VIVEKANANDA COLLEGE

THAKURPUKUR

KOLKATA-700063

NAAC ACCREDITED 'A' GRADE

Topic:	TAXONOMY OF ANGIOSPERMS
Course Title:	Plant diversity II
Paper:	BOT-G-CC-2-2-TH b
Unit:	
Semester:	II
Name of the Teacher:	Mrs. Rinku Halder Sahu
Name of the Department:	Botany (Morning)

Characters of Malvaceae:

Vegetative characters:

Habit:

The plants are generally herbs (*Abutilon, Malva, Sida, Urena)*, shrubs (*Hibiscus, Gossypium*), and a few trees (*Gossypium arboreum*) with a mucilaginous sap in all parts. Usually young parts of the plants are covered with stellate hairs.

Root:

Tap, root, branched.

Stem:

Herbaceous (*Malva*) or woody (*Hibiscus*), branched, erect or spreading (*Sida, Malva parviflora*) pubescent with **stellate hairs**.

Leaves:

Alternate, petiolate, **stipulate**, stipules deciduous (*Malva*), simple, entire or palmately divided or lobed, margin wavy or serrate, apex acute, multicostate reticulate venation.

Floral characters:

Inflorescence:

Solitary axillary *(Hibiscus, Urena*), solitary terminal (*Abutilon),* raceme (*Althaea*), panicle (*Kydia).*

Flower:

Pedicellate, **bracteate, bracteolate in the form of epicalyx**, hermaphrodite rarely unisexual (Napaea), complete, actinomorphic, **pentamerous,** hypogynous.

Epicalyx:

Epicalyx 3 (*Gossypium*), 7 to 9 (*Althaea*) and in a few totally absent (*Abutilon, Sida*).

Calyx:

Sepals five, connate at the base, persistent, sometimes forming a tube (*Urena*), valvate aestivation.

Corolla:

Petals 5, polypetalous sometimes slightly connate at the base with the staminal tube-thus epipetalous, large showy, **twisted**. Prominent veins can be observed on the petals.

Androecium:

Stamens indefinite, **monadelphous,** forming a staminal tube; **epipetalous staminal tube united with the corolla**, anthers monothecous, **reniform**, **basifixed**, filament short, introrse.

Gynoecium:

Multicarpellary usually five (*Hibiscus)* or ten (*Althaea*) indefinite *(Abutilon*) or 3 (*Kydia*); syncarpous, ovary superior, penta or multilocular with **axile placentation**, ovules one to many in each loculus; style one, long, passing through the staminal tube; stigma correspond to the number of carpels.

Fruit:

Schizocarpic carcerulus (*Abutilon, Malva, Sida*), capsule (*Hibiscus, Gossypium*), berry (*Malvaviscus*).

Seed:

Non-endospermic, in some genera seed coat is densely tomentose (*Gossypium).*

Pollination:

Entomophilous. Insects are attracted to nectar, the showy nature of corolla and protandrous flowers.

Floral formula:

⊕ ☿ Epi 3–7 K (5) C5 A (α) G (5–α).

Fig. 38.1. Floral diagram of *Althaea* (after Eichler).

Distribution of Malvaceae:

It is commonly called cotton family or mallow family. The family consists of about 85 genera and 1500 species among which 111 species found in India. The plants are almost cosmopolitan in distribution but many of which are confined to tropics and sub-tropics.

Economic Importance of Malvaceae:

Economically this family is of much importance because there are a number of fibre yielding plants. According to certain authorities nearly all genera can produce some or other kinds of fibres.

A. Fibre yielding plants:

1. **Cotton** is perhaps the most important fibre in spite of many synthetic textile fibres. The seed coat of *Gossypium* produces epidermal hairs which is cellulosic in nature. This is cotton wool. These hairs are flattened, twisted and from the staple.

Egyptian cotton is derived from *G. peruvianum* whose staple length is 4 7/8 cms. *G. barbadense* produces sea inland cotton; its staple length is 5 cm. *G. hirsutum* is a native American species and is also considered superior cotton. The main Indian species is *G. herbaceum*;

its staple length is 1 7/8 cms. *G. arboreum* is a small tree or a large shrub. It is also cultivated in India.

Cotton seed is further important for it **produces an edible oil** which is semi drying and useful as oleomargarine and in soap. The oil cake is also a very nourishing cattle feed. The residue is also used in washing powder, in preparation of oil cloth, artificial leather, nitroglycerine etc.

2. *Hibiscus cannabinus* (Hindi-Patsan, Deccan Hemp or Bilipatam Jute) produces a very valuable **fibre** from its stem which is used for making rope, cordage, coarse canvas, sacs, floor matting. It is thus used as a substitute for jute.

3. Hibiscus sabdariffa, (Hindi-Patwa). A strong silky brown **fibre** is produced from its stem. This is a good substitute for jute in the textile and paper industry.

4. Other species of Hibiscus also produce **fibres** of minor importance. *H. tiliaceus* produces majanga fibres. Abelmoschus esculentus gives okra fibres.

5. *Abutilon theophrasti* (syn. A. avicennai) produces **China jute** or Indian mallow. It is extensively cultivated in China. It takes up dyes quickly and is used in making rugs.

