PLANT TAXONOMY

Plant taxonomy is the science that finds, identifies, describes, classifies, and names plants. It is also known as systematic botany. It helps to identify and name various plants on the earth.

AIM AND SIGNIFICANCE OF PLANT TAXONOMY

- To know all plants on the earth with their names.
- To build up a reference system for plants for easy identification , naming and classification.
- To understand the facts of evolution of different plants.
- To give every plant an universal name to avoid confusions in naming of plants.

PLANT NOMENCLATURE

Naming of plants is known as nomenclatureϖ It was first introduced by Linnaues In 175. Naming of plants by two words is called binominal nomenclature. The starting letter of genus should be in capital letter. Species name should be in small letter. Binomials are mostly in greek or latin name. Eg. Mangifera indica.

ADVANTAGES OF BINOMIAL NOMENCLATURE

1. Binomial names are universal

2. They are definite and precise

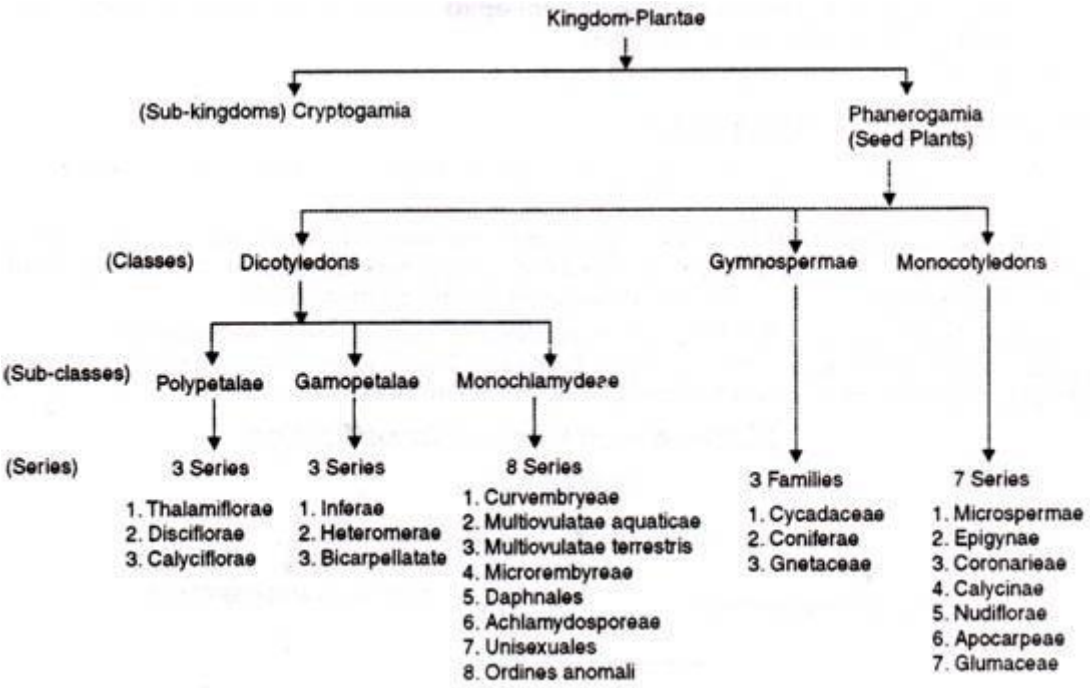
3. The names themselves describes the main features of the plants

4. Binomial helps to arrange the plants according to the systematic relationship.

BENTHAM AND HOOKER SYSTEM OF CLASSIFICATION

Two English Taxonomists namely George Bentham and Joseph Dalton Hooker were closely associated with the Royal Botanic Garden at Kew, England have given a detailed classification of plant kingdom, particularly the Angiosperms. An outstanding system of classification of Phanerogams in their famous book Genera Plantarum which was published in three volumes between the years 1862 to 1883 by them.

It is a natural system of classification. However, it does not show the evolutionary relationship between different groups of plants, in the strict sense. Nevertheless, it is the most popular system of classification particularly for Angiosperms. The popularity comes from the face that very clear key characters have been listed for each of the families. These key characters enable the students of taxonomy to easily identify and assign any angiosperm plant to its family.



Bentham and Hooker divided Plant Kingdom into two divisions: Cryptogamia (non-flowering plants) and Phanerogamia (flowering plants). The division Phanerogamia divided into three classes-Dicotyledon, Gymnosperm and Monocotyledon.

Class Dicotyledonae

This group includes angiosperms in which the seed bears two cotyledons and leaves exhibit reticulate venation. It is divided into three subclasses - Polypetalae, Gamopetalae and Metachlamydae.

Sub-class Polypetalae

The flowers contain distinct non-essential whorls calyx and corolla. In the corolla petals are free. This sub-class includes three series Thalamiflorae, Disciflorae and Calyciflorae.

1. Series Thalamiflorae: Thalamus drum shaped, many stamens in the androecium, Flower is hypogynous e.g. Michellachampara.

2. Series Disciflorae: Thalamus expanded and disc present. Hypogynous flowers with a cushion-like disc around or below the ovary e.g.Glycosmisarborea.

3. Series Calyciflorae: Flowers epigynous or perigynous. Thalamus is in the form of a cup e.g. Senna sophera.

Sub-class Gamopetalae

Flowers with distinct calyx and corolla, and the corolla petals are fused. This sub-class includes following three series:

1. Series Inferae: Flowers with inferior ovary e.g.Mikaniacordata.

2. Series Heteromerae: Flowers with superior ovary, number of carpels are more than two e.g.Rhododendron arboretum.

3. Series Bicarpellatae: Flowers with superior ovary, number of carpels e.g. Leucasaspera.

Sub-class Monochlamydae

The flowers are with only one non-essential whorl (perianth) or absence of non-essential whorls. It includes following 8 series:

1. Series-1 Curvembryae: Usually single ovule, embryo coiled around the endosperm e.g.Persicariahydropier

2. Series-2 MultiovulateAquaticae: Aquatic plants with syncarpous ovary and many ovules e.g.Lacismonadelpha

3. Series-3 MultiovulateTerrestris: Terrestrial plants with syncarpous ovary and many ovules e.g. Aristolochiaindica

4. Series-4 Microembryae: Only one ovule, small, tiny embryo endospermic seed e.g. Piper nigrum.

5. Series-5 Daphnales: Only one carpel and contains single ovule.

6. Series-6 Achlamydosporae: Ovary inferior, 1 to 3 ovules –unilocular e.g.Santalum album

7. Series-7 Unisexuales: Flower unisexual, perianth usually absent e.g.Croton bonplandianum.

8. Series-8 Ordines Anomali: (Anomolous families) Plants with uncertain systematic position but closer to unisexuales e.g.Ceratophyllumdemersum.

Class Gymnospermae

This group includes the gymnosperms in which seeds are not enclosed in fruits. This class is divided into three families Gnetaceae, Confiraceae and Cycadaceae.

Class Monocotyledonae

This group includes angiosperms in which the seed bears only one cotyledon. The leaves exhibit parallel venation. It is divided into the following seven series:

1. Series Microspermae: Ovary is inferior, seeds are minute and non-endospermic e.g. Vallisneriaspirallis

2. Series Epigynae: Ovary inferior, seeds are large and endospermic e.g.Musa paradiasiaca

3. Series Coronarieae: Ovary superior, perianthpetalloid e.g. Allium cepa.

4. Series Calycinae: Ovary superior, perianthsepalloid e.g. Cocos nucifera.

5. Series Nudiflorae: Perianth reduced or absent. Seeds are endospermic e.g. Lemna minor.

6. Series Apocarpae: Carpels more than one, free, seeds are endospermic e.g. Sagittariasinensis.

7. Series Glumaceae: Perianth reduced or absent, scaly bracts present e.g. Oryza stativa.

Each of the series mentioned under dicotyledonae and monocotyledonae have been further divided into orders and families. Bentham and Hooker classified the angiosperms into 202 families. They were able to provide distinct diagnostic key characters to each of these families

Merits:

1) It is simple and easy to use for practical purpose.

2) Every genus and species were studied from the actual specimens

3) Ranales is placed first in the dicot which is very reasonable.

4) Monocots followed dicots

5) Gymnosperms were treated by Bentham and Hooker as a third taxon and placed between Dicots and Monocots

Demerits:

1) Placing of Gymnosperms between dicot and monocot is not accepted.

2) Artificial characters are considered here and there.

3) Monochylamydeae is considered to be the most highly evolved among polypetalae is the most primitive groups among dicots

4) Some of the related orders are widely separated from each other.

5) There is no uniformity in the arrangement of groups.

6) In the classification of monocotyledon, importance is not given to all natural characters.

PHYLOGENETIC SYSTEM OF CLASSIFICATION (ENGLER AND PRANTL)

This classification was developed by two German Botanists Gustav AdlofEngler (1844-1930) and Anton Eugen Prantl (1849-1893). They divided plant kingdom into 13 Divisions mentioned as below:

Division I : Schizophyta

Division II : Myxothallophyta

Division III : Flagellatae

Division IV : Dinoflagellatae

Division V : Bacillariophyceae

Division VI : Conjugatae

Division VII : Chlorophyceae

Division VIII : Charophyta

Division IX : Phaeophyceae

Division X :Rhodophyceae

Division XI :Eumycetes

Division XII :EmbryophytaAsiphonogama

Division XIII :EmbryophytaSiphonogama

Division- EmbryophytaSiphonogama further classified into two sub-divisions: Subdivision Gymnospermae and Subdivision Angiospermae

Subdivision-Gymnospermae: Gynospermae subdivision further classified into following classes:

Class 1 : Cycadfilicales

Class 2 : Cycadales

Class 3 : Bennentiales

Class 4 : Ginkgoales

Class 5 : Coniferales

Class 6 : Cordiaitales

Class 7 : Gnetales

Subdivision-Angiospermae

Class 1- Monocotyledon Order- 11 Family-45

Class 2 -Dicotyledon

Subclass 1-Archiclamydeae Order-30 Family-190

Subclass 2-Metaclamydae Order-10 Family-53

HERBARIUM TECHNIQUES

Herbarium is a collection of dried specimen of plants mounted on herbariumϖ sheets. The individual sheets of the herbarium are known as herbarium specimens. Herbarium was first made by Cesalpini in 1550. Each herbarium specimen contains number and description of the plant. It consists of a three part processϖ collecting the plant material, pressing, drying and mounting.

Basic Tools For Herbarium Techniques

Plant press• Plastic bags• Chopper• Garden trowel• Small note book• & pencil Labels and tags• Camera• GPS• & altimeter Binocular• Drying sheets• Plant Specimen.

Collection of plant material

Specimens are collected usually at the time when they have flowers and fruits.ϖ Two or three specimens are collected.ϖ The collection number of the specimen entered in the field note book is given toϖ the collected specimen. This is done by entering a number on a label and tieing it into the specimen.ϖ After labeling, the specimens are put inside the vasculum or polythene bags.

Pressing

After collection, the unwanted parts of the plants are removed. One or two drying sheets are spread on a flat ground.ϖ One specimen is placed on the sheets and leaves, flowers are spread with fingers. Another two drying sheets are kept above. Another specimen is kept over the drying sheets. This is done until it reaches 1½ feet. One board of the plant press is kept below the drying sheets and another above theϖ drying sheets.

Drying:

On the next day, the bundles are opened and the wet sheets are replaced by newϖ one They are tied and exposed to the sunlightϖ They are shade dried and stored. This is followed for one week.ϖ DDT powder may be applied over the half dry specimens. The dried specimens may be damaged by small insectsϖ Mercuric chloride is used for this purpose.

Mounting :

The dried specimens are mounted on thick white boards called herbarium sheets.ϖ The sheet should be 11½ " wide and 16" long. They are prepared from high quality paper. At lower right hand corner, there is a printed label to write down the particulars ofϖ the specimen. The specimen is placed on a paper on its upper surface and gums on lower

surface. A drying sheet is placed over the specimen and some weight is kept over the specimen.

Labeling :

All the relevant details are filled in the herbarium label. The label should contain the following details. Name of the genus and species, name of the place, name of the collector, name of season, rainfall, altitude, sample number.

Storage:

The arranged herbarium sheets are maintained in herbarium cases. It will have three to five shelves. They are placed in herbarium house. DDT or carbon tetrachloride and ethylene dichloride is used to protect the herbarium specimens.

USES OF HERBARIUM TECHNIQUES

It shows individual variations and evolution patterns of plants. It can be used as teaching aids. It is helpful for plant identification. It helps to match with a new plant. It is used for proposing new system of classification. It provides complete information about wild, cultivated and introduced plants and their uses.

ANNONACEAE

Characters of Annonaceae:

Wood aromatic, leaves exstipulate, floral parts usually numerous, free spirally arranged; stamens with distinctive enlarged and flat connective; gynoecium multipistilate, apocarpous.

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. Takhtajan (1966) included 120 genera and 2,100 species in this family. The family is widely distributed in the tropical regions of the world. Some genera are also found in the temperate climates. In India it is represented by 129 species.

A. 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: $\oplus\, ♀\, K_3\, C_{3+3}\, A_{\infty}\, \underline{G_{\infty}}$ or $(\underline{\infty})$

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.

CRUCIFERAE (BRASSICACEAE)

Habit : Annual, biennial or perennial herbs. Farsetia jacquemontii is an undershrub. The plants possess pungent juice having sulphur-containing glucosides.

Root : Tap root alongwith hypocotyl is swollen in Radish (Raphanus sativus) and Turnip (Brassica rapa).

Stem : Erect, cylindrical, hairy or glabrous, herbaceous or rarely woody. It is reduced in the vegetative phase in Radish and Turnip. The stem is swollen in Kohlarabi (Knol-Kohl = Ganthgobi, Brassica, oleracea var. Gonglylodes). Axillary buds enlarged in Brussel's Sprouts (= Button gobhi) or Brassica oleracea var. gemmifera. Brassica oleracea var. capitata (Cabbage) has the largest terminal bud.

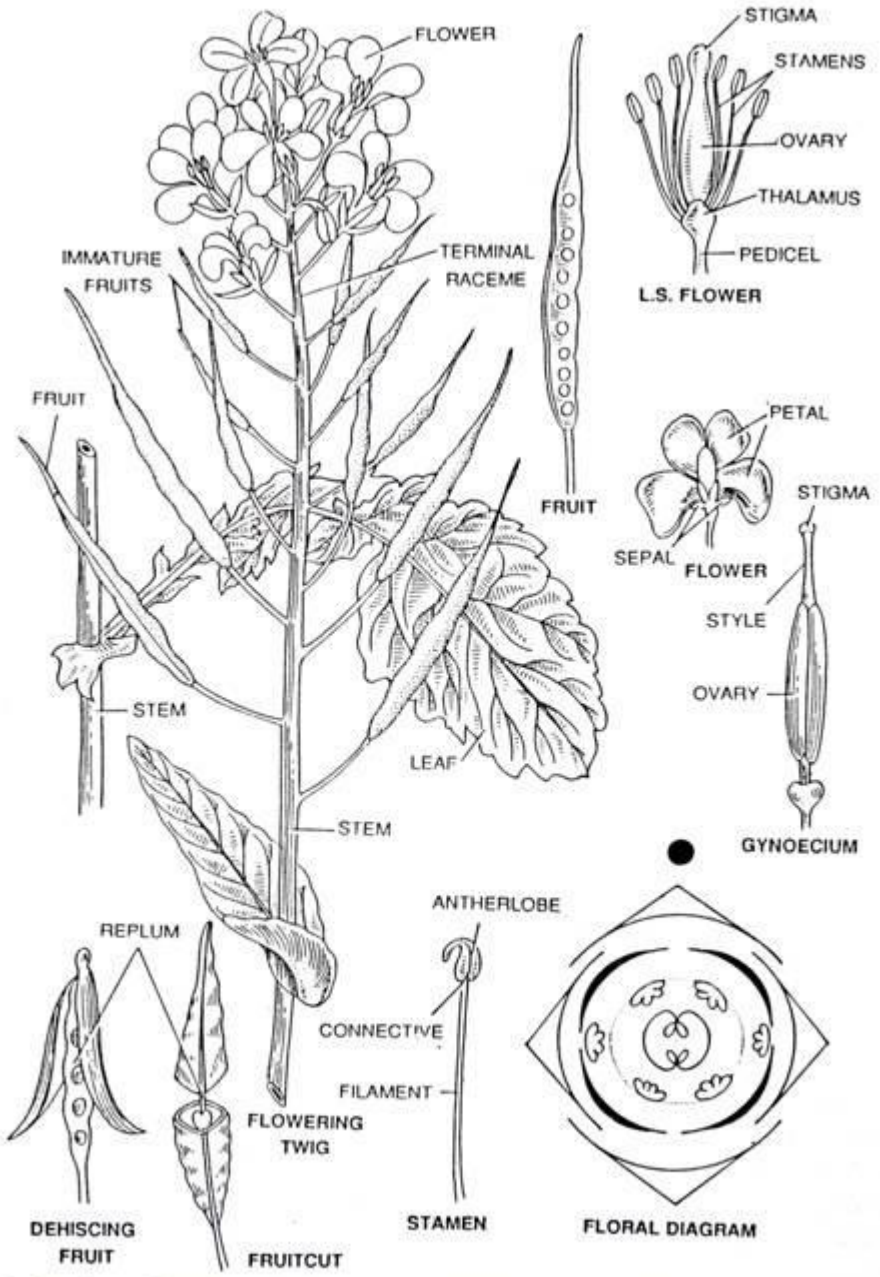


Fig. 22.1. Cruciferae (Brassicaceae). *Brassica campestris* Linn.; Eng. Yellow mustard; Verna. **Sarson.**

Leaves : Radical, cauline and ramal, alternate or sub-opposite but forming rosettes when radical, exstipulate with sheathing leaf base, sessile simple or rarely compound (e.g., Nasturium officinale), hairy. Bulbils occur in the leaf axils of Dentaria bulbifera and on the leaves of Cardamine pratensis.

Inflorescence : Flowers are usually arranged in racemose racemes. Occasionally they are in corymbs (candtuft).

Flower : Ebracteate or rarely bracteate (e.g., Rorippa montana), pedicellate, complete, perfect, regular, actinomorphic, rarely zygomorphic (e.g., Iberis, Teesdalia), tetramerous or bimerous, hypogynous (perigynous in Lepidium), cyclic, cruciform.

Calyx : Sepals 4, polysepalous, aestivation imbricate, generally arranged in two whorls, outer of antero-posterior sepals and inner of lateral sepals, lateral sepals generally saccate or pouched at the base, green or petaloid, inferior.

Corolla : Petals 4, polypetalous, arranged in one whorl and alternate with sepals, often with long claws and spread out in the form of a Greek cross. This arrangement of petals which is characteristic of the family is known as the cruciform arrangement and corolla is described as cruciform corolla, valvate aestivation. Petals reduced or absent in Lepidium and Rorippa.

Androecium : Stamens 6, (four in Cardamine hirsuta, two in Coronopus didymus, 16 in Megacarpaea), free (polyandrous), tetradynamous, arranged in two whorls, outer of two short lateral stamens while the inner whorl is made up of 4 long stamens arranged in two median pairs, anthers basifixed or dorsifixed, dehiscence longitudinal, inferior. Green nectaries are often associated with the bases of stamens.

Gynoecium : Bicarpellary (tricarpellary in species of Lepidium, tetracarpellary in Tetrapoma and Tropidocarpum), syncarpous, carpels placed transversely, ovary superior, placentation parietal, ovary bilocular due to the presence of a false septum called replum, style short, stigma capitate, simple or lobed.

Fruit : Siliqua of silicula, lomentaceous siliqua occurs in radish.

Seed : Non-endospermic, often oily.

Economic Importance of Family – Cruciferae (Brassicaceae):

The family is fairly important from the economic point of view. Most of the plants contain sulphur compounds.

The seeds of many plants yield vegetable oil of multipurpose use:

1. Brassica campestris var. dichotoma (Verna.-Kali Sarson) cultivated as an oil yielding crop, mostly in the Punjab.

2. Brassica campestris var. sarson; (Verna.-Sarson)-An oil-seed crop grown mainly in Uttar Pradesh, the Punjab, Bihar and Assam. The oil is used for cooking and burning purposes, and the oil cake as a cattle feed. The tender leaves and shoots are used as vegetable.

3. Brassica campestris var. toria (Verna.-Toria)-An oil-yielding crop grown in Uttar Pradesh, West Bengal and the Punjab. The oil is edible and the oil-cake is used as cattle and manure.

4. Brassica hirta; Syn. B. alba (Eng.-White Mustard; Verna.-Safed Rai)-The young leaves and tender shoots are used as vegetable. The seeds yield fatty oil.

5. Brassica juncea (Verna.-Rai)-The seed oil is used for cooking purposes. Cultivated in the Punjab, West Bengal and Uttar Pradesh.

6. Brassica juncea var. cuneifolia; Syn. B. rugosa var. cuneifolia (Verna.-Rai)-Commonly grown in the terai areas of Nainital, North Bengal and Assam. The young leaver and tender shoots are used as vegetable.

7. Brassica napus (Eng.-Rape; Verna.-Toriya, Kali sarson)-The seeds are used as vegetable. Cultivated in the Punjab, Bengal and Bihar.

8. Brassica nigra (Eng.-Black mustard; Verna.-Kali Rai)-The seeds are used as spice and condiment. Cultivated in the Punjab, Uttar Pradesh and Tamil Nadu.

9. Brassica oleracea var. acephala (Eng.-Kale; Verna.-Karam-Sag)-The young shoots and leaves are eaten as vegetable. Cultivated in Assam, Kashmir and Maharashtra.

10. Brassica oleracea var. botrytis (Eng.-Cauliflower; Verna.-Phulgobhi)-Grown all over Northern India for its edible inflorescence

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.

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 hemisphere

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: $\oplus \, ☿ \, K_{2+2} \, C_4 \, A_{4-6}$ or $\alpha \, \underline{G(2)}$

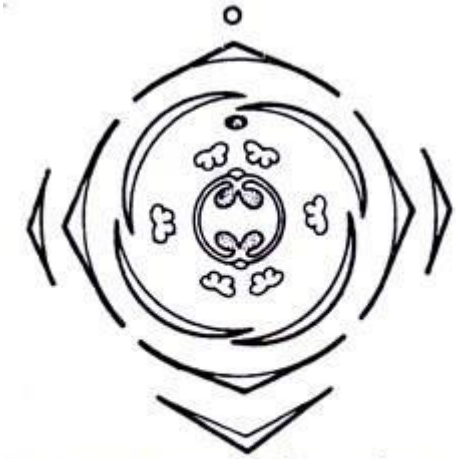


Fig. 32.1. Floral diagram of *Cleome spinosa* with six stamens and a nectary on the posterior side (after Eichler).

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.

RUTACEAE

Characters of Rutaceae:

Leaves gland dotted, simple or compound; flower hermaphrodite, hypogynous, actinomorphic with a disc below the ovary; corolla polypetalous; stamens ten, obdiplostemonous; carpels 5 or many, ovary superior, multilocular; fruit capsule or berry; aromatic odour is present.

Distribution of Rutaceae:

The family is commonly is called orange family. The family comprises 150 genera and 1300 species out of which India contributes 71 species. The members of the family are distributed in tropical and temperate regions and they are predominant in South Africa and Australia.

A. Vegetative characters:

Habit: The plant are generally shrubs (Murray a, Limonia, Zanthoxylum), trees (Aegle, Citrus, Feronia), rarely herbs (Ruta graveolens) with strong fragrance Paramignya is a shrub but climbs by means of axillary thorns.

Root: Tap root, branched often infected with fungus.

Stem: Woody (Citrus, Feronia), erect, cylindrical, branched, solid often thorny (Citrus), gland dotted.

Leaves: Alternate (Citrus, Murraya) or opposite (Evodia), petiolate, petiole may be winged (Citrus aurantium), simple or compound-pinnate (Murraya), palmate (Aegle and Citrus) smooth gland dotted, glands with essential oils, exstipulate, margin entire or serrate, unicostate reticulate venation. In Citrus petiole is winged.

B. Floral characters:

Inflorescence: Usually cyme or axillary or terminal corymb (Murraya paniculata) some times racemose or solitary.

Flower: Pedicellate, ebracteate, hermaphrodite, or unisexual (Zanthoxylum, Evodia, Feronia), actinomorphic rarely zygomorphic (Dictamnus and Correa), hypogynous, complete, pentamerous or tetramerous (Acronychia and lateral flowers of Ruta).

Calyx: Sepals 5 or 4, free or fused; in zygomorphic flower it becomes gamosepalous and tubular; imbricate; sometimes deciduous.

Corolla: Petals 5 or 4, polypetalous rarely gamopetalous (Correa speciosa) or absent (Zanthoxylum), variously coloured, imbricate.

Androecium: In majority of cases the stamens are obdiplostemonous and 10 in number; in Citrus numerous stamens with polyadelphous condition; in Zanthoxylum 3 stamens and in Skimmia 5 stamens; anthers introrse, dithecous, basifixed or versatile.

Gynoecium: Pentacarpellary and only slightly united at the base or the sides forming a deeply lobed ovary with fused styles originating from the centre. In Citrus and Toddalia the carpels are fully united. In Feronia the carpel is only one celled with many parietal placentae. In other genera the placentation is of the axile type. Topically the ovary is superior with a prominent nectariferous disc below it. Ovule anatropous.

Fruit: In Flindersioideae there is septicidal or loculicidal capsule; in Toddalioideae a drupaceous fruit; hesperidium in Citrus and berry in Murraya.

Seed: Endospermic or exalbuminous.

Pollination: Entomophilous; insects are attracted by the coloured petals, the nectar secreted by the disc is easily available. The flowers are protandrous. Thus in Ruta the stamens arise

successively to the centre of the flower and after shedding the pollen grains wither away and fall back again.

The stigma now matures and if no insect visitor has come then the stamens rise again and the pollen grains that still remain are once again shed over the stigma. Thus self pollination is effected.

Floral formula:

⊕ ☿ K4–5 or (4–5) C4–5 A8 or 10 or α G (4–α).

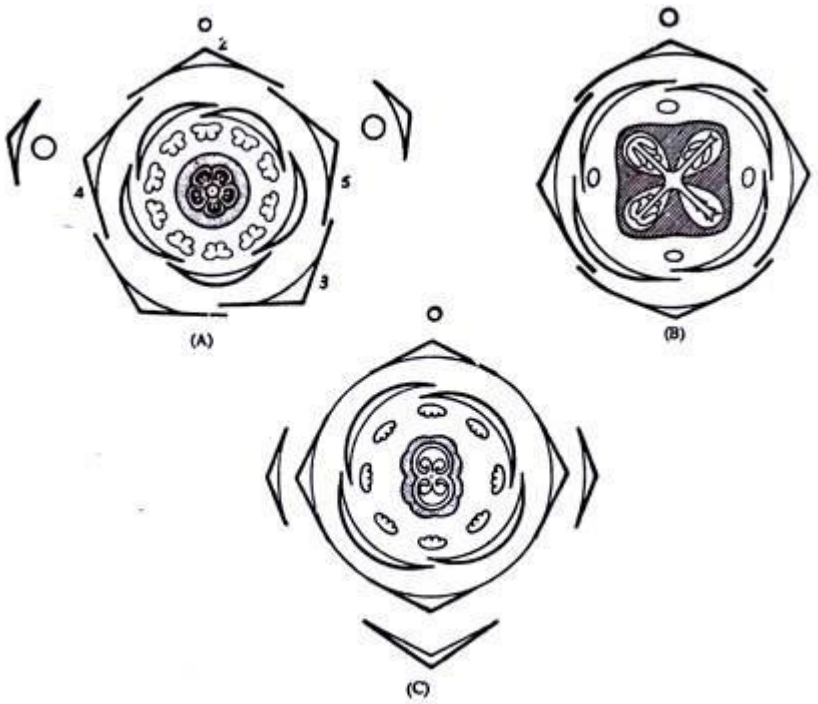


Fig. 45.1. Floral diagram of :
(A) *Ratu graveolens*, (B) *Tetradiclis* and (C) *Thamnosma* (Rutosma) *texana* (After Eichler).

Economic Importance of Rutaceae:

1. Fruits: The genus Citrus provides a number of fruits:

(a) C. aurantifolia (H-Kaghzi nimbu) has citric acid in its fruits and used in bilous vomiting. The fruit wall has essential oils.

(b) C. aurantium var. bergamia (H-Nimbu). The ripe fruit is digestive and a tonic, fruit wall gives oil of bergamot.

(c) C. aurantium var. bigardia. (H-Khatta). Rich in pro-vitamins A and vitamin B. Oil present in fruit wall.

(d) C. maxima (H-Chakotra) produces edible fruits.

(e) C. sinensis (H-Musumbi). The fruit is widely used during illness; it purifies blood, reduces thirst and improves appetite.

(f) C. reticulata (H-Santara or Narangi). The ripe fruit is highly nutritive and rich in assimilable calcium, the fruit wall also produces citrus oil.

(g) C. limettioides (H-Mitha Nimbu) is useful in fever and jaundice; oil also obtained from the wall.

(h) C. limon (H-Pahari Nimbu). The juice of ripe fruits is useful in rheumatism and dysentery.

(i) Aegle marmelos (H-Bel). This is normally edible. The fruit is particularly useful in stomach disorders. The plant is considered holy and its leaves used in worshipping the God Shiva.

(j) Feronia limonia (H-Kaith bel). The fruits edible; leaf and bark used medicinally.

2. Medicinal: Citrus is not only edible but produces vitamins particularly vitamin C (ascorbic acid). Barosma betulina produces buchu from its leaves which is useful in urinary diseases.

Pilocarpus microphyllus:

The active principle is pilocarpine which causes contraction of the pupil – it is just opposite to atropine. Jaborandi is prepared from the leaflets of this plant; this is useful in kidney diseases.

Murraya koenigii. (H-Katnim) has several medicinal properties. The green leaf is eaten raw in dysentery while bark and roots are useful in bites of poisonous animals when applied externally. The leaves are also used in curry powder particularly by S. Indians.

3. Ornamental and miscellaneous:

Plants like Ruta, Luvunga scandens, Ptelea, Calodendrum, Limonia, Murraya are cultivated in gardens for their fragrant flowers.

Zanthoxylum piperitum gives Japan pepper. Ruta graveolous gives French oil of Rue; Galipea officinalis yields cusparia bark.

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.

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.

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

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.

MYRTACEAE

Characters of Myrtaceae:

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.

Distribution of Myrtaceae:

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

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.

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.

Economic Importance of Myrtaceae:

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.

Leguminosae

The family Leguminosae is divided into 3 sub-families as:

Sub-family 1. Papilionaceae or papilionoideae:

Flowers medianly zygomorphic; calyx gamosepalous, imbricate; corolla papilionaceous, vexillary; stamens 10, diadelphous or monadelphous.

Sub-family 2. Caesalpinioideae:

Flowers slightly irregular; calyx free or united, corolla free, imbricate; stamens 10 or few, free.

Sub-family 3. Mimosoideae:

Flowers actinomorphic; sepals and petals valvate; free or united, stamens 4 to many.

PAPILIONACEAE:

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.

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).

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) $G_{\underline{1}}$.

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.

MIMOSACEAE

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.

A. Vegetative characters:

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.

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 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).

CAESALPINIACEAE:

Characters of Caesalpiniaceae:

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

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.

Vegetative characters:

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 of Caesalpiniaceae:

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.

CUCURBITACEAE

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.

A. 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.

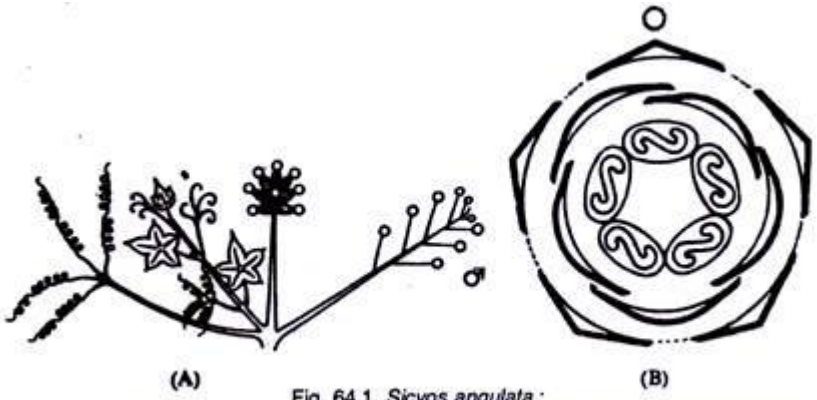


Fig. 64.1. *Sicyos angulata* :
(A) diagram of an inflorescence along with tendril and shoot. (B) F.D. Male flower (after Eichler).

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.

B. 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 through out (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.

Genoecium: 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).

Economic Importance of Cucurbitaceae:

This family is particularly important economically because its fruits are edible.

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

APIACEAE

Characters of Apiaceae:

Stem fistular, leaves alternate, much dissected mostly decompound, sheathing leaf base; inflorescence umbel or compound umbel occasionally simple; flowers epigynous, pentamerous, regular rarely zygomorphic, hermaphrodite; calyx superior, pentafid or 0; corolla five, polypetalous, often inflexed; stamens 5; carpels 2; syncarpous, bicarpellary with 2 pendulous ovules; honey-disc surrounding the stigmas – stylopodium is present; fruit cremocarp; seeds endospermic and oily.

Distribution of Apiaceae:

The family is commonly called carrot family. It was also named as Umbelliferae. It includes 295 genera and 2,850 species according to Willis. In India the family is represented by 180 species and 30 genera. The plants are distributed almost throughout the world except the arctic regions. The chief centres of the distribution are north temperate and sub-tropical regions.

A. Vegetative characters:

Habit: Plants are mostly herbs which may be annual, biennial or perennial, the herbs may be large (Bupleurum, Heracleum, Agelica) rarely shrubs with aromatic odour due to the presence of oil ducts. Pseudocarum climbs by means of its petioles which are very sensitive to contact.

Root: Tap, branched sometimes swollen for the storage of food material e.g., Carrot (Daucus carota).

Stem: Erect or prostrate; climbing in Pseudocarum; swollen nodes, sometimes ridged, usually fistular, glaucous or glabrous.

Leaf: Cauline and ramal; radical in young plants of Daucus, usually exstipulate, stipulate in Centella; alternate, opposite in some species or Apiastrum; simple or much dissected, often decompound; petiolate, petiole usually sheathing at the base, venation reticulate unicostate (Centella), multicostate (Astrantia), parallel in Eryngium and Aciphylla. Palmately lobed leaves in Sanicula.

B. Floral characters:

Inflorescence: Simple or compound umbel surrounded by thin leafy bracts called involucre; in some reduced to single flower e.g., in some species of Centella and Azorella; and to a compact head in Eryngium.

Flower: Pedicellate, bracteate (Centella) or ebracteate (Foeniculum), perfect, complete, actinomorphic and in some zygomorphic due to the enlargement of the outer petals of the marginal flowers of the umbel (Coriandrum); hermaphrodite, pentamerous, epigynous, discus present.

Calyx: Sepals 5, gamosepalous, small teeth or scales or absent (Foeniculum), adnate to the ovary, valvate, green.

Corolla: Petals 5, polypetalous, epigynous often emarginate, tips inflexed, valvate (Foeniculum) imbricate, coloured.

Androecium: Stamens 5, polyandrous, inserted under the disc, anthers dithecous, versatile, introrse, filament long, equal in length, bent in the bud but ultimately spreading out.

Gynoecium:\ Bicarpellary, syncarpous, inferior, bilocular with a single pendulous bvule in each loculus, antero-posteriorly placed, axile placentation, style two; stigmas two; on the top of the ovary an epigynous glandular-stylopodium is present.

Fruit: Schizocarpic cremocarp which splits into two one seeded mericarps, which rejnain attached to a slender often forked axis – the carpophore; mericarps are longitudinally ridged, in between the ridges are the farrows having oil ducts or vittae.

Seed: Endospermic, embryo small.

Pollination: Entomophilous due to nectar, scent and protandrous nature of flowers.

Floral formula: ⊕ or ♂ ☿ K (5) or 0 C5 A5 G (2).

Economic Importance of Apiaceae:

This family is of considerable importance from economic point of view chiefly because the plants have essential oil from which condiments or medicine are prepared.

Food: Carrot (Daucus carota), celery (Apium graveolens), parsnip (Pastinaca sativa) and sowa (Peucedanum graveolens) are chiefly used as pot herbs.

Condiments: Hing {Ferula foetida), Ajwain (Carum copticum), Zira (Cuminum cyminum), Saunf (Foeniculum vulgare), Dhania (Coriandrum sativum), are used as condiments or carminatives. Hing is a oleogum resin obtained from the roots. Ferula sumbul and F. galbaniflua also produce hing. Dorema also produces oleogum resin.

Fodder: Several members as carrot, Heracleum, Angelica provide fodder for cattle and horses.

Medicinal: Centella (H. Brahmi) is a very good tonic for brain. Hing, Saunf, Sowa, are used in digestive disorders. Peucedanum, graveolens (H. Sowa) is used as Dill water for children. Conium maculatum is the Hemlock plant. Its poison was given to Socrates; medicinally it is

important in all spasmodic affections such as cholera, epilepsy, whooping cough, mania etc. Conium yields the alkaloid coniine.

Apium graveolens (H. Ajmud) produces apiin and used medicinally as cardiac tonic, or in asthma etc.

The fleshy roots of Cicuta and Aethusa are poisonous to all kinds of livestock.

Ornamental: Trachymene, Angelica, Eryngium, Heracleum are cultivated in gardens for their beautiful flowers.