

**18MBO31C-U3**

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## **NYMPHAEACEAE**

**THALAMIFLORAE**

**RANALES**

This a very small family containing only 8 genera and

about 100 species (Rendle).the plants are cosmopolitan being distributed both in the temperature as well as the tropical regions.

**HABIT:** Perennial aquatic herbs with large rhizome .

### **VEGETATIVE CHARACTERS:**

**STEM:** Rhizome, short, thick and erect living

for a number of years (*Victoria*), or for a year only (*Euryale*) or a branched rhizome creeping on the mud and living for a very long time (*Nymphaea*, *Nuphar*); stem is cauline in *Cabomba*.

**LEAVES:** Leaves are alternate, simple, usually floating and

either peltate or ovate. Sometimes they are dimorphic with with peltate or ovate floating and finely dissected submerged leaves (*Cabomba*). Leaves are smooth with shining surface ,but sometimes become prickly below(*Victoria*, *Euryale*). They are usually with long petioles, but rarely they become sessile (*Cabomba*).

The lactiferous vessels containing milky leaves are often present The important anatomical features of the family are:

The reduction of woody elements in the vascular bundles,

The reduction of strengthening tissues,

The absence of cambium,

The scattered arrangement of the vascular bundles in the group tissue

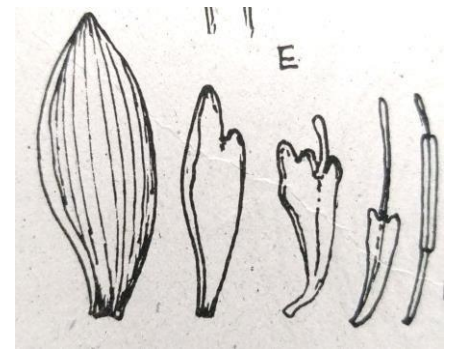
**FLORAL CHARACTERS:** Flowers are solitary, being situated on long pedicels. They are large, showy, beautifully coloured, bisexual, actinomorphic, Complete and hypo-to epigynous.

Calyx consists of either 3 to many sepals; sepals green, but often become

petaloid and even larger than the petals (*Nuphar*)

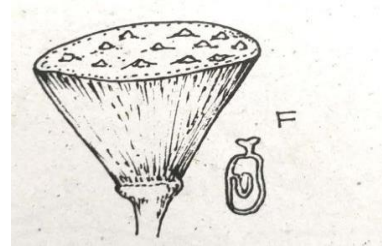
Corolla is a polypetalous and consists of numerous petals, frequently grading into the stamens; petals large and attractive but sometimes become minute and scale like (*Nuphar*)

Androecium consists of numerous stamens; anthers are introrse and the filaments often extend as sterile appendages beyond the anther sacks. They are 2-celled dehiscing longitudinally.



(androecium)

Gynoecium consists of simple pistils each having one carpel; with 1 locus; ovules numerous, placentation margin, ovary superior to inferior.

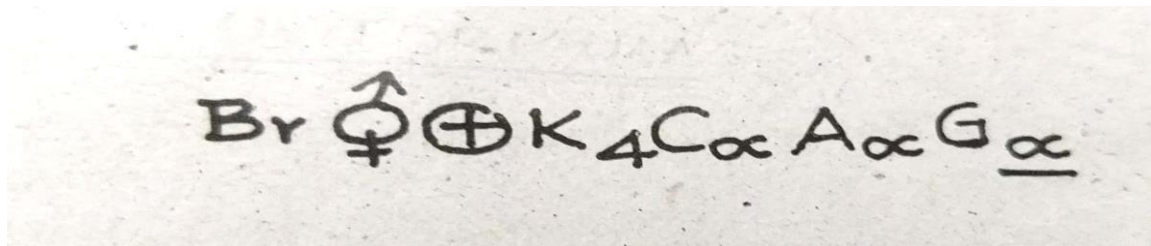


(gynoecium)

Fruit may be a follicle, a spongy berry or an etaerio of indehiscent nutlets.

Seeds with endosperm and perisperm, straight embryo; sometimes seeds are arillate.

### Floral formula:



The family is divided into three sub families:

#### a) CABOMBOIDEAE:

This sub-family contains 2 genera, *Cabomba* and *Brasenia*. The

flowers possess 3 sepals, 3 petals and alternating with them 3-6 stamens and usually 2-3 free carpels. A few ovules are situated on the sides of the carpels. The fruit is a pod containing usually 3 sides. The embryo is with scanty endosperm in the form of a layer surround it. The perisperm is abundant. This sub-family has its affinities with

Ranunculaceae in having small flowers with free, hypogynous parts and in its fruit.