6. *Urena lobata* – It is a weed in all tropical countries and furnishes a yellowish ***fibre*** that lasts longer than jute and is used as a substitute at some places. In Brazil it is used for making coffee sacks.

7. *Malachra capitata* also produces a strong silky **fibre** like jute and is used as a substitute.

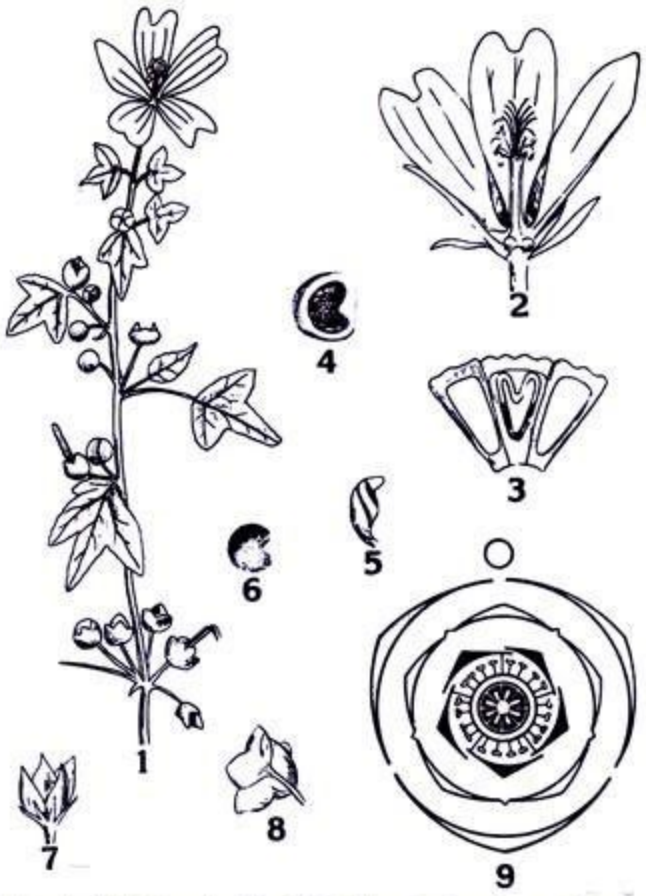


Fig. 38.2. *Malva sylvestris* 1. Flowering twig, 2. L.S. Flower 3. Carpel open 4 & 6. Seed. 5. Floral bud 7. Calyx. 8. Corolla 9. Floral diagram.

B. Miscellaneous uses:

8. *Abelmoschus esculentus* (Hindi-Bhindi, Eng.-Lady's finger) fruits are used as a **vegetable.**

9. *Hibiscus rosa-sinensis* or shoe flower is widely cultivated as an **ornamental plant** .Althea rosea is also a garden plant with its lovely pinkish flowers. *Abutilon indicum* (Hindi-Kanghi) is a wild plant which is sometimes used **medicinally**.

Malva sylvestris is also a **garden plan**t. *Urena repanda* is supposed to be a cure for **hydrophobia**.

Characters of Acanthaceae:

Vegetative characters:

Habit:

Plants are mostly herbs, shrubs or a few climbers (*Thunbergia*)-, some xerophytes (*Barleria, Blepharis, Acanthus*), aquatic (Asteracantha *longifolia*).

Root:

Branched tap root system.

Stem:

Aerial, erect, underground (*Ruellia tuberosa*), herbaceous or woody, branched cylindrical, **node swollen**, climbing or twining (*Thunbergia)*, spinous (*Barleria*).

Leaves:

Opposite decussate, simple, **exstipulate**, petiolate, usually entire, **acute apex,** hairy, **cystoliths** are present in the epidermal cells of stem and leaves.

Floral characters:

Inflorescence:

Solitary axillary (*Thunbergia*), spike (*Blepharis*) racemes, dichasial or monochasial cymes.

Flower:

Bracteate, bracteolate, bracts and bracteoles conspicuous, pedicellate or sessile, and brightly coloured, hermaphrodite, complete, zygomorphic, **pentamerous, or tetramerous**, **hypogynous**, nectariferous disc present below the ovary wall.

Calyx:

Sepals 4 or 5 gamosepalous, mostly bilabiate, hairy, imbricate, inferior.

Corolla:

Petals 2 to 5, bilipped, gamopetalous, variously coloured, **imbricate or twisted**, inferior.

Androecium:

Generally **4**, rarely 5 (**Penstemon**), in some 2 fertile stamens and 2 staminodes, epipetalous, filaments free, dithecous, **dorsifixed**, alternate with the corolla lobes, **one anther lobe may be smaller than the other and unequally placed**, anthers sometimes **spurred**.

Gynoecium:

Bicarpellary, syncarpous, superior, bilocular, **axile placentation**, carpels median, one or more ovules per loculus, style simple, **stigma bilobed**, disc present below the ovary.

Fruit:

Loculicidal **capsule** or rarely drupe.

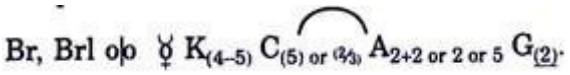
Seed:

Non-endospermic with hooks **(jaculators).**

Pollination:

Entomophilous.

Floral formula:



Distribution of Acanthaceae:

It is commonly known as Acanthus family. It includes 250 genera and 2500 species. The family is chiefly distributed in tropics and sub-tropics. In India 508 species are present.

Economic Importance of Acanthaceae:

1. Medicinal:

Many plants of the family are medicinal. *Adhatoda vasika* and *Barleria cristata* are used in cough. Roots of *Rhinanthus, Ruellia* are also used in medicine. Roots of *Ecbolium* are used in jaundice. *Andrographis paniculata* is used for liver diseases. Fruits and leaves of *Phlogacanthus thyrsiflorus* are used for fever. Leaves of

Phlogacanthus tubiflorus when rubbed in water yields lather which is used like soap for washing purposes.

2. Dye yielding: leaves of *Strobilanthes cusia* yield blue dye.

3. Ornamental: Many plants are cultivated for ornamental purposes viz., Acanthus, Barleria, Justicia, Thunbergia, Jacobinia, Ruellia, are often used as hedge.

Primitive characters:

1. A few shrubs.

2. Leaves simple.

3. Flowers hermaphrodite, hypogynous.

4. Gynoecium superior.

5. Pollination by insects.

Advanced characters:

1. Plants mostly herbs.

2. Leaves exstipulate and opposite.

3. Flowers are zygomorphic.

4. Calyx gamosepalous.

5. Corolla is gamopetalous.

6. Stamens epipetalous, 2 fertile and 2 staminodes.

7. Gynoecium bicarpellary, syncarpous.

8. Seed non-endospermic.

Common plants of the family:

1. *Acanthus ilicifolius, 2. Barleria, 3. Justicia adhatoda (syn. Adhatoda vasica), 4. Lepidagathis cuspidata, 5. Peristrophe bicalyculata, 6. Phlogacanthus, 7. Ruellia, 8.Thunbergia*

Characteristics and economic importance of family Leguminosae

- This family is also known as **Papilionaceae** or **Fabaceae** or commonly known as **pea family**.
- It is considered to be the second largest family of dicotyledonous plants.
- It is a terrestrial plant widely distributed in temperature and tropical countries of the world.
- The plants are of great economic importance.
- They are herbs, shrubs and trees.

Roots:

- The roots are tap roots, fibrous or tuberous.
- The outstanding feature is the presence of roots tubercles or nodules which harbor **nitrogen fixing bacteria** (***Rhizobium***) inside them.
- Plants are grown to enrich the soil with **nitrogenous substances**.

Leaves:

- Leaves are stipulate(stipules are large and foliaceous), **alternate** and **pinnately compound.**
- Stipules may be modified into **spines**.
- Generally, the leaves are compound and sometimes the leaf petiole is modified to form a
- In some other plants, the leaves form tendrils for climbing purposes.

Stem: It is branched, smooth or **glaucious**, may be erect or weak, herbaceous or woody. Some are climbing with the help of leaf tendrils.

Inflorescence: Raceme, flowers are arranged in **axillary racemes**.

Flowers:

- Flowers are complete, **bracteate** and **pedicellate**.
- They are either **actinomorphic** or **zygomorphic.**
- They are **hypogynous** and **cyclic,tetramerous.**

Calyx:

- Sepals are generally 5 in number.
- They are usually **gamosepalous** and the odd sepal is always anterior in position.
- Aestivation may be **ascending imbricate** or **vexillary.**

Corolla:

- Petals are 5 in number, white or pink in color.
- They may be **polypetalous** or **gamopetalous** (generally polypetalous) and are variously shaped.

Androecium:

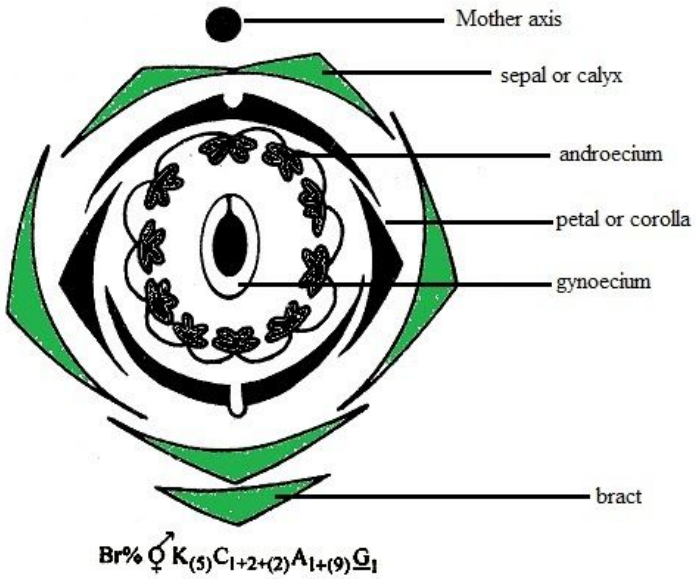
- There are generally 10 stamens, 9 stamens united to form a tube around the ovary while the tenth stamen is free.
- They are **polyandrous** or **diadelphous**.

Gynoecium:

- It is monocarpellary, **superior and unilocular**.
- There are numerous ovules on **parietal or marginal placentation**.

Fruit: A **legume or pod** with few seeds.

Floral diagram with floral formula (*Pisum sativum* or garden pea):



Floral diagram with floral formula

Some important plants of the family:

- ***Pisum sativum*** (Garden pea)
- ***Melilotus indica*** (Motha)
- ***Lathyrus odoratus*** (Sweet pea)
- ***Phaseolus mungo*** (Urad)
- ***Phaseolus aureus*** (Mung)
- ***Cajanus cajan*** (Arhar)
- ***Arachis hypogaea*** (Mungphali or ground nut)
- ***Dalbergia sissoo*** (Shisham)
- ***Cicer arietinum*** (Charia)

Economic importance:

- **As pulses**: Large number of plants are the sources of pulses which are rich in proteins. E.g. *Pisum sativum* (garden pea), *Vicia faba* (broad bean), *Glycine max* (soyabean) *Vigna mungo* (black gram), *V*. *radiate* (green gram), *Cajanus cajan* (pigeon pea), *Lens esculenta* (Musur) etc.
- **Vegetables**: Garden pea, mungfali or groundnut
- **Natural fertilizers**: *Crotalaria juncea* (sun hemp), *Trifolium repens* (Clover), *Medicago sativa* (alfalfa)
- **Oil**: Oil can be extracted from soybean and groundnut.
- **Condiments (flavoring agent)**: Seeds of *Trigonella foenum graecum* (Methi) are used to add flavor to food.
- **Fibers**: Sun hemp and *Sesbania cannabina* (river hemp or yellow pea bush) are used to extract fibers.
- **Timber**: Shisham and *Dalbergia latifolia* (India rosewood)
- The leaves of *Indigofera tinctoria* yield indigo dye.
- The red seeds of *Arbus precatorious* are used as jeweler's weights.

Characteristics and economic importance of family Solanaceae

- This is a family of wide distribution.
- Plants are terrestrial and are adapted to grow in temperate and tropical places, growing wild in shady places.
- They are annual herbs, shrubs and rarely trees.

Roots: They have tap root system, and the roots are branched.

Stem:

- Stem is erect and weak, may be aerial or underground.
- It is herbaceous, may be profusely branched, hairy or prickly.
- It is solid and cylindrical with tuberous in the case of potatoes.

Leaves:

- They may be simple or pinnately compound (as in tomato).
- They are alternate or opposite, exstipulate, hairy, petiolate, dentate, ovate, unicostate and reticulate venation.

Inflorescence: Cymose or solitary axillary

Flowers:

- They are complete, small, usually white in color, pentamerous, hypogynous and bisexual.

- They are pedicellate, ebracteate, and actinomorphic.

Calyx:

- 5 sepals, green in color, gamosepalous, campanulate or tubular.
- Valvate or imbricate aestivation, persistent.

Corolla:

- 5 petals,of various shape and color, gamopetalous, rotate, lobes oblong or tubular
- valvate or imbricate aestivation

Androecium:

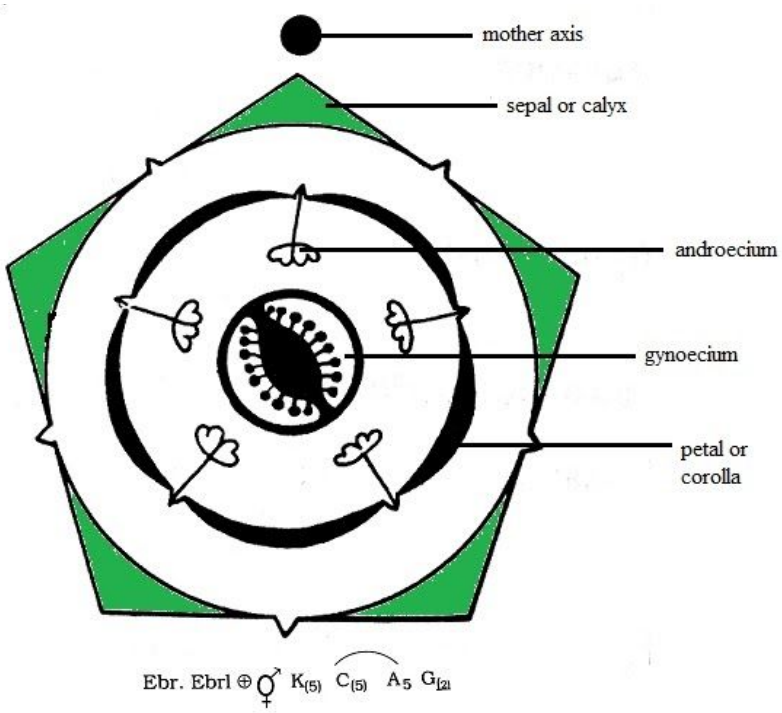
- Stamens 5, generally yellow in color, polyandrous, epipetalous anthers, massive
- Filaments are short, anther oblong, basifixed and bicelled
- Dehiscence of anthers is by means of apical pores as in *Solanum* species or by longitudinal slits.
- Anthers form a cone around the style.

Gynoecium:

- Bicarpellary, syncarpous, ovary is superior and obliquely placed.
- Ovary is bilocular with swollen placenta, placentation is axile.
- Style is thick and short, stigma is sticky, bifid or bilobed and capitate.

Fruit: Berry with persistent calyx or spinous capsule

Floral diagram with floral formula (*Solanum nigrum* or black nightshade):



Floral diagram with floral formula

Some important plants of the family:

- ***Solanum tuberosum*** **(**potato)
- ***Solanum melongena*** **(**brinjal)

- ***Capsicum annum*** **(**green pepper)
- ***Lycoperscum esculentum*** (tomato)
- ***Nicotiana tobaccum*** (tobacco)
- ***Petunia hybrida*** (petunia)
- ***Datura metel*** (devil's trumpet)
- ***Datura stramonium*** (jimsonweed)
- ***Withania somnifera*** (ashwagandha or rennet)

Economic importance:

- *Solanum tuberosum*, *melongena*, *Capsicum annum*, *Lycopersicum esculentum* etc. are used as vegetables.
- *Nicotiana tobaccum* leaves and stem are used for preparing cigarettes and tobacco products.
- *Atropa belladonna*'s dried leaves, stems and roots yield 'belladona' to relieve pain, cough and excessive perspiration. Atropine is a drug obtained from the dried leaves of some plants to dilate the pupil of the eye.
- Dried leaves and roots of *Datura metel* and *stramonium* are used for the treatment of asthma.
- *Withania somnifera* can coagulate milk for making cheese.
- *Petunia hybrida*, *Cestrum nocturnum*, *Solanum villosum* have ornamental value.

Characters of Lamiaceae:

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, **quadrangula**r, 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.

Floral characters:

Inflorescence:

Very commonly a **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.

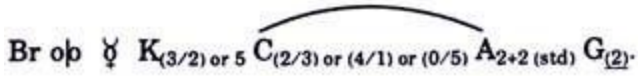
Fruit:

Usually schizocarpic carcerulus or achenes or nutlets rarely drupaceous.

Seed:

Non-endospermic.

Floral- formula:



Distribution of Lamiaceae:

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.

Economic Importance of Lamiaceae:

1. Food:

Tubers of *Stachys sieboldii* 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. *Leucas cephalotes* are used in fever. *Mentha piperita* and *Thymus vulgaris* 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 is 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), 2. *Leucas aspera* 3.*Lavandula vera* , *4. Mentha piperita (H. Podina)* , *5.Roylea, 6. Ocimum sanctum (H. Tulsi), 7. Salvia, 8.Thymus vulgaris*

Characters of Poaceae:

vegetative characters:

Habit: Herbs, annuals or perennials or shrubs, sometimes trees like (*Bambusa, Dendrocalamus)*.

Root: Adventitious, fibrous, branched, fascicled or stilt (*Zea mays*).

Stem: Underground rhizome in all perennial grasses, cylindrical, culm with conspicuous nodes and internodes, internodes hollow, herbaceous or woody, glabrous or glaucous, vegetative shoots are arising from the base of aerial stem or from underground stems are called tillers.

Leaves: Alternate, simple, distichous, exstipulate, sessile, ligulate (absent in *Echinochloa*), leaf base forming tubular sheath, sheath open, surrounding internode incompletely, ligule is present at the junction of the lamina and sheath, entire, hairy or rough, linear, parallel venation.

Floral characters:

Inflorescence: Compound spike which may be sessile or stalked. Each unit of inflorescence is **spikelet**. The spikelets are arranged in various ways on the main axis called rachilla. A compound

inflorescence may be spike of spikelets (*Triticum),* panicle of spikelets (*Avena*).

The spikelet consists of a short axis called rachilla on which 1 to many sessile or short stalked flowers are borne. The florets may be arranged in alternate or opposite manner on the central axis.

At the base of the rachilla **two sterile scales**, called **glumes**, are present. The glumes are placed one above the other on opposite sides. The lower one is called **first glume** and the upper is called **second glume**. Both the glumes are boat shaped and sterile. Above the glumes a series of florets are present. Each floret has an inferior **palea or lemma** and above it a superior palea. The lemma frequently bears a long, stiff hair called **awn**.

Flower: Bracteate and bracteolate, sessile, incomplete, hermaphrodite, or unisexual (*Zea mays*), irregular, zygomorphic, hypogynous, cyclic.

Perianth: Represented by membranous scales called the **lodicules**. The lodicules are situated above and opposite the superior palea or may be absent, or many (*Ochlandra)*, or 2 or 3.

Androecium:

Usually stamens 3, rarely 6 (*Bambusa, Oryza*) and one in various species of *Agrostis, Lepturus*; polyandrous, filaments long, anthers dithecous, **versatile**, linear, **extrorse**; pollen grains dry.

Gynoecium: Monocarpellary, according to some authors carpels 3, of which 2 are abortive, ovary superior, unilocular with single ovule, **basal placentation**, style short or absent; **stigmas two feathery or papillate** and branched.

Fruit: Caryopsis (achene with pericarp completely united or adherent with the seed coat) or rarely nut (Dendrocalamus) or berry (Bambusa).

Seed: Endospermic and containing a single cotyledon called scutellum, which is shield shaped and pressed against the endosperm.

Floral formula:

Floral formula – o|o ☿ $P_{0 \text{ or } 2 \text{ (Lodicules)}}$ $A_{3 \text{ or } 6}$ $G_{\underline{1}}$.

Distribution of Poaceae:

The family is commonly known as the grass family. It is one of the largest among the angiosperm families. It consists of 620 genera and

6,000 species. The members are cosmopolitan in distribution. The plants represent all the 3 ecological types as hydrophytes, xerophytes and mesophytes. In India it is represented by 850 species.

Economic Importance of Poaceae:

The family stands first and foremost in respect of economic importance in the whole of Angiosperms. The staple food grains of the population of the world is derived from Oryza sativa (Rice) and Triticum aestivum (Wheat). They are cultivated from time immemorial.

The family has been divided on economic basis as follows:

Food:

Triticum aestivum, Oryza sativa, Zea mays (Maize)*, Hordeum vulgare* (Jaw), *Sorghum vulgare* (Jowar*), Avena sativa (*Oats*),* *Pennisetum typhoides* (Bajra) are cultivated for cereals and food grains.

Fooder:

Many grasses such as *Cynodon dactylon, Panicum, Cymbopogon, Agrostis, Poa* are grown for fodder.

Sugar:

Saccharum officinarum (Sugarcane; H. Ganna) is cultivated for gur and sugar.

Building material:

Some species of *Bambusa* e.g. *B. tulda*, *B. vulgaris* are used for scaffolding, thatching huts etc.

Furniture:

Species of *Dendrocalamus* (H. Bent), *Arundinaria, Melocalamus* are used in the manufacture of furniture.

Aromatic grasses:

Many grasses yield scented oils which are used in perfumery viz. *Vetiveria zizanioides* (H. Khus khus) yields vetiver oil from the roots. The roots are also woven into curtains. *Andropogon odoratus* (Ginger grass), *Cymbopogon citratus* (Lemon grass), *Cymbopogon martini* (Geranium grass), *Cymbopogon jwarancusa* etc. also yield oil.

Medicinal:

Phragmites karka, *Cymbopogon schoenanthus* etc. are medicinal.

Secale cereale is cultivated for infection of its inflorescence by *Claviceps purpure*a for production of **Ergot** and for extraction of **ergotine**. Ergotine is an excellent remedy for uterine contraction.

Paper:

It is manufactured from certain species of grasses and bamboos.

Ornamental:

Rhynchelytrum repens, Cortaderia selloana and some species of the tribe Bambusoideae are ornamentals.

Besides these a number of grasses are grown to form fine lawns, playgrounds etc.

Primitive characters:

1. A few plants are arboreal in habit.

2. All florets in a spikelet are fertile.

3. Glumes are persistent.

4. Lemmas are herbaceous and leafy.

5. Stigmas are three.

6. Leaves are simple and alternate.

7. Flowers are hypogynous and hermaphrodite.

8. Seeds are endospermic.

Advanced characters:

1. Plants are mostly herbaceous, annuals and perennials.

2. Leaves are exstipulate.

3. Flowers are arranged in distinct inflorescence.

4. Flowers are small, inconspicuous and zygomorphic.

5. Perianth is represented by lodicules.

6. Stamens are reduced to 3.

7. Gynoecium is monocarpellary and unilocular.

8. Basal placentation.

9. Fruit is caryopsis.

10. Seeds are small sized.

Characters of Orchidaceae:

Vegetative characters:

Habit: Perennial terrestrial, succulent, scapose herbs; many are epiphytic or saprophytic, sometimes climbers *Vanilla*.

Root: Adventitious, tuberous, (*Orchis*), fleshy, **climbing or aerial**. Main roots always absent.

Stem: Erect, sometimes climbing or trailing, annual in terrestrial forms, perennial in epiphytic forms; generally thickened into rhizome or **pseudobulbs** (*Bulbophyllum*), bearing aerial assimilatory roots. (*Taeniophyllum*).

Leaf: Simple, alternate, sometimes opposite or whorled, usually fleshy, linear to ovate, sheathing base, sometimes reduced to achlorophyllous scales.

Floral characters:

Inflorescence: Solitary or spike, racemes or panicle (*Oncidium*).

Flower: Flowers are of variable and peculiar, shape, size and colour, often showy, bracteate, **zygomorphic**, bisexual or rarely unisexual, **epigynous**, trimerous, mostly **resupinate** i.e. twisted to 180° or upside down.

Perianth: Tepals 6, in two whorls of each, outer 3 tapals (representing calyx) green; inner 3 tepals coloured (representing corolla), dissimilar-the 2 lateral or wings like, the third posterior tepals is slightly modified often projected basally the **labellum** or lip; broad, shoe-like spursed, tubular, strap-shaped or butterfly shaped or variously branched and contributing most to the oddity and beauty of the flower.

The labellum is actually posterior it comes to lie on the anterior side of the flower due to twisting (or resupination) of the inferior ovary through 180° or by the bending back of the pedicel over the apex of the stem.

Androecium: Stamens 3, which unite with the pistil to form a column, the **gynandrium or gynostemium** opposite to the labellum; functional stamen (*Orchis*) or 2 (*Cypripedium*), dithecous,

introrse; pollen granular or coherent in each cell into one, 2 or 4 stalked pollen masses or **pollinia**.

A connection between ovary and stamen is made by the beak-like sterile stigma; occupying almost the centre of the column. Sometimes staminodes are also present.

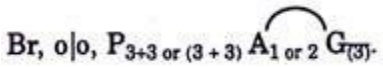
Gynoecium: Tricarpellary, syncarpous, ovary inferior, unilocular, **parietal placentation**, rarely trilocular and axile placentation (Apostasia); stigmas 3, of which 2 lateral are often fertile, the third stigma is sterile forming a small beaked outgrowth – the **rostellum** lying in the centre of column between the anther and fertile stigma. In *Cypripedium* and *Paphiopedium*, all the 3 stigmas are functional.

Fruit: A capsule.

Seed: Small, light (0.004 gm. each), non-endospermic.

Pollination: Entomophilous.

Floral formula:



Distribution of Orchidaceae: It is the second longest family of angiosperms. It is represented by about 900 genera and 20,000

species, which are cosmopolitan in distribution. In India it is represented by about 130 genera and over 800 species. The family has a great variety of flowers in shape, longevity and beauty.

Economic Importance of Orchidaceae:

1. Food: During scarcity the tuberous roots of *Habenaria susannae* and *Orchis latifolia* are used as food.

2. Flavour: The capsules of *Vanilla planifolia, V. fragrans* yield commercial '**Vanilla'** a flavouring agent for chocolate and confectionery.

3. Medicine: The root-stocks of *Eulophia epidendraeas* are used as vermifuge.

4. Dye: The leaves of *Calanthe veratrifolia* contain a glycoside 'indican', which on hydrolysis yields 'indigo blue'.

5. Ornamentals: Many orchids are cultivated in the green houses for their beautiful sweet-scented flowers of various forms, shapes with highly attractive labellum of various hues and bright colors. The orchid flowers are in great demand and are much more sought after than any other flowers.

Hence extensively grown from a commercial point of view. Some commonly grown orchids are – *Cypripedium* (lady's slipper),

*Epidendrum (*Green-fly orchid) *Habenaria* (fringe- orchid), *Oncidium* (butterfly orchid), *Vanda, Vanilla, Odontoglossum* (lady orchid).

Primitive characters:

1. Plants are perennial by means of pseudobulbs or root-tubers.

2. Leaves simple.

3. Presence of large, coloured and scented flowers.

4. Flowers solitary, terminal and bisexual.

5. Parietal placentation.

6. Entomophilous pollination.

7. Ovules numerous.

Advance characters:

The Orchidaceae is agreed upon by almost all botanists to be the most advanced family in the monocots for the following reasons:

1. It is an immense family of 20000 species.

2. Plants only herbs that are widely distributed and successfully invaded in various situations. Cosmopolitan all over the globe.

3. Leaves exstipulate.

4. Adventitious roots-variously modified.

5. Flowers of diverse shape, size and colour, small and inconspicuous.

6. Flowers are zygomorphic due to labellum, which is variously modified.

7. Epigynous flowers.

8. Reduction in number of stamens to two or one.

9. Adhesion of stamens with style and stigma to form-column.

10. Gynoecium 3, syncarpous and inferior.

11. Reduction in the number of fertile lobes of stigma to 2.

12. Modification of the third sterile lobe of stigma into a structure called restellum.

13. Pollen-grains are agglutinate into pollinia.

14. Fruit is a simple capsule.

15. Seeds non-endospermic, minute-and light in weight.

Common plants of the family:

1. *Calanthe* 2. *Acampe praemorsa* and *Vanda roxburghii*. 3. *Cattleya* 4. *Corallorhiza* , 5. *Vanilla planifolia* , 6. *Cypripedium calceolus*

Characters of Cucurbitaceae:

Vegetative characters:

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

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

Stem: Herbaceous, climbing, angular, fistular, branched.

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

Morphological nature of the tendril:

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

According to Braun (1876) it is a modified bracteole. Engler considered it a 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 are partly vascularised in the manner of a stipule in some cases.

Floral characters:

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

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

Male flower: Produced in large numbers.

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

Corolla: Petals 5, gamopetalous united at the base (**Momordica)** or 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.

Gynoecium: Reduced or rudimentary or absent.

Female flower:

They are fewer in number than the male flowers.

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

Corolla: Petals 5, gamopetalous, **inserted on calyx tube**; **imbricate** aestivation, superior.

Androecium: Staminodes 0, 3, 5.

Gynoecium: Tricarpellary, syncarpous, ovary inferior, unilocular with **parietal placentation**, the intruding placentae makes the ovary 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.

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).

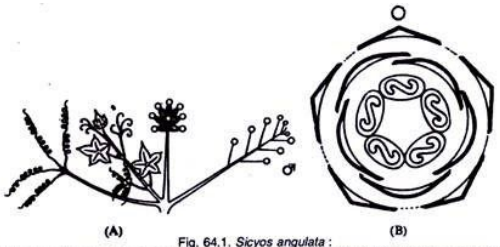


Fig. 64.1. *Sicyos angulata* :
(A) diagram of an inflorescence along with tendril and shoot. (B) F.D. Male flower (after Eichler).

Distribution of Cucurbitaceae:

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

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):

C. vulgaris var. *fistulosus* is Tinda which is used as a vegetable.

3. *Cucurbita maxima* is Kaddu:

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

4. *Benincasa heipida* is Petha:

It is used as a vegetable; PETHE-KI-MITHAI is also prepared from the fruits.

5. *Lagenaria vulgaris* is Lauki:

The fruit is commonly used as a vegetable. From ripe fruit-shells sitar is made.

6. *Trichosanthes dioca* is Parwal:

T. anguina is Chachinga which is also used as a vegetable.

7. *Luffa acutangula* is Torai:

This is also a popular vegetable.

8. *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 elaterium* fruits produce elaterium of medicine which has a narcotic effect and is useful in hydrophobia.

III. Ornamental:

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

Primitive characters:

1. Leaves simple and alternate.

2. Flowers actinomorphic.

3. Petals and stamens are free in some genera.

4. Ovules are bitegmic.

Advanced characters:

1. Plants herbaceous and climbers.

2. Leaves exstipulate and palmately lobed.

3. Flowers unisexual and epigynous.

4. Calyx gamosepalous.

5. Stamens 3 to 5 in number.

6. Stamens show a tendency towards fusion.

7. Anther lobes curved and controlled.

8. Gynoecium syncarpous.

9. Ovules campylotropous.

10. Fruit simple.

11. Seeds non-endospermic.

Common plant of the family:

1. *Cucurbita, 2. Trichosanthes , 3. Lagenaria (H. Lauki), 4. Luffa aegyptiaca (H. Tori) ,5. Momordica charantia (H. Karela), 6. Ecballium elaterium*

Characters of Rubiaceae

Vegetative characters:

Habit: Mostly shrubs (*Gardenia, Ixora, Mussaenda, Hamelia*); trees (*Morinda, Adina*) and a few herbs (, *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 (*Rubia)*, stipules mostly interpetiolar or sometimes intrapetiolar; unicostate reticulate venation.

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**, inserted near the mouth of the corolla tube, stamens dithecous, introrse, dehiscing longitudinally, superior.

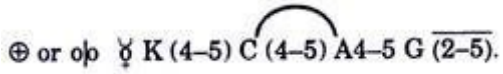
Gynoecium: Bicarpellary, rarely polycarpellary, **syncarpous**, inferior rarely half inferior (*Synaptanthera*) or superior (*Pangaea*), sometimes unilocular (*Gardenia*) with one to many anatropous ovules in each loculus, **axile placentation** (parietal placentation in *Gardenia*), style one sometimes 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:



Distribution of Rubiaceae:

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.

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 are mostly hermaphrodite and actinomorphic.

4. Stamens polyandrous.

5. Ovules are anatropous and many in some genera.

6. Seeds endospermic.

Advanced characters:

1. A few plants are herbs (*Rubia, Gallium*).

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),2. *Cinchona officinalis* (Quinine)

3. Hamelia, 4. Rubia, 5. Gardenia ,6. Ixora ,7. Mussaenda

Characters of Asteraceae:

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.

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.

On the basis of form of flowers the heads are of three types:

1. Heterogamous or radiate heads. The outer or ray-florets are ligulate and zygomorphic and inner or disc-florets tubular and actinomorphic e.g. *Helianthus*.

2. Homogamous-rayed or ligulate heads. All the flowers in the head are ligulate, zygomorphic and alike; e.g. *Sonchus*.

3. Homogamous-non-rayed or discoid heads. All the flowers are tubular, actinomorphic and alike, e.g., *Ageratum*.

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 $G\overline{(2)}$ 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.

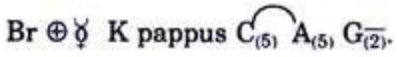
Gynoecium: Bicarpellary, syncarpous, inferior, unilocular with single anatropous ovule, **basal placentation**; style simple, long, **stigma bifid**.

Fruit: Cypsela.

Seed: Non-endospermic.

Pollination: Entomophilous.

Floral formula:



Distribution of Asteraceae:

The family is commonly known as the 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 worldwide in distribution and abundant in tropics and in cold arctic or alpines regions.

Economic Importance of Asteraceae: 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 *Emilia sonchifolia* leaves has a 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* is used as insecticide.

6. Ornamental: *Zinnia, Dahlia, Cosmos, Chrysanthemum, Calendula, Aster, Helianthu*s 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 flowers 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 a 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 are epigynous and in many species zygomorphic.

9. Calyx reduced to pappus or scales.

10. Corolla is 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.

Besides these morphological features and specialization there are also anatomical characters viz.:

1. Homogeneous medullary rays.

2. Small vessels and fibres.

3. Fibres with simple pits.

4. Presence of intraxylary phloem, medullary and cortical bundles and anomalous secondary growth.

These suggest that the Asteraceae is the most highly evolved and most successful family in the plant kingdom.