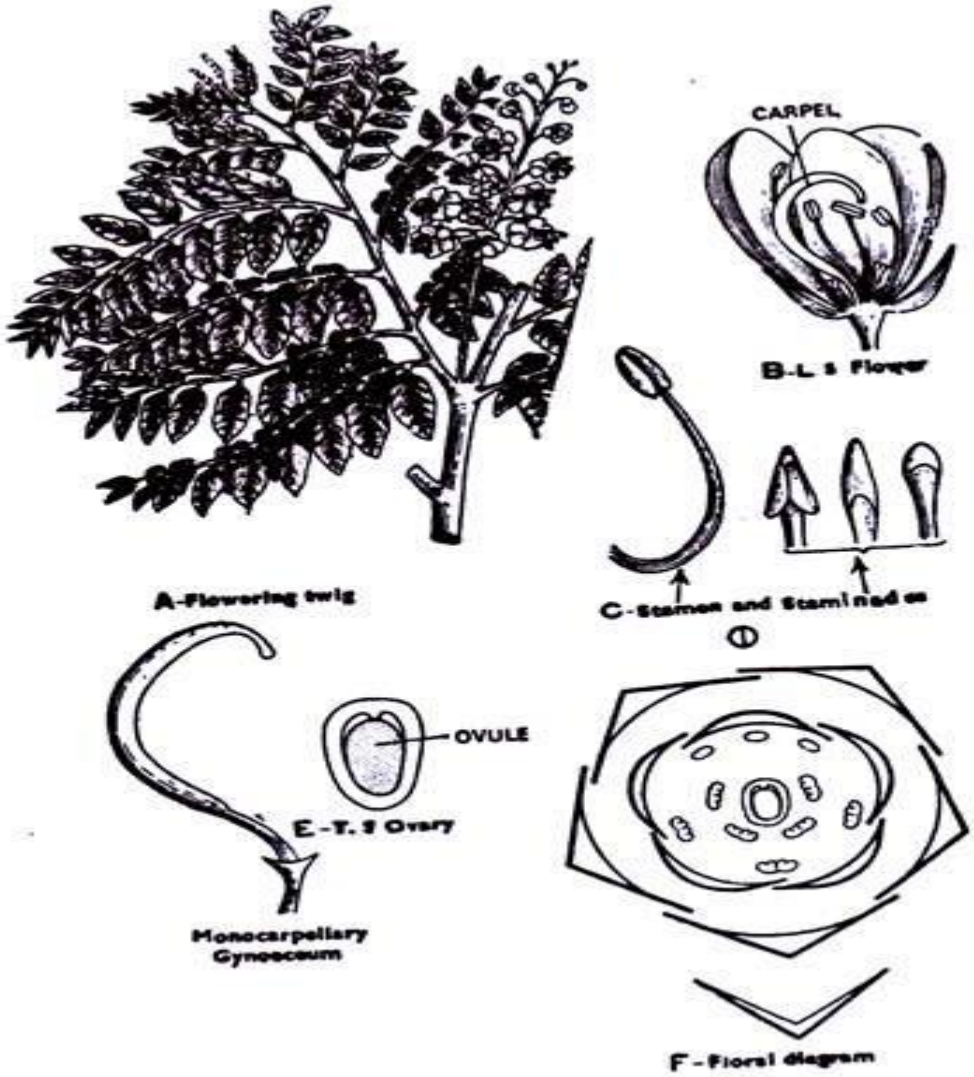


Fig. 53.1. *Cassia fistula.*

3 Mimoseae :

Distribution: 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.

Characters : 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.

A. 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).

B. 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: $Br \oplus ⚥ K (4) \text{ or } (5) C_{4 \text{ or } 5}, A10 \text{ or } \alpha G_{\underline{1}}.$

Economic Importance of Mimoseae:

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 lebbek.
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).

Primitive characters:

1. Plants are mostly trees shrubs.
2. Leaves are stipulate and spirally arranged.
3. Flowers actinomorphic, hermaphrodite and hypogynous.
4. Petals are mostly free.
5. Stamens are numerous and free.

Advanced characters:

1. Leaves are compound and in many stipules are modified into spines.
2. Leaves modified into phyllode in Australian Acacias.
3. Flowers are small and inconspicuous.
4. Calyx is gamosepalous.
5. Reduction in number of petals and stamens (Mimosa).
6. Gynoecium is monocarpellary and unilocular.

7. Fruit is simple-pod.
8. Seeds are non-endospermic.

Common plants of the sub-family:

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.

Important Types of Mimosaceae:

1. Acacia nilotica (Linn.) Dd. (Syn. A. arabica Wild).

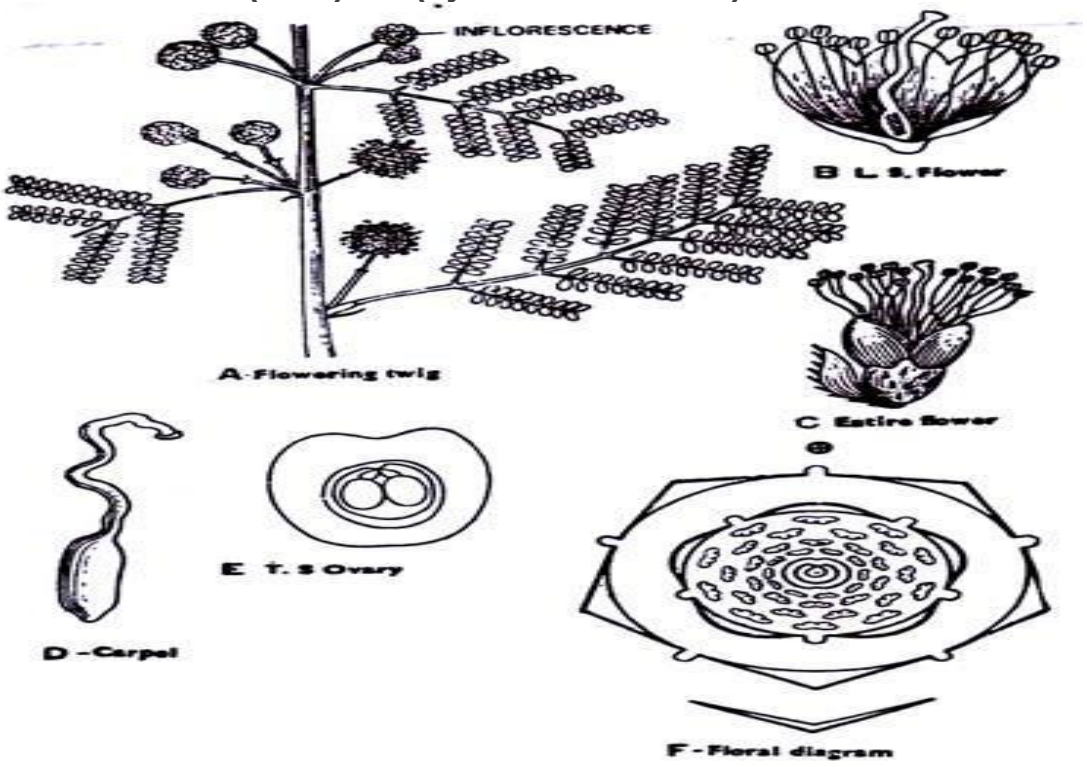


Fig. 54.1. *Acacia nilotica.*

Habit: Tree.

Root: Tap, branched, deep.

Stem: Erect, cylindrical, solid, woody, branched.

Leaf: Compound, bipinnate, alternate, petiolate, stipulate, modified into spines, leaflet oblong with entire margin, obtuse, or retuse, opposite, unicostate reticulate venation.

Inflorescence: Cymose head.

Flower: Small, sessile, bracteate (bracts caducous), brocteolate, actinomorphic, complete, hermaphrodite, pentamerous, hypogynous.

Calyx: Sepals 5, gamosepalous, campanulate, valvate aestivation, inferior.

Corolla: Petals 5, yellow, gamopetalous, tubular, valvate aestivation, inferior.

Androecium: Stamens numerous, polyandrous, filament long, anthers small, versatile, introrse.

Gynoecium: Monocarpellary, ovary superior, unilocular, marginal placentation, style long filiform and stigma minute.

Floral formula: $\mathbf{Br,\ brl.\ \oplus\ \varnothing\ K(5)\ C(5)\ A\ \alpha\ G_{\underline{1}}.}$

Myrtaceae.

Distribution: The family contains 100 genera and 300 species out of which India contributes 116 species. The chief centres of distribution are Australia and America.

Characters: Leaves aromatic, gland dotted, exstipulate, entire margin; flower hermaphrodite, actinomorphic, epigynous; calyx 4-5, gamosepalous, sometimes thrown off as a lid; corolla 4-5, free or united; stamens indefinite; carpels 2-5 syncarpous, ovary inferior, placentation axile; style and stigma simple; fruit a berry or drupe.

A. Vegetative characters:

Habit: The members of this family are mostly trees (Eucalyptus, Syzygium, Psidium) or shrub (Carreya) very rarely herbs. Some of the species of Eucalyptus may attain a height of 300 ft.

Root: Tap root and branched.

Stem: Erect woody, branched, bark very shining, smooth and goes off in old trees (Eucalyptus); vascular bundle bicollateral.

Leaves: Simple, opposite, alternate (Eucalyptus), or whorled, shortly petiolate, exstipulate or with minute stipule, gland dotted, coriaceous, evergreen. Leaves of Eucalyptus show adaptation to dry climatic and intense sunlight conditions and may become needle like and take up vertical position.

B. Floral characters:

Inflorescence: Usually of cyme type, sometimes panicle cyme or corymbose cyme, proliferous drooping spike in Callistemon; axillary in Psidium; solitary axillary (Myrtus communis); trichotomous cyme (Syzygium); paniculate cyme (Eucalyptus).

Flower: Pedicellate (Eucalyptus) or sessile (Callistemon), bracteate usually with two bracteoles (Callistemon), ebracteate (Eucalyptus) actinomorphic, hermaphrodite, epigynous sometimes perigynous; complete.

Calyx: Sepals 4-5, polysepalous or united, rarely reduced or thrown off like a lid as the flower opens (Eucalyptus) or entirely absent in some of Eucalyptus spp; quincuncial aestivation.

Corolla: Petals 4-5 more or less circular in form, polypetalous sometimes gamopetalous and forming cap (Eucalyptus), quincuncial aestivation.

Androecium: Stamens indefinite, arranged in several whorls at the edge of the receptacle, polyandrous rarely mondadelphous (Callistemon); 5 and antipetalous in Melaleuca. In Melaleuca leucadendron the stamens are numerous but in five bundles

opposite to petals, anthers dorsifixed or versatile, dithecous, small, introrse, connectives of anthers are usually gland dotted. In the bud condition the stamens are bent.

Gynoecium: Carpels 2 to indefinite, syncarpous; perigynous to fully epigynous; inferior, two to many locular, axile placentation rarely parietal (Rhodamnia), 2 to indefinite anatropous or campylotropous ovules per loculus; style simple, long, stigma capitate.

Fruit:A berry (Psidium), capsule (Eucalyptus, Callistemon)-, drupe (Eugenia).

Seed: Non-endospermic.

Pollination: Entomophilous. Insects are attracted by coloured stamens and floral parts.

Floral formula: $\oplus$ ⚥ $\dot{K}4\text{–}5\ C4\text{–}5\ A\ \alpha\ G\ \overline{(2\text{–}5)}.$

Economic Importance:

1. Fruits: Some members of the family produce edible fruits e.g. Syzygium cumini (syn. Eugenia jambolana) (H. Jamun), Psidium guajava (Amrood) with edible fruits.

2. Oil: The essential oils are obtained by the steam distillation of leaves and branches of Eucalyptus species.

3. Spice: Syzygium caryophyllata (syn. Eugenia caryophyllata) yields the cloves of commerce. Clove oil (H. Laung ka tel) is extracted out of them.

4. Medicine: Eucalyptus oil is used in influenza. It is mixed with clove oil and used in rheumatism. The roots of Eucalyptus are purgative. Clove oil is antipyretic and largely used in gum troubles. The leaves of S. cumini are used in indigenous medicine for dysentery.

The fruits of Myrtus communis are carminative and given in dysentery, diarrhoea, and rheumatism.

5. Wood : The wood of Eucalyptus and Psidium is used in engraving and making handles. In Australia the wood of Eucalyptus is used for railway sleepers, bridges and plywood industries.

6. Ornamental: Many plants viz., Callistemon, Myrtus, Melaleuca leucadendron, Tristania, Eucalyptus are cultivated for their showy nature in the gardens.

Primitive characters:

1. Plants trees, shrubs and climbers.
2. Leaves simple and alternate.
3. Flowers hermaphrodite and actinomorphic.
4. Petals free.
5. Stamens numerous and free.

Advanced characters:

1. Flowers epigynous.
2. Calyx gamosepalous.

3. Gynoecium syncarpous and reduction in the number of carpels to two (Eugenia, Eucalyptus).
4. Ovules campylotropous.
5. Fruit simple.
6. Seeds non-endospermic.

Common plants of the family:

1. Callistemon (Bottle brush tree): Filaments of the anthers are scarlet in colour and form brush like structure.

2. Eucalyptus: Beautiful tall tree.

3. Eugenia caryophyllata:

The dried flower buds form the spice – the cloves (H. Laung).

4. Psidium guajava: Small tree yielding the fruit guava (H. Amrood).

5. Myrtus: Aromatic shrub with shinning leaves.

6. Carreya: Large deciduous tree of shady places.

Important Types of Myrtaceae:

Callistemon citrinus (= C. lanceolatus D.C.) (Common name – Bottle brush or Laila Majnu).

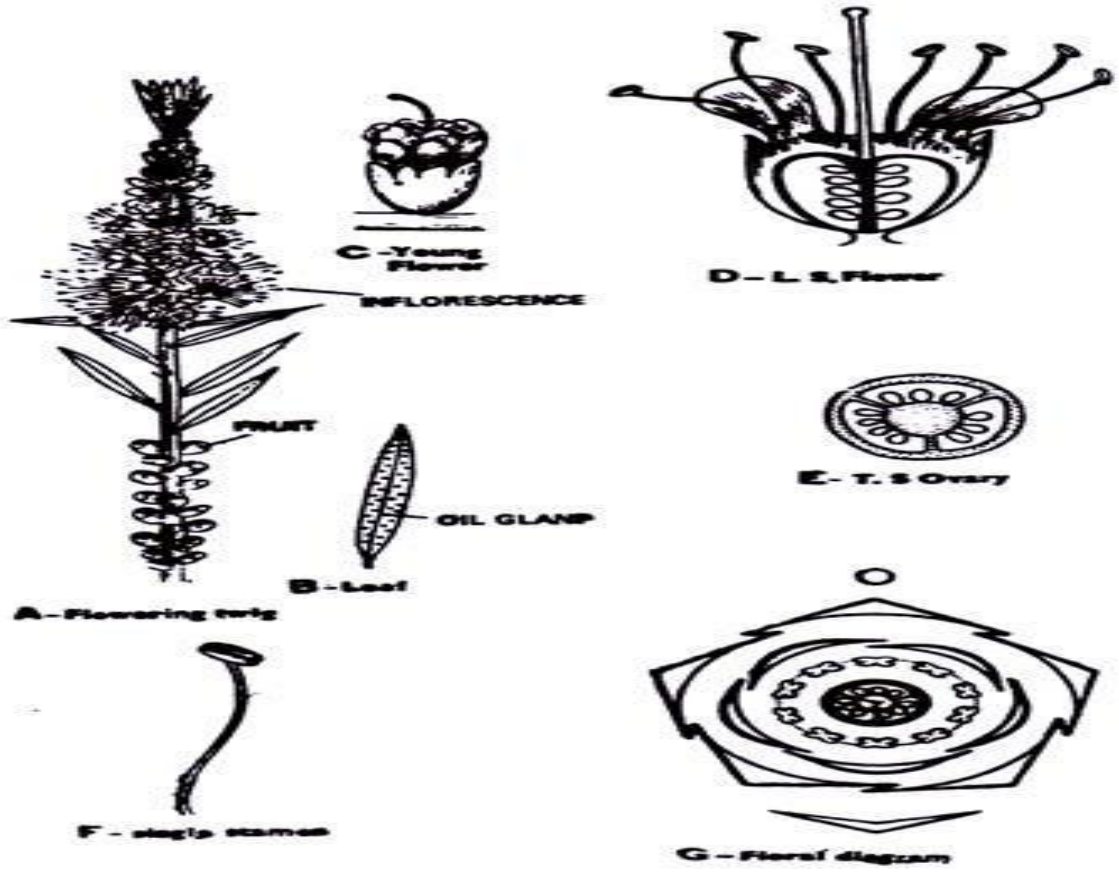


Fig. 60.1. *Callistemon.*

Habit:A large tree with crimson-yellow to red flowers.

Root: Branched, tap root, deep feeders.

Stem: Woody but upper portions herbaceous, erect, woody, branched, cylindrical and solid.

Leaf : Ramal and cauline, simple, alternate, entire, acute, gland dotted, leathery, unicostate reticulate venation, with inframarginal veins.
Inflorescence: Pendant spike, 4 to 8 inches long.
Flower: Bracteate, bracts caducous but sometimes green, leafy and persistent; pedicellate or shortly stalked, complete, hermaphrodite, actinomorphic, pentamerous, epigynous, crimson- yellow to bright red.
Calyx: Sepals 5, gamosepalous, imbricate, persistent, small and green.
Corolla: Petals 5, polypetalous, obovate, quincuncial, small and coloured.
Androecium: Stamens many, polyandrous, filaments long, basally conate and form a staminal sheath, dithecous, dorsifixed, introrse, filaments bright red, giving the same colour to the flower.
Gynoecium: Bi-to tetracarpellary, generally tricarpellary, syncarpous, inferior, number of the locules as many as the carpels, many ovules in each locule, axile placentation, style long and curved, stigma flat.
Fruit:A capsule
Floral formula: $\mathrm{Br}, \oplus, \varnothing, \mathrm{K}_{(5)}, \mathrm{C}_{5}, \mathrm{A} \propto \mathrm{G}_{\overline{(2-4)}}$.
Gamopetalae : Rubiaceae,
Distribution: It is commonly known as Madder or Coffee family. It includes 6000 species and 500 genera. In India it is represented by 551 species. The members of this family are distributed in tropics, sub-tropics and temperate regions.
Characters: Trees or herbs; leaves alternate or opposite; stipules interpetiolar or intrapetiolar, inflorescence cymose; flowers tetra or pentamerous, hermaphrodite, actinomorphic, epigynous, corolla, gamopetalous; stamens 4-5; epipetalous, introrse, dithecous; ovary inferior, bilocular with one or many ovules in each loculus; fruit capsule or berry.
A. Vegetative characters:
Habit: Mostly shrubs (Gardenia, Ixora, Mussaenda, Hamelia); trees (Morinda, Adina) and a few herbs (Galium, Rubia).
Root: Much branched tap root system.
Stem: Erect, herbaceous or woody or twinning (Manettia), climbing by hooks (Uncaria), branched, cylindrical or angular, hairy or smooth.
Leaves: Cauline, ramal, opposite or verticillate, simple, entire or toothed, stipulate, stipules bristle like (Pentas) and leafy (Galium, Rubia), stipules mostly interpetiolar or sometimes intrapetiolar; unicostate reticulate venation.
B. Floral characters:
Inflorescence: Solitary (Gardenia) usually cymose or globose head (Adina), or panicled cyme; may be axillary (Coffea arabica) or terminal cyme (Mussaenda glabra).
Flower: Actinomorphic, rarely zygomorphic (some what bilabiate as in Henriquezia), mostly hermaphrodite, rarely unisexual, epigynous, pedicellate or sessile (Greenia,

Randia), bracteate or ebracteate, complete, tetra or pentamerous, cyclic, variously coloured.

Calyx: Sepals 4 or 5, gamosepalous, superior, sometimes one sepal modified into coloured bract like structure (Mussaenda), valvate.

Corolla: Petals 4 or 5, gamopetalous, lobed, generally funnel shaped (Asperula), tubular (Ixora), valvate to twisted or imbricate, superior.

Androecium: Stamens 4 or 5, rarely many (Gardenia), epipetalous, alternipetalous, inserted near the mouth of corolla tube, stamens dithecous, introrse, dehiscing longitudinally, superior.

Gynoecium: Bicarpellary, rarely polycarpellary, syncarpous, inferior rarely half inferior (Synaptanthera) or superior (Paganea), sometimes unilocular (Gardenia) with one to many anatropous ovules in each loculus, axile placentation (parietal placentation in Gardenia), style one sometimes bifid or multifid, stigma simple or bilobed.

Fruit: Capsular (Anotis), berry (Mussaenda, Hamelia, Ixora).

Seed: Endospermic, sometimes winged.

Pollination: Entomophilous; ant pollination is well known.

Floral formula: ⊕ or ♂♀ ☿ K (4–5) C (4–5) A4–5 G $\overline{(2–5)}$.

Economic Importance of Rubiaceae:

I. Medicinal plants:

Bark of Cinchona officinalis yields an alkaloid called Quinine which is the best remedy for malarial fever. The roots of Rubia cordifolia are also used as medicine.

II. Beverage plants:

The seeds of Coffea arabica, C. liberica and C. robusta are roasted and ground to give coffee powder.

III. Ornamental plants:

Rubia, Hamelia, Gardenia, Ixora, Mussaenda are cultivated in gardens for their beautiful flowers.

Primitive characters:

1. Plants mostly trees and shrubs.
2. Leaves simple and stipulate.
3. Flowers mostly hermaphrodite and actinomorphic.
4. Stamens polyandrous.
5. Ovules anatropous and many in some genera.
6. Seeds endospermic.

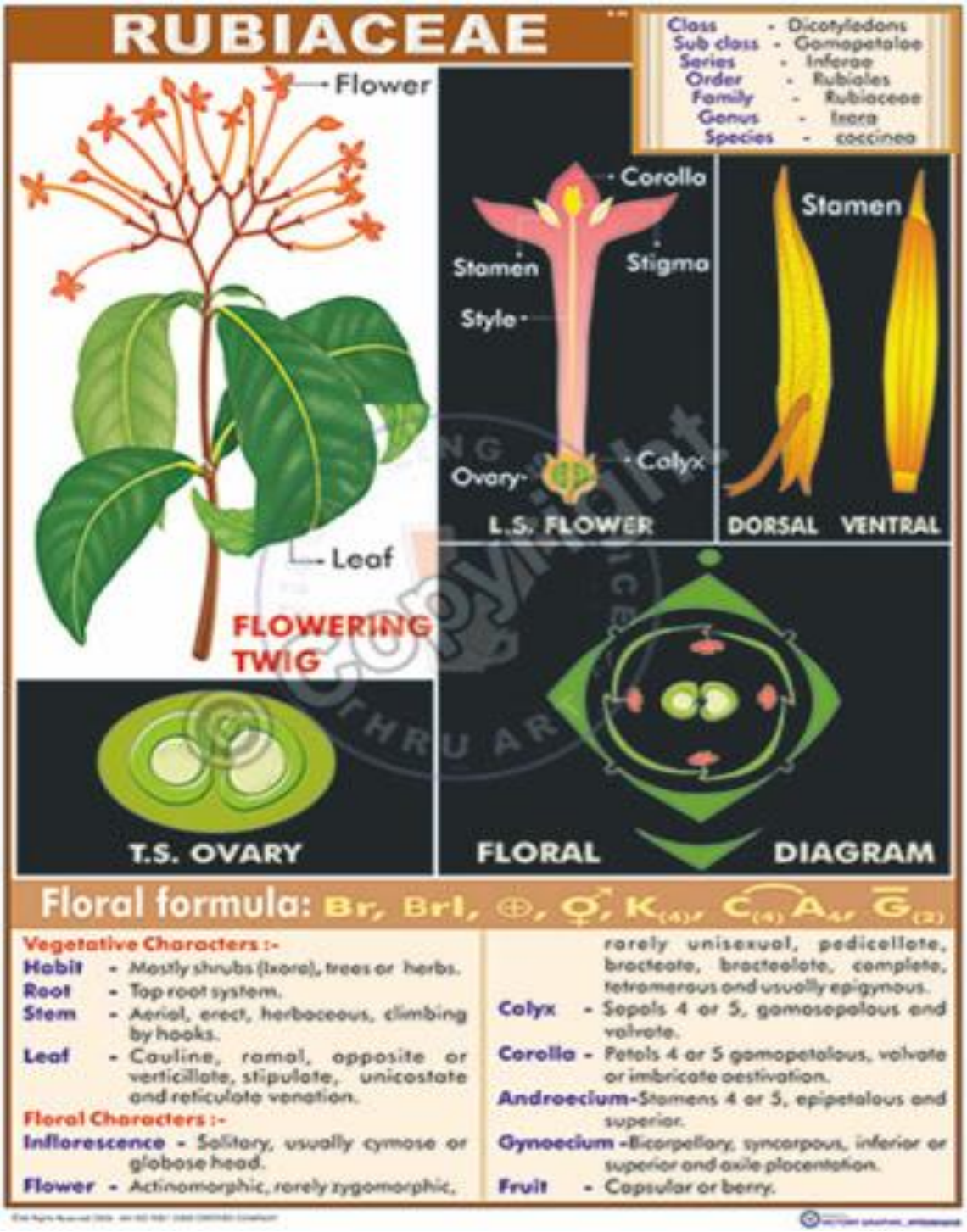
Advanced characters:

1. A few plants are herbs (Rubia, Galium).
2. Leaves opposite or whorled.
3. Flowers epigynous and rarely unisexual, zygomorphic.
4. Calyx and corolla fused.
5. Stamens epipetalous.
6. Carpel number reduced to two.
7. Fruit simple.

Common plant of the family:

1. Coffea arabica (Coffee): An evergreen shrub, cultivated for seeds.

2. Cinchona officinalis (Quinine): Tree cultivated for medicinal importance.
3. Hamelia:A large evergreen shrub with reduced flowers.
4. Rubia:A common climbing herb.
5. Gardenia:A resinous shrub or tree.
6. Ixora: Evergreen shrub with showy flowers. Many species are cultivated in gardens as ornamentals.
7. Mussaenda:A shrub, very conspicuous during flowering.
Important Types of Rubiaceae:Ixora coccinea



Asteraceae,

Distribution: The family is commonly known as Sunflower family. It is the largest family of dicotyledons, comprising 950 genera and 20,000 species, out of which 697 species occur in India. They are world wide in distribution and abundant in tropics and in cold arctic or alpines regions.

Characters: Mostly herbs or shrubs or rarely trees; leaves alternate rarely opposite, exstipulate rarely stipulate; inflorescence capitulum or head surrounded by involucre of bracts; ray and disc florets, flower tubular or ligulate, flowers bi- or unisexual or outer male or female, pentamerous, actinomorphic or zygomorphic, caryxpappus, corolla gamopetalous, petal lobes 5, stamens 5, epipetalous, usually dithecous, filament free and anthers united i.e. syngenesious, introrse, ovary unilocular, inferior, with basal placentation, style slender stigma bifid; fruit cypsela.

A. Vegetative characters:

Habit: Herbs (Ageratum, Lactuca, Dahlia, Sonchus), shrubs (Inula, Senecio) rarely trees (Vernonia arborea and Leucomeris). Many of the plants are xerophytes (Proustia), hydrophytes (Cotula) some are semiaquatic (Caesulia axilaris).

Root: Tap root, sometimes modified into tubers (Dahlia).

Stem: Erect, or prostrate, herbaceous or woody (Artemisia), hairy, sometimes with latex. Stem tubers are also present (Helianthus); tubers are edible (H. tuberosus); cylindrical; glabrous, solid or fistular, stem may be leaf-like (Baccharis).

Leaf: Alternate rarely opposite (Zinnia, Dahlia) or whorled; leaves may be radical, petiolate or sessile, exstipulate, mostly simple sometimes scale-like (Senecio), unicostate or multicostate reticulate venation.

B. Floral characters:

Inflorescence:A head or capitulum, consisting of a few or large number of flowers or florets closely arranged on an axis surrounded by involucral bracts. The whole head or capitulum is apparently similar to a single flower because the involucral bracts perform the function of protection.

In Helianthus the outer or peripheral, ligulate and zygomorphic florets are called ray-florets; whereas inner or central, tubular and actinomorphic ones are called disc-florets.

In capitulum or head the form of flowers and distribution of sex also varies.

Distribution of sex : The flowers of a head may be all hermaphrodite (Ageratum), or ray-florets are female or neuter and inner ones hermaphrodite, or male; rarely the complete head bears unisexual flowers.

Flower: Bracteate, sessile, (Sonchus, Ageratum), complete or incomplete, hermaphrodite or unisexual, pentamerous, tubular (actinomorphic) or ligulate (zygomorphic), epigynous and inconspicious.

Ray-florets: Zygomorphic, ligulate, pistillate, or neuter or sometimes also bisexual, epigynous.
Calyx: Modified into pappus or absent or scale-like.
Corolla: Petals 5, gamopetalous, highly coloured, ligulate, strap-shaped, valvate.
Androecium: Absent.
Gynoecium: Either absent or if present then bicarpellary, syncarpous, inferior, unilocular with basal placentation, one anatropous ovule; style one; stigma bifid.
Fruit: Absent; if present cypsela.
Seed: Non-endospermic.
Floral formula: Br. ♂♀ or neuter K pappus C (5) A0 $\underline{G(\overline{2})}$ or 0.
Disc florets:
Flower: Bracteate, sessile, complete, hermaphrodite, actinomorphic, pentamerous, epigynous and tubular.
Calyx: Modified into pappus or scale, persistent.
Corolla: Petals 5, gamopetalous, tubular, coloured.
Androecium: Stamens 5, epipetalous, syngenesious, dithecous, introrse, dehiscing longitudinally.
Gynoecium: Bicarpellary, syncarpous, inferior, unilocular with single anatropous ovule, basal placentation; style simple, long, stigma bifid.
Fruit: Cypsela.
Seed: Non-endospermic.
Pollination: Entomophilous.
Floral formula: Br ⊕ ♂♀ K pappus $\underset{(5)}{\overset{\frown}{C}}$ $A_{(5)}$ $\underline{G_{(\overline{2})}}$.
Economic Importance:
1. Food: Leaves of Lactuca sativa are used as salad. The roots of Helianthus tuberosus are edible.
2. Oil: The seeds of Helianthus and Artemisia yield oil.
3. Medicinal: Solidago used in dropsy. Artemisia yields santonin which is used as vermifuge. The roots of Taraxacum used in bowel disorders. The juice of Emillia sonchifolia leaves has cooling effect and is used in eye inflammation and also for night blindness. Eclipta alba used as tonic in spleen enlargement. Centipeda orbicularis is used in cold and toothache.
4. Rubber: It is obtained from Solidago laevenworthii and Taraxacum.
5. Insecticide: The capitula of Chrysanthemum roseum and C. cinerriefolium are dried, powdered and used as insecticide.
6. Ornamental: Zinnia, Dahila, Cosmos, Chrysanthemum, Calendula, Helichrysium, Aster Helianthus etc. are well known garden plants.
7. Weeds: Xanthium, Blumea, Sonchus, Vernonia are the common weeds.

Primitive characters:
1. Some plants are woody and perennial.
2. Leaves alternate and simple.
3. Capitulum of only actinomorphic, hermaphrodite flower in some genera viz. Vernonia, Ageratum, Mikania.
4. Ovules anatropous.
5. Pollination by insects.

Advanced characters:The family Asteraceae (Compositae) is regarded as the most advanced and highly evolved and is considered to occupy the highest position in the plant kingdom.
1. It includes maximum number of genera (950) and species (20000).
2. The members of this family are worldwide in distribution.
3. Plants mostly herbaceous annuals, biennials or perennials.
4. Leaves exstipulate, opposite or whorled.
5. Floral buds are well protected by involucral bracts.
6. Flowers sessile, small, inconspicuous.
7. Flowers arranged to form capitulum inflorescence.
8. Flowers epigynous and in many species zygomorphic.
9. Calyx reduced to pappus or scales.
10. Corolla gamopetalous and tubular.
11. Reduction in the number of stamens.
12. Stamens epipetalous and syngenesious.
13. Gynoecium bicarpellary, syncarpous, inferior, unilocular.
14. Single ovule.
15. Basal placentation.
16. Fruit simple, in some mechanism of wind dispersal (parachute).
17. Some plants are wind pollinated.
18. Seed non-endospermic.
19. Due to small flowers much of the material is saved.

Important Types of Asteraceae:Helianthus annuus :

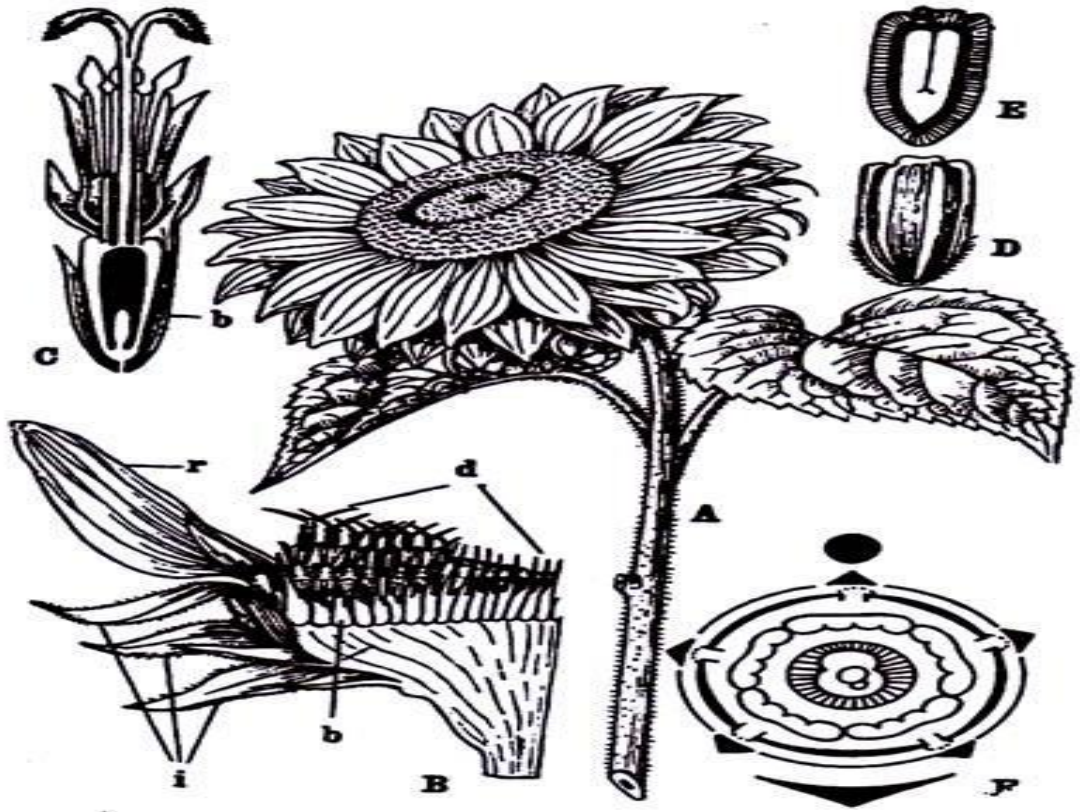


Fig. 68.1. *Helianthus annuus.*

Root: Tap, root branched.
Stem: Erect, herbaceous above and woody below, cylindrical, solid, branched, glabrous ordinary.
Leaf: Ramal and cauline, alternate, simple, petiolate, exstipulate, ovate, serrate, acute, surface hispid, unicostate reticulate venation.
Inflorescence: Capitulum surrounded by involucre.
Capitula large with two kinds of flowers:
(a) The peripheral flowers or ray florets, which are large, attractive and ligulate.

(b) Disc florets, in the centre and tubular.

Ray florets: Bracteate, sessile, incomplete, zygomorphic, ligulate, pistillate or neuter, epigynous.
Calyx: Pappus-2-3, persistent.
Corolla: Petals 5, gamopetalous, a short basal tube and a large flat strap shaped limb, with 5 teeth (sometimes lesser) indicating the number of petals.
Androecium: Absent.
Gynoecium: Absent, or if present then bicarpellary, syncarpous, inferior, unilocular, basal placentation, simple style, bifid stigma.
Disc florets:
Bracteate, sessile, complete, hermaphrodite, tubular, actinomorphic, pentamerous, epigynous.

Calyx: Pappus or reduced, modified into 2-3 scales, persistent.

Corolla:5, gamopetalous, tubular, 5 toothed, teeth represents the number of petals, valvate.

Androecium: Stamens five, epipetalous, filaments free, short, alternating with the petals, anthers syngenesious, basifixed, dithecous, introrse.

Gynoecium: Bicarpellary, syncarpous, unilocular, inferior, basal placentation, single basal ovule, style single long; stigma bifid.

Floral formulae – Ray floret – Br ♂♀ Neuter or ♀ K pappus C (5) A0 $\underline{G(\overline{2})}$ or 0

Disc floret – Br ⊕ ☿ K (pappus) $\overset{\frown}{C_{(5)}}$ $\overset{\frown}{A_{(5)}}$ $\underline{G_{(\overline{2})}}$.

Floral formula: Br ♂♀ ☿ K pappus $\overset{\frown}{C_{(5)}}$ $\overset{\frown}{A_{(5)}}$ $\underline{G_{(\overline{2})}}$.

2. Launea asplenifolia (Fig. 68.2):

Habit: A perennial herb, grows in rosettes.

Root: Tap, branched.

Stem: Herbaceous, reduced but trailing, cylindrical, solid, glabrous.

Leaves: Radical, alternate, sessile, simple, exstipulate, margin spinulose toothed, unicostate reticulate venation.

Inflorescence: Head of homogamous ligulate flowers.

Flower: Bracteate, sessile, complete, hermaphrodite, zygomorphic, pentamerous, epigynous, all ligulate, yellow

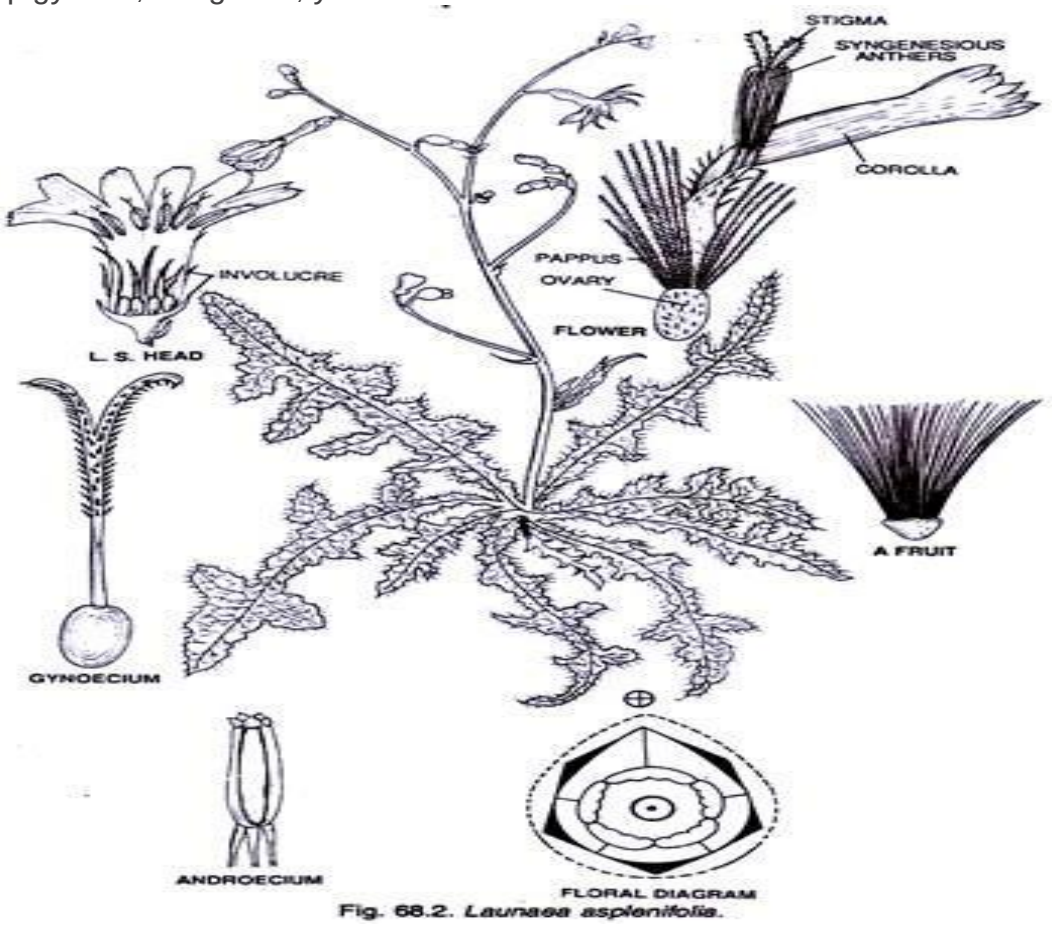


Fig. 68.2. *Launaea asplenifolia.*

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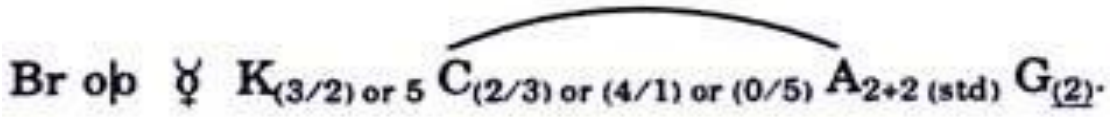
Calyx: Represented by pappus i.e., tuft of hairs, superior.
Corolla: Petals 5, gamopetalous, ligulate, valvate, superior, yellow.
Androecium: Stamens 5, epipetalous, syngenesious, basifixed, dithecous, introrse, superior.
Gynoecium: Bicarpellary, syncarpous, inferior, unilocular, basal placentation, single basal ovule; style simple, stigma bifid.
Fruit: Capsela.
Floral formula: $Br \ \oplus \ ⚥ \ K_{pappus} \ \overset{\frown}{C_{(5)} \ A_{(5)}} \ G_{\overline{(2)}}$

Lamiaceae,
Distribution: It is commonly called Mint family. The family includes 260 genera and 3200 species of world wide distribution. In India it is represented by 400 species.
Characters:
Sweet aromatic smell due to essential oils present in sessile glandular hairs; stem rectangular in cross section, leaves opposite decussate rarely alternate, simple, exstipulate with hairs; inflorescence verticillaster; flowers zygomorphic, hermaphrodite, hypogynous, bracteate; calyx gamosepalous, persistent; corolla bilabiate; stamens 4 epipetalous, didynamous; gynoecium 2 four celled by false septum, syncarpous, axile placentation, gynobasic style, seated on lobed disc; fruit schizocarpic carcerulus.

A. Vegetative characters:
Habit: Plants are mostly aromatic herbs or shrubs (Leonotis, Pogostemon). Tree habit is found in the Brazilian genus Hyptis and climbing habit in American species of Scutellaria.
Root: Tap, branched, rarely adventitious (Mentha).
Stem: Aerial, herbaceous, rarely woody, erect or prostrate, quadrangular, hairy, branched, solid or hollow, sometimes underground suckers (Mentha).
Leaves: Opposite decussate, rarely whorled, simple, petiolate or sessile, exstipulate, hairy with aromatic smell, entire, pinnatifid (Perovskia), unicostate reticulate venation.
B. Floral characters:
Inflorescence: Very commonly verticillaster consisting of a pair of condensed dichasial cymes at each node; often the verticillasters are grouped together in a thyrsus form; rarely solitary (Scutellaria).
Flower: Pedicellate or sessile, bracteate, complete, zygomorphic rarely actinomorphic (Mentha, Elsholtzia), hermaphrodite, rarely unisexual (Nepeta, Thymus), pentamerous hypogynous.
Calyx: Sepals 5, gamosepalous, bilabiate (Salvia, Thymus) campanulate (Teucrium), persistent, valvate or imbricate aestivation. When a bilabiate calyx is present the arrangement of the sepals may be (1/4) as in Ocimum or (2/3) as in Calamintha.

Corolla: The corolla possesses a tubular base which widens towards the mouth. Petals generally 5, gamopetalous and the five teeth are sub-equal and mostly bilabiate. In Mentha a four lobed corolla arises due to the fusion of two upper teeth. When a distinct bilabiate condition is found the arrangement of the petals may be gamopetalous 2/3 i.e. two petals in the posterior upper lip and three in the anterior lower lip (Salvia, Nepeta, Leucas etc.).
In Ocimum, Coleus, Plectranthus etc. the petals arrangement is gamopetalous 4/1 i.e. four petals in the posterior upper lip and only one petal in the anterior lower lip. In extreme cases the arrangement may be gamopetalous 0/5 i.e. all the five petals forming the lower lip so that the corolla becomes one lipped. Aestivation in the petals is valvate or imbricate.

Androecium: Typically only 4 stamens, didynamous (2+2) and posterior stamen is reduced or represented by a staminode; in Calamintha only two perfect stamens are found, two are imperfect and the fifth reduced. In Salvia only two stamens on the anterior side are found; they are characterised by peculiarly long connectives which help in insect pollination stamens generally introrse and dithecous.
Gynoecium: Bicarpellary, syncarpous, superior, situated on hypogynous honey secreting disc; bilocular becomes tetralocular by the formation of false septum; axile placentation, one ovule in each loculus; style gynobasic (arising from the base of the ovary), stigma bilobed. The gynoecium character is thus uniform without any variation.
Fruit: Usually schizocarpic carcerulus or achenes or nutlets rarely drupaceous.
Seed: Non-endospermic.
Floral- formula:



Economic Importance of Lamiaceae:
1. Food: Tubers of Stachys sieboldi are edible. Leaves of Mentha viridis, Ocimum basilicum, Melissa officinalis etc. are used as condiments.
2. Medicinal: Many plants of this family are used in medicines. Ajuga bracteosa, Leucas cephalotes are used in fever. Mentha piperata and Thymus serphyllum give Menthol and Thymol respectively, which are extensively used in medicines. Leaves of Ocimum kilimandus charicum give camphor.
Ocimum sanctum and other species of Ocimum are used in various ailments.

3. Ornamental: Several species of Salvia, Coleus, Ajuga, Leonotis, Dracocephalum, Thymus, Lavandula etc. are cultivated in gardens for ornamental purposes.
4. Perfumes: Aromatic oil is extracted from Thymus, Lavandula (Lavender oil), Rosmarinus (Rosemary oil), Calamintha, Pogostemon etc.
5. Dye: Fruits of Lycopus europaeus yield red dye.

Primitive characters:
1. Some members are perennial shrubs.
2. Leaves simple.
3. Flowers hermaphrodite, hypogynous, coloured and scented.
4. Pollination by insects.

Advanced characters:
1. Plants mostly herbaceous.
2. Leaves exstipulate, opposite or whorled.
3. Flowers in distinct inflorescence.
4. Flowers zygomorphic and in some unisexual (Iboza).
5. Calyx gamosepalous and bilabiate.
6. Corolla gamopetalous and bilabiate.
7. Stamens epipetalous and reduced to 2.
8. Gynoecium bicarpellary, syncarpous, axile placentation.
9. One ovule per loculus.
10. Fruit simple.
11. Seeds non-endospermic.

Common plants of the family:

1. Coleus aromaticus (H. Ajwain): An aromatic herb with beautiful variegated leaves.

2. Leucas lantana: Herb clothed with white tomentose hairs.

3. Lavandula vera: Aromatic smell; flowering shoots yield volatile oil.

4. Mentha piperata (H. Podina): Cultivated, branching herb, perennate by means of suckers.

5. Roylea: Woody undershrub with white pinkish flowers.

6. Ocimum santcum (H. Tulsi): Sacred plant for Hindus; also used medicinally.

7. Salvia: Cultivated ornamental herb.

8. Thymus vulgaris: Aromatic procumbent shrub; yields oil of much medicinal importance.

Important Types of Lamiaceae:

Ocimum santcum (Fig. 85.1):

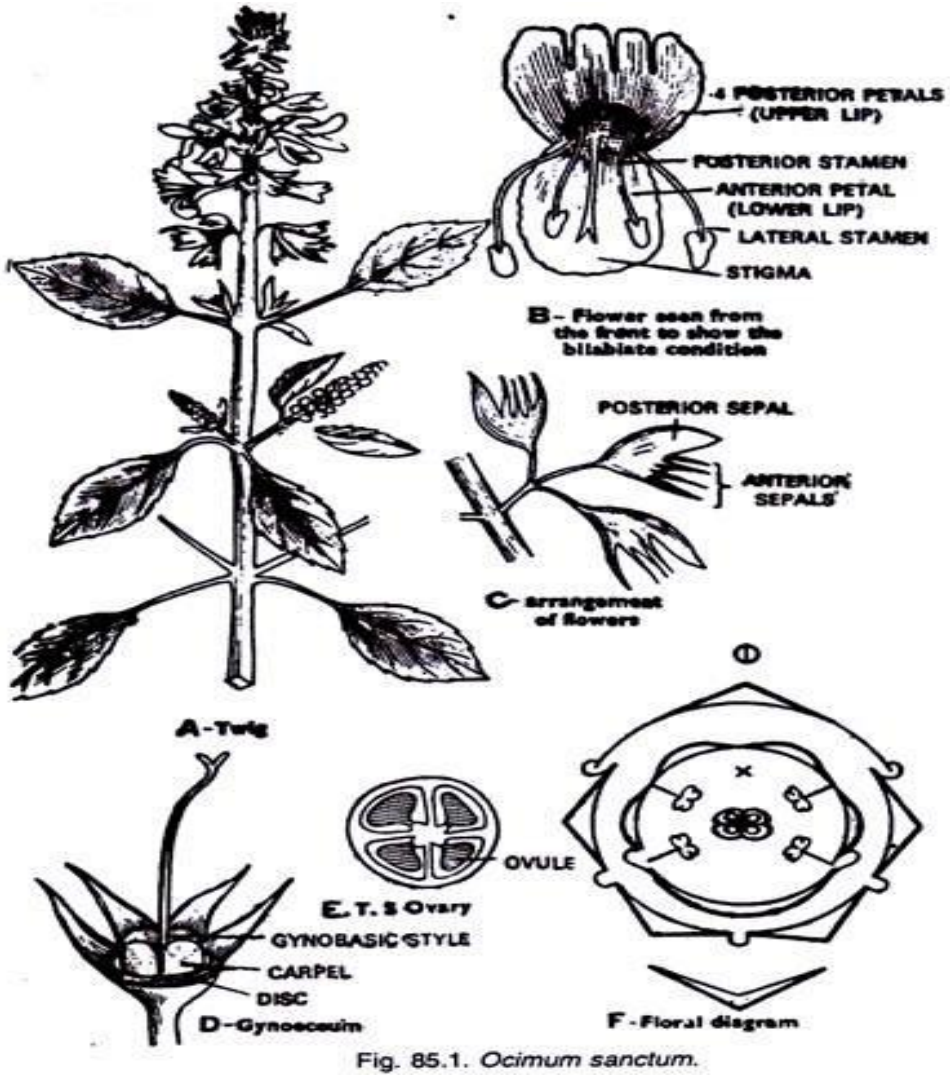


Fig. 85.1. *Ocimum sanctum.*

Habit:A perennial herb with strong aromatic smell.

Root: Tap, branched.

Stem: Herbaceous above and woody below, aerial, erect, solid, quadrangular, branched, hairy with aromatic smell.

Leaves: Opposite decussate, simple, petiolate, exstipulate, ovate, serrate, acute, hairy, unicostate reticulate.

Inflorescence:A verticillaster.

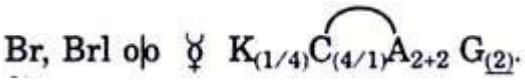
Flower: Bracteate and bracteolate, pedicellate, complete, hermaphrodite, zygomorphic, pentamerous, hypogynous bilabiate, small and pink.

Calyx: Sepals 5, gamosepalous, bilabiate (1/4), posterior or upper lip broad and lower or anterior lip with small sepals; gland dotted, violet green, imbricate aestivation.

Corolla: Petals 5, gamopetalous, bilabiate (4/1), corolla tube short, upper lip of 4 petals and lower of 1 petal; pink, imbricate aestivation.

Androecium: Stamens 4, polyandrous, epipetalous, didynamous 2+2, anthers versatile; anterolaterals are longer and two postero-lateral are smaller, each postero-lateral has elongated connective bearing fertile anther lobe at the posterior side and sterile lobe at the anterior side; dithecous, introrse.

Gynoecium: Bicarpellary, syncarpous, superior, bilocular but becoming tetralocular, axile placentation, one ovule in each loculus; style gynobasic; stigma bifid.
Fruit: Carcerulus.
Seed: Non-endospermic.
Floral formula:



Apetalae: Euphorbiaceae,

Distribution: There are about 283 genera and 7,300 species in this family. The plants of this family are found throughout the world. However, they are not found in arctic regions. In our country the family is represented by several genera such as, Euphorbia, Ricinus, Phyllanthus, Croton, Pedilanthus, etc. In the desert regions of Africa and elsewhere the family is represented by cactus-like plants of different species of Euphorbia.
Heath like Euphorbias are quite common in Australia. In Britain only two genera, i.e., Euphorbia and Mercurialis are found, which are represented by sixteen and two species respectively.

Habit: The plants exhibit great variation in their habit. The plants may be herbs, shrubs or trees. Euphorbia hirta, E. thymifolia, E. helioscopica, E. peplus; E. heterophylla, E. cristata, E. elegans; Phyllanthus niruri, Croton sp., Acalypha indica, etc., are annual or prennial herbs. Euphorbia pulcherrima, E. splendens, are beautiful shrubs. Pedilanthus sp., and Jatropha sp., are shrubby plants.
Euphorbia royleana, E. tirucalli are cactus like shrubs. Ricinus communis (Arand) is a tall annual and becomes small tree-like in habit. The tree habit of the family is represented by Phyllanthus emblica (Amla), Bischofia javanica, Putranjiva roxburghii, etc.

Havea brasiliensist (rubber tree) is a large tree 60 to 100 feet in height and 8-12 feet in girth. Species of the genus Tragia are tropical climbers. Majority of the members of the family possess large laticiferous vessels which contain latex.

Root: Tap and branched. The roots of Manihot utilissima and M .palmata are tuberous and rich in starch.
Stem: Herbaceous or woody, erect, very rarely climbing as in a tropical genus Tragia. The species of Xylophylla possess flat phylloclades. The stem is branched. It may be cylindrical, angular or flat. Usually solid but sometimes hollow as in Ricinus communis. Many stems possess spines. In many Euphorbia sp., the stems become fleshy, green and cactus like in appearance.
Leaves: The form and position of leaves are variable. The arrangement is usually alternate but sometimes they are opposite, e.g., Euphorbia hirta. In Pedilanthus the

leaves are arranged alternately in the lower region of the plant whereas opposite in the floral region.

Usually the leaves are simple but in some they are deeply incised, e.g., Ricinus, Manihot, etc. In many Euphorbias the leaves are scaly and caducous. In many cases the leaves are reduced to spines. In few cases the leaves are replaced by cladodes. Usually the leaves are stipulate. In Jatropha sp., the stipules become branched and hair-like. In many Euphorbia sp., they are represented by glands or spines.

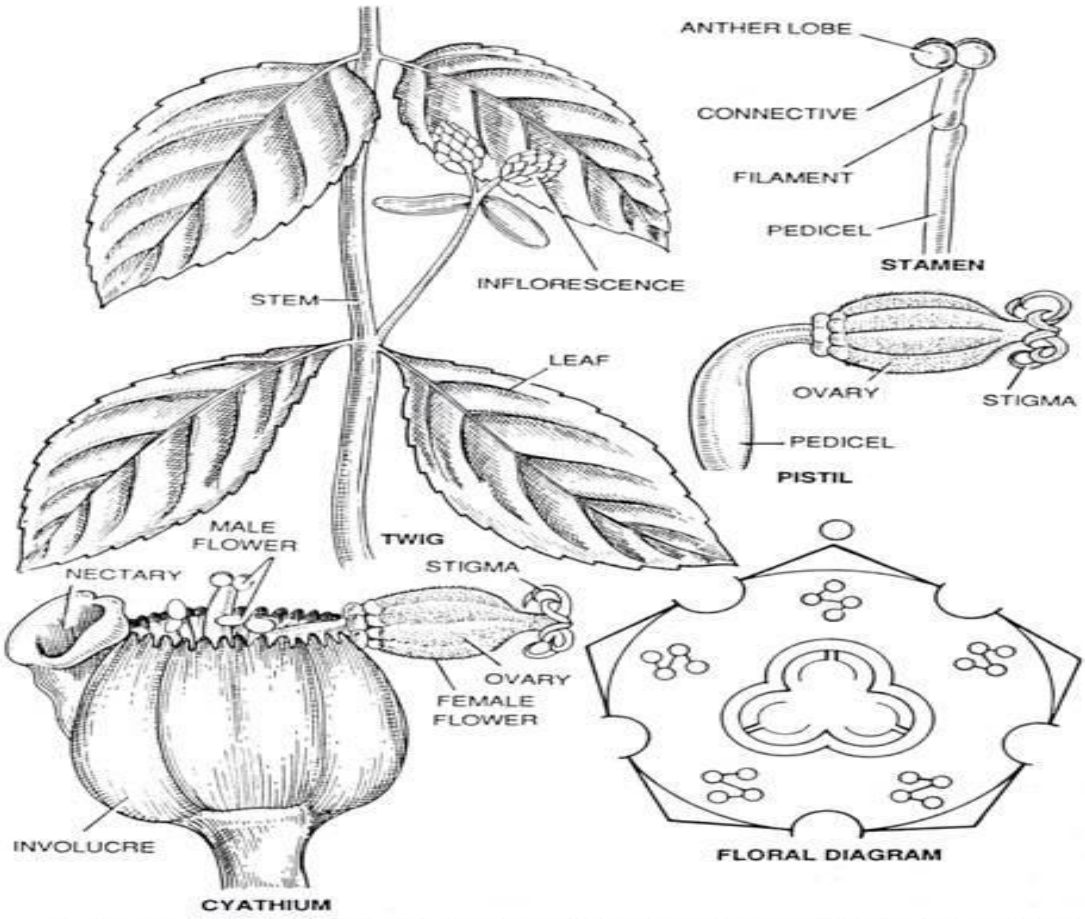


Fig.17.1. Euphorbiaceae. *Euphorbia* spp., plant with latex and cyathium inflorescence

Inflorescence: The inflorescence varies greatly. It may be racemose or cymose or sometimes complex. In Euphorbia, the inflorescence is peculiar but very characteristic and known as cyathium. This is the modification of a cyme. In cyathium inflorescence a large number of male flowers each represented by a stalked stamen are found arranged around a central stalked female flower. The female flower consists of gynoecium only.

The complete inflorescence looks like a single flower. The bracts are being arranged like a perianth. The bracts are so united that they form a cup-like structure. In Acalypha the inflorescence is catkin type. In Croton and Ricinus the flowers are arranged in terminal racemes. In Jatropha the inflorescence is of cymose type and the flowers are arranged in terminal cymes. In Manihot the flowers are being arranged in racemes.

Flowers: The flowers are always unisexual. They are much reduced and may be monoecious or dioecious. In Euphorbia sp., each male flower is represented by a single stalked stamen. The flowers are incomplete, regular, actinomorphic and hypogynous.
Perianth: Occasionally, both calyx and corolla are present, e.g., Croton. In majority of cases either calyx or corolla or both are absent. In Ricinus communis the calyx is present and the corolla absent. In Euphorbia hirta both the whorls of calyx and corolla are absent. In Jatropha sp., both calyx and corolla are present.
In Acalypha indica the perianth is represented by four minute sepaloid petals. In Phyllanthus only sepaloid perianth is present. In Euphorbia the perianth is absent or represented by tiny scaly structures.

The perianth consists of 4 to 5 petals. The calyx and corolla consists of 4 or 5 sepals or petals. The aestivation is valvate or imbricate.

Androecium: The number of stamens varies from one to many. Usually as many stamens are present as many perianth leaves. In Euphorbia a single stalked stamen represents a single male flower. In Ricinus sp., usually five stamens are present, each stamen is profusely branched. In Jatropha they are arranged in two whorls each of five stamens.
In many the stamens are indefinite, e.g., Croton. The filaments may be free or united. The anthers are dithecous. They dehisce either by apical pores or by transverse or longitudinal slits.

Gynoecium: Three carpels (tricarpellary), syncarpous; the ovary is trilocular, superior. Each locule contains one or two pendulous, anatropous ovules. The placenation is axile.
Fruit: The fruits are schizocarpic. The fruits break violently and dehisce into one seeded cocci. Such type of fruit is termed regma which is characteristic of Ricinus sp. The sp., of Trewia and Bridelia bear drupe fruit. Phyllanthus emblica also bears drupe.
Seeds: The seed is endospermic. In Ricinus caruncle develops from the micropyle. The cotyledons either lie flat or are folded within the endosperm.
Pollination: Usually entomophilous, i.e., through the agency of insects. Only cross-pollination takes place. In many species the leaves and bracts become coloured and showy to attract the insects. Sometimes anemophily is also found.
Floral Formulae:
The floral formulae of different genera are as follows:

Euphorbia — ♂ K0, C0, A1

♀ K0, C0, G(3).

Ricinus — ⊕ ♂ K5, C0, A5 (branched)

⊕ ♀ K3, CO, G(3).

Croton — ⊕ ♂ K5, C5, A ∝

⊕ ♀ K5, C5, G(3).

Bentham & Hooker (1862)	Engler & Prantl (1931)	Hutchinson (1959)
Phanerogams	Phanerogams	Angiospermae
Dicotyledones	Dicotyledones	Dicotyledones
Monochlamydeae	Archichlamydeae	Lignosae
Incompletae or	Geraniales	Euphorbiales
Unisexuales	Euphorbiaceae	Euphorbiaceae
Euphorbiaceae		

Economic Importance of the Family – Euphorbiaceae:

The family consists of the plants of great economic value. Some of the important ones are given below:

1. Acalypha hispida; An ornamental herb.
2. Acalypha wilkesiana- (Eng. -Garden Acalypha). Grown in the gardens as ornamental plant.
3. Bischofia Javanica; (Eng.-Bishop wood; Verna-Bhillar)- A tree. A red dye, obtained from the bark is used to stain rattan baskets. The bark is also used as a tan. The wood is extremely resistant to water effect and therefore, largely utilized in the construction of bridges and boats.
4. Bridelia retusa, (Verna.-Ekdania, Khaja)-A tree, found in Rajasthan, Madhya Pradesh, the Western Peninsula and Bihar. The bark is used for tanning. The fruits are edible and the leaves are used as fodder.
5. Cleistanthus collinus' (Verna-Garari)-A small tree, found in Tamil Nadu, Malabar, Bihar, Orissa and Madhya Pradesh. The bark, leaves and green fruits are used as tan.
6. Croton aromaticus; An aromatic shrub or small tree found in Andhra Pradesh produces a gum-resin, which is used in varnishes.
7. Croton oblongifolius; (Verna-Chuka) – The seeds yield an oil, which is used as a purgative and also as an insecticide.
8. Croton tigllium; (Verna-Jamalgota)-A shrub or small tree, native of South East Asia but cultivated in Assam, Bengal and South India. The seeds are the source of croton oil, which is used as a purgative.
9. Baccaurea courtallensis: Found in the Western Ghats. The fruits are edible.
10. Baccaurea sapida- (Verna-Lathua)-Found in Assam, Bengal and Andaman Islands The fruits are edible.
11. Chrozophora prostrata (Verna-Subali)-The root ashes are given to the children for cough treatment. The seeds are used as a purgative.
12. Baliospermum montanum; (Verna-Danti)-The seeds are used as a strong purgative. The decoction of leaves is used in asthma.
13. Euphorbia milii; Syn. E. splendens; A small climbing shrub; native of Madagascar. Grown in gardens as ornamental.
14. Euphorbia pulcherrima-, Syn. Poinsettia pulcherrima', Eng-Poinsettia; (Verna.-Lal Patta)-A shrub, native of Central America.Grown as an ornamental.
15. Euphorbia tirucalli, (Verna.-Tohar)-Succulent spineless small tree, native of Africa. The roots are used for poisoning fish and birds.
16. Euphorbia hirta, (Verna.-Dudhi)-The plant is of medicinal value and used in many diseases of children and adults.

17. Euphorbia thymifolia; (Verna.-Chhoti dudhi)–The juice of leaves and seeds is used as a strong purgative. The juice is also used for remedy of ringworms and other skin diseases. It is an antidote for snake bite.
18. Euphorbia royleana- (Verna.-Thar)-The plants are used in hedges. The latex is used medicinally in several ways.
19. Euphorbia antiquorum- (Verna.-Tridhara, sehund)-The decoction of stem is used as a remedy of gout. The juice of the plant is also used as a strong purgative. The root bark is also used as a purgative.
20. Glochidion zeylanicum; (Verna.-Kumbalm)-The leaves are used in itches.
21. Securinega leucopyrus; Syn. Phyllanthus leucopyrus; Flueggea leucopyrus (Verna.- Hartho)-A large shrub or small tree, found in Uttar Pradesh, the Punjab, Maharashtra and Tamil Nadu. The fruits are edible.
22. Jatropha curcas; (Verna.-Safed arand)- A shrub or small tree, native of tropical America, now cultivated in Travancore. The seed oil is used for manufacturing candles, soaps and as a lubricant and for illumination. The seed oil is also used as a purgative. The tender shoots are edible. Oil also used as biodiesel.
23. Jatropha gossypifolia; (Verna.-Bherenda)-A shrub, native of Brazil. Cultivated as an ornamental.
24. Jatropha hastate; Grown as an ornamental for bright crimson flowers.
25. Jatropha padagrica; (Eng.-Gouty stemmed Jatropha)-Native of Panama, grown for its bright scarlet flowers.
26. Manihot esculenta; Syn. M. utilissima; (Eng.-Tapioca; Verna.-Sakarkand)- A small shrub; native of Brazil, now grown in Kerala, Tamil Nadu and Karnataka. The tapioca tubers are exploited commercially to obtain starch, sago, semolina and flour.
27. Hevea brasiliensis; (Eng.-Para rubber; Verna.-Rabar) – A tall tree; native of Brazil;, now grown in Kerala, Tamil Nadu, Karnataka and North-Eastern Assam. The latex, obtained from the bark of the tree, is used for preparing rubber, which is used for tyres and inner tubes, waterproof clothing and various electrical goods.
28. Mallotus philippinensis- (Verna.-Kamala, Rauni)-A small tree found commonly in Bengal, Madhya Pradesh, Maharashtra and Orissa. The red dye, obtained from the surface of the fruits, is used for dyeing silk. Also used medicinally to remove thread worms and Ascaris.
29. Cicca acida; Syn. Phyllanthus acidus; Averrhoa acida; (Eng.-Stargoose-berry; Verna.- Hariphul)- A small tree cultivated in Bengal and South India for the edible fruits. The leaves are edible. The bark is used as a tan.
30. Emblica officinalis; Syn. Phyllanthus emblica; (Verna.-Amla)- A common tree with edible fruits. The fruits are also used in diarrhoea and dysentery. The bark, leaves and fruits are used in dyeing and tanning. The wood yields excellent charcoal. The pickle or jam is prepared from the fruits. The fruit is very rich in vitamin C.
31. Emblica fischeri; A small tree, found in South India.The fruits are edible.
32. Kiganelia reticulate; Syn. Phyllanthus reticulatus; (Verna.-Panjoli)- A climbing shrub, commonly found in Northern India. The roots are the source of a red dye.
33. Putranjiva roxburgii, (Eng.-Child-life tree; Verna.-Putranjiva)-A tall tree, grown as a hedge plant. The nuts are made in rosaries. The Hindus believe that if the hard stones of the fruits are made into rosaries and placed around the neck of the children, they keep them in good health.
The seeds also yield an oil which is used for burning purposes. The leaves are used as fodder. The leaves, fruits and stone of fruits are used medicinally in colds and fevers.
34. Ricinus communis; (Eng.-castor-oil plant; Verna-Arand)-A small tree, cultivated chiefly in Andhra Pradesh, Maharashtra, Karnataka and Orissa. The seeds are the source of castor-oil, which is mainly used as a lubricant and as a purgative. It is also

used for transparent soap, textile soap, typewriter-inks, perfume, aromatics, varnishes and paints.
The seed cake is used as a fertilizer. The writing and printing-papers are made of the wood-pulp. Castor stems are used for strawboards and cheap wrappings.

Monocotyledonae: Liliacaeae.

Distribution: It is commonly called “Lily family”. It includes 250 genera and 4000 species, which are world wide in distribution. In India it is represented by 169 species. Herbs rarely shrubs, stem underground rhizome, corm or bulb; leaves alternate, flowers actinomorphic, trimerous, hypogynous, perianth 6 in two whorls of 3 each, free or fused; stamen 3+3, epiphyllous, antiphyllous; gynoecium tricarpellary, syncarpous, ovary superior, axile placentation, two to many ovules per loculus; fruit capsule or berry; seed endospermic.

A. Vegetative characters:

Habit: Mostly herbs (Asphodelus), perennating by rhizome (Aloe), bulb (Lilium, Tulipa, Allium), tree (Dracena), climber (Asparagus, Smilax), xerophytic plants like Yucca, Aloe; cladodes in Asparagus and Ruscus.
Root: Fibrous adventitious, sometimes tuberous (Asparagus).
Stem: Herbaceous, or woody, solid or fistular, underground; aerial climbing or erect; underground stem may be corm, bulb or rhizome. In Ruscus and Asparagus aerial stems bear phylloclades (modified leaf-like branches), corm (Colchicum); secondary growth in Yucca.Dracaena, Aloe.
Leaves: Alternate, opposite or whorled, radical and cauline, exstipulate, sessile or petiolate, sheathing leaf base; shape is variable scale-like (Asparagus), thick succulent and mucilaginous in Aloe, broad in Phormium tenax. In Smilax stipulate and stipules are modified into tendrils. Venation is usually parallel but reticulate in Smilax and Trillium.

B. Floral characters:

Inflorescence: Variable-solitary (Tulipa, Fritillaria), panicled raceme (Asphodelus), cymose umbel (Allium, Smilax), solitary axillary (Gloriosa).
Flower: Pedicellate, actinomorphic or zygomorphic (Lilium, Hemerocallis), hermaphrodite or unisexual in Smilax, Ruscus; hypogynous, complete or incomplete (in unisexual flowers), trimerous rarely 2 or 4-merous (Maianthemum, Paris).
Perianth:6, in two words of three each, polyphyllous (Lilium, Tulipa) or gamophyllous (Aloe, Asparagus) and of various shapes; petaloid or sepaloid; imbricate in bud, usually valvate aestivation, perianth may be scarious or membranous.
Androecium: Stamens 6 or 3 (Ruscus), 8 in Paris; polyandrous, epiphyllous, antiphyllous, filaments long, anthers versatile or basifixed, dithecous, introrse or extrorse. In Ruscus outer whorl of stamens is reduced to staminodes.
Gynoecium: Tricarpellary, syncarpous, ovary superior or half inferior, trilocular or unilocular with two ovules, axile placentation, style simple; stigma trilobed or 3-parted.

Fruit:A berry (Asparagus, Smilax), capsule (Asphodelus).

Seed: Endospermic; endosperm horny or cartilagenous.

Pollination: Entomophilous rarely self-pollination.

Floral formula: $\oplus$ ⚥ $P_{3+3 \text{ or } (3+3)} A_{3+3} G_{\underline{(3)}}$.

Economic Importance of Liliaceae:

1. Food: Allium cepa (Onion), Allium sativum (Garlic) and Asparagus are edible and used as food.

2. Medicinal: Smilax, Aloe, Gloriosa, Veratrum, Colchicum, Scilla and Urginea yield useful drugs. Rat poison is obtained from Urginea and the bulbs of Scilla. Aloe vera yields "Aloin". The roots of Asparagus (H. Satavaer) yields a tonic. From Colchicum, colchicine is obtained.

3. Fibres: Yucca, Phormium tenax yield fibres of commerce.

4. Resin: Dracaena and Xanthorrhoea yield resin. From the acrid resin of Xanthorrhoea sealing wax is prepared.

5. Ornamentals: The common cultivated garden plants are Tulipa, Lilium, Gloriosa, Aloe, Ruscus, Dracaena, Asparagus, Yucca, Hemerocallis etc.

Primitive characters:
1. Perennial and arboreal habit in some genera (Aloe, Yucca).
2. Leaves simple and spirally arranged in most genera.
3. Solitary flowers in some genera.
4. Flowers hermaphrodite and actinomorphic.
5. Flowers are large and hypogynous.
6. Perianth polyphyllous in some genera (Asphodelus, Veratrum).
7. Seeds endospermic.

Advanced characters:
1. Many plants are herbaceous.
2. Leaves exstipulate, opposite or whorled in some genera.
3. Flowers are zygomorphic in some genera (Lilium, Hemerocallis).
4. Flowers unisexual (Ruscus, Smilax).
5. Perianth gamophyllous in many genera.
6. Stamens epiphyllous.
7. Reduction in the number of stamens to 3 (Ruscus).
8. Carpels 3 or 2 and syncarpous.
9. Axile placentation.

Common plants of the family:

1. Allium: Cultivated in winter for bulbs.

2. Aloe: Shrubby xerophytic plant, wild on rocks with dull red flowers.

3. Asphodelus: Common winter weed in wheat fields.

4. Asparagus:A thorny climbing under-shrub with cladodes and fasiculated roots.

5. Colchicum (Meadow saffron): Corm is very useful. It gives Colchicine.

6. Dracaena: Tree with anomalous secondary growth in the stem.

7. Fritillaria: Grown in garden as ornamental.

8. Gloriosa (Glory lily): Climber with tips of leaves turned into tendrils.

9. Ruscus: Flowers arise on the upper surface of phylloclades.
10. Smilax:A climber with stipular tendrils and reticulate venation.
11. Tulipa: Grown in garden as ornamentals.
Climbing shrubs with netveined leaves, e.g. Smilax.

Important Types of Liliaceae: Allium cepa (H. Paiz) .

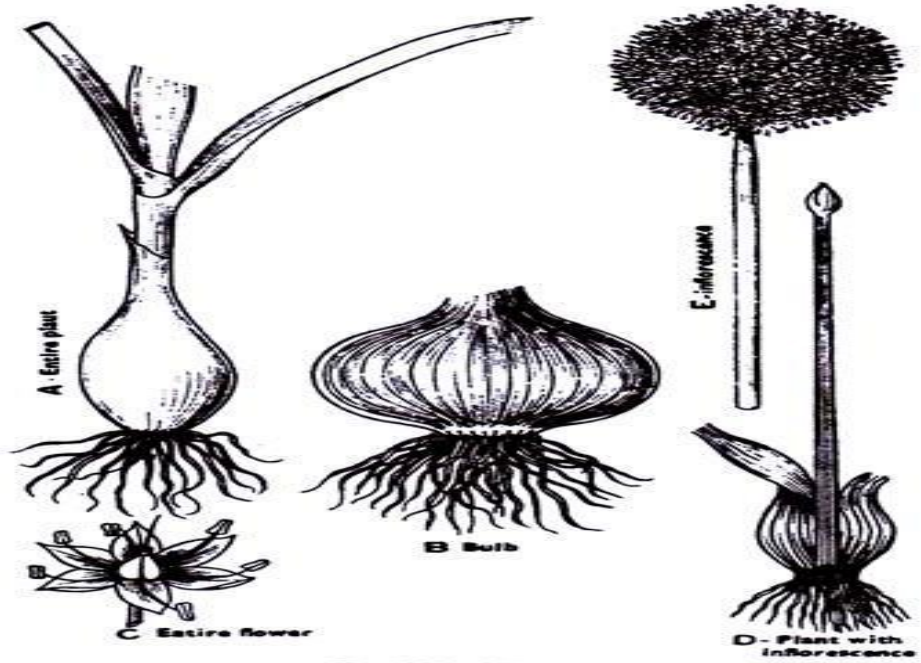


Fig. 107.2. *Allium cepa.*

Habit: An annual cultivated herb.
Root: Adventitious fibrous.
Stem: Underground tunicated bulb, extremely reduced to a conical disc like structure.
Leaves: Radical, cylindrical, long, exstipulate, sessile, fleshy, sheathing leaf-base, hollow, multicostate parallel venation.
Inflorescence: Monochasial cymes enclosed by 2 or 3 membranous bracts arranged in an umbellate fashion on an erect leafless scape.
Flower: Pedicellate, small, hermaphrodite, hypogynous, complete, actinomorphic, trimerous, white, bracteate.
Perianth: Tepals 6, in 2 whorls of 3 each, gamophyllous, united at the base, white, inferior.
Androecium: Stamens 6, polyandrous, in two whorls of 3 each, epiphyllous, filament narrow, dilated at the base, anthers dithecous, dorsifixed.
Gynoecium: Tricarpellary, syncarpous, ovary superior, trilocular, axile placentation, 2 ovules per loculus; style short filiform, stigma minute.

Floral formula: $\mathrm{Br.}\ \oplus\ \varnothing\ \overbrace{P_{(3+3)}}\ A_{3+3}\ \underline{G_{(3)}}$