#### b) NELUMBONOIDEAE:

This sub-family contains a single genus *Nelumbium N.speciosum* is

the sacred lotus has long-stalked, large, beautiful flowers. Perianth consists of indefinite number of free petaloid leaves which are either white or rose-coloured. The stamens are also indefinite in number and are arranged spirally beneath a large obconical receptacle. In the flat upper surface of this receptacle are found indefinite number of carpels, each being buried in a round pit. There is present a pendulous ovule in each carpel which matures into an indehiscent nut with very hard and resistant pericarp entirely filled up by the embryo.

These ripe carpels are buried loose in the cavities of the enlarged spongy and edible tours.

#### c) NYMPHAEOIDEAE:

This is the largest of all the 3 sub-families containing 5 genera,

characterized by the presence of syncarpous gynoecium and many chambered ovary. The flowers may be hypo-peri or epigynous (Example: *Nuphar*, *Nelumbium*, *Euryale*)

#### **IMPORTANT CHARACTERISTICS:**

- 1). Aquatic herbs with rhizomatous stems.
- 2). Leaves long petioled, peltate or pseudopeltate.
- 3). Flowers solitary on long peduncle.
- 4). Perianth leaves, 6-many, differentiated into sepals and petals; there is gradual change from sepals to petals, petals to stamens.
- 5). Stamens many.
- 6). Carpels many, free or connate.
- 7). Ovules on parietal or lamellate placentas.

#### **COMMON PLANTS:**

*Euryale ferox* Salisb, *Nymphaea alba* L; *N. esculenta* Roxb;

*N. nouchali* Burm.f. (Syn. *N. lotus* Hf.k. Thomas); *N. rubra* Roxb. ex. Salisb;

*N. pubescens* Wild.); *N. stellata* Wild; *Nelumbo nucifera* Gaertn. (Syn.

*Nelumbium speciosum* Wild; *Nymphaea nelumbo* L); *Nuphar luteum* L.

#### **ECONOMIC IMPORTANCE:**

*Nymphaea lotus* (chota kamal), *Nymphaea stellata* (bambher) *Nelumbium speciosum* (lotus, kamal), tuberous underground stems are eaten. Seeds of *Euryale ferox* are eaten after being roasted in hot sand. Seeds and flower stalks of kamal are eaten. Tuberous underground stems of *Nymphaea nouchali* are used in dysentery, the decoction of flowers of *Nymphaea Stellata* is used in curing diseases. Flowers *Nelumbo nucifera* are used in the treatment of diarrhea, cholera and liver troubles.

*Nelumbo nucifera* Gaertn. Botanical description Habit: A perennial aquatic herb.

Root: Adventitious slender and perennial.

Stem: Rhizomatous, branched and rooted in mud.

Leaves: Simple, petiolate, petiole long and beset with prickles; stipulate, stipules ochreate; foliage leaf peltate, round, upper surface smooth and waxy, multicostate divergent reticulate venation.

INFLORESCENCE: Axillary, solitary terminal.

FLOWER: Ebracteate, pedicellate, pedicel long and beset with prickles; complete, bisexual, actinomorphic, spirocyclic, hypogynous, large showy with sweet fragrance.

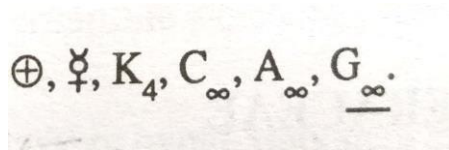
CALYX: Sepals 4, polysepalous, small, triangular, waxy, greenish pink, imbricate

COROLLA: petals numerous, polypetalous, ovate, waxy, pink, spirally arranged.

ANDROECIUM: stamens indefinite, spirally arranged, filament long, slender, anthers long, basifixed, erect, introrse, connective protrudes beyond anther as an appendage.

GYNOECIUM: Polycarpellary, apocarpous, superior, carpels embedded at the top of a flattened spongy receptacle; each carpel unilocular, one ovulated, ovule pendulous, style very short, stigma flat.

**FLORAL FORMULA**:



**SALIENT FEATURES OF NYMPHACEACEAE**:

- 1). Aquatic herbs. Roots are adventitious, fibrous.
- 2). Leaves simple, long, peltate or pseudopeltate.
- 3). Flowers solitary on long peduncle, bisexual, hypogynous, actinomorphic.
- 4). Perianth members are many, differentiated into sepals and petals; sepals 3-6, imbricate, free; petals 3-many, spirally arranged, free.
- 5). Stamens 6-many; spirally arranged on elongated cup-shaped thalamus.
- 6). Carpels 3-many, free or connate loosely or sunk in torus(thalamus). Ovary many chambered, superior or interior. Ovules one to many. Placentation lamellate or parietal.
- 7). Fruit spongy berry or aggregate of achenes.
- 8). Seeds arillate with endosperm and perisperm.

**CLASSIFICATION**:

B & H

Dicotyledons

Polypetalae  
Thalamiflorae  
Ranales

## CAPPARIDACEAE

### SYSTEMATIC POSITION

**CLASS :** Dicotyledanae

**SUBCLASS :** Polypetalae **SERIES :** Thalamiflorae

**ORDER :** Parietales

**FAMILY :** Capparidaceae

**GENUS :** Cleome

**SPECIES :** Viscosa

**HABITATE :** Tropical & warm temperature regions.

**HABIT :** Annual herbs: cleome and gynandropsis

Shrubs : Capparis and Maerua

Trees : Crataeva(Mavilangam- tamil name)

Xerophyte : Capparis aphylla (leafless shrub)

### VEGETATIVE CHARACTERISTICS

**LEAF :** Simple(*Cadapa*), Palmately compound (*Cleome*, *Gynandropsis* ),  
Alternate stipulatemodified into spines in *Cadapa spinosa* and *C.horrída*

**FLORESCENCE :** Racemose type

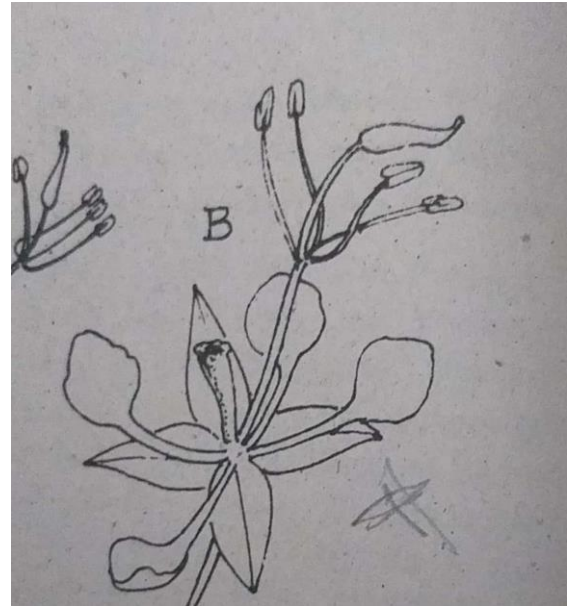
- Raceme in *Cleome*, *Gynandropsis*
- Corymb in *Maerua*, *Capparis aphylla*, *Crataeva religiosa*
- Umbel – *Capparis sepiaria*
- Solitary – *Niembuhria*, *Capparis ovalifolia*

**FLOWER** : Bisexual,  
hypogynous, Complete  
tetramerous, actinomorphic, zygomeric  
in *Pteropetalous*, *Capparis aphylla*

Androphore or Gynophore or  
both are well developed

Gynophore – *Capparis* &  
*Cretaeva*

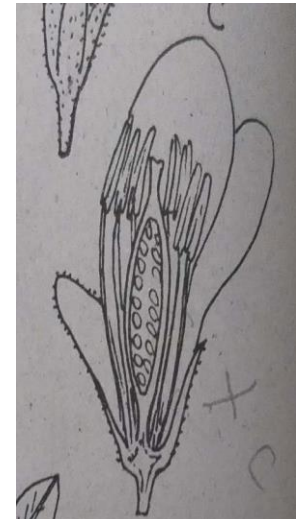
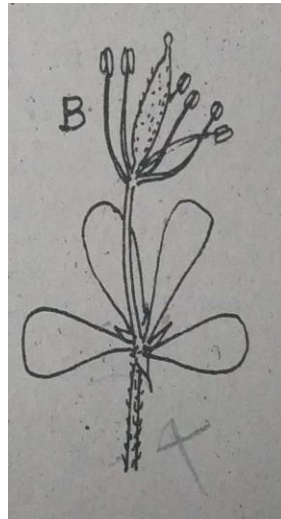
Gynandrophore – *Cleome*  
*pentaphylla*(or)*Gynandropsis*  
*pentaphylla*



- **Calyx** : 4 sepals, free, dimerous (2 whorls) valvate aestivation
- **Corolla** : 4 petals, free, valvate, imbricate and cleome, petals clawed, apetalous in *Cadapa*, *Roydsia koeberlinia*, *Niebuhrria*

**Androecium**: four to many in *Cadapa indica* and *Cleome tetraphylla* – four stamens alternate with four petals

In *Gynandropsis* two median stamens divide once so six stamens, ditheous, introse, basifixed anther, longitudinal dehiscence





**Gynoecium:** Bicarpellary, syncarpous, unilocular, superior ovary, capitate stigma, numerous ovules, parietal placentation

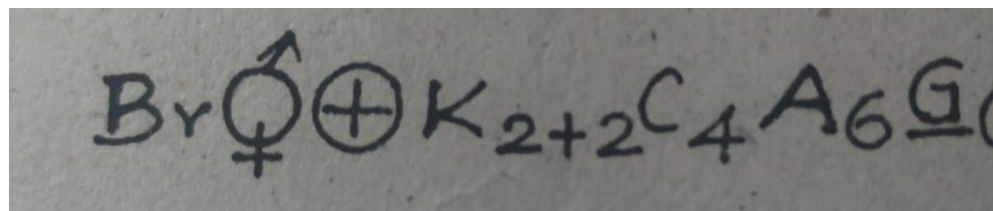


**POLLINATION:** By insects. Self pollination – not possible due to protandry and herkogamy

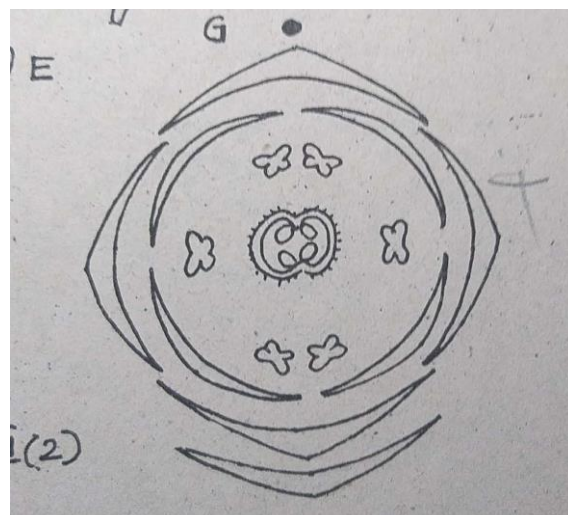
**FRUITS:** Siliqua – splitting into two halves. Berry in *Capparis*, *Maerua*. Nut in *Emblingia*

**SEEDS:** Exalbuminous, kidney shaped, large folded embryo

**FLORAL FORMULA:**



**FLORAL DIAGRAM:**



### **ECONOMIC IMPORTANCE:**

**Vegetables** – fruits of *Capparis aphylla*, *C. horrida* – preserved as pickles, *C. breyispina* – fruit edible

**Fodder** – *Crataeva roxburghii* leaves used as fodder

**Ornamental plants** – *Roydsia* and *Maerua*

**Worship** – *Crataeva religiosa* leaves are used for worship in Hindu temples.

### **IMPORTANT CHARACTERS:**

- Herbs with glandular pubescence
- Stipulate, simple or compound leaves
- Racemose types of inflorescence
- Bracteate, tetramerous flowers with clawed petals
- Bicarpellary, unilocular ovary with parietal placentation

**AFFINITIES:** *Capparidaceae* shows advance over *Ranales* families in herbaceous, shrub nature, cyclic arrangement of floral parts, definite number and united condition of carpels. Presence of disc shows family allied with *Resedaceae*.

**COMMON PLANTS:** *Polanisia viscosa* (syn. *Cleome viscosa* L.), *Cleome gynandra* (syn. *Gynandropsis gynandra*), *Capparis spinosa* L., *Crataeva nurvala* (syn. *Crataeva religiosa*)



## **POLYGALACEA**

### **HABIT:**

Herbs, shrubs/small trees with simple entire alternate, opposite whorled leaves, ex-stipulate.

### **INFLORESCENCE:**

Raceme, spikes and panicles.

### **FLOWER:**

Bract and bracteoles are present, slightly zygomorphic.

### **CALYX:**

5 Sepals, free, inner sepal- large and petaloid like wing petals of Papilionoidae flower, deciduous/persistent. Imbricate in buds.

### **COROLLA:**

3/5, free, upper- 2 and median petals are present. Latter forms a keel and bears dorsal fimbriated appendage, petals adnate with staminal tube.

### **ANDROECIUM:**

Stamens-8, Monodelphous, rarely distinct, 1-2 celled anther, dehiscence transverse slit/ terminal pores

### **GYNOECIUM:**

Ovary 1-2 celled, style simple, slightly curved, filiform/variously dilated above, stigma capitate, 1 or more ovule per cell.

### **FRUIT:**

Loculicidal capsule/ indehiscent samara.

## IMPORTANT PLANTS:

Salomonina sp.,  
Polygala sp.-  
Ornamental,  
medicinal.

Xantaphyllum(Mattei), Yellow  
wood-furniture.

## PORTULACACEAE

### 21.16 PORTULACACEAE (PURSLANE FAMILY)

#### 21.16.1 Systematic Position

Polypetalae, Thalamiflorae, Caryophyllineae.

#### 21.16.2 Field Recognition

Annual or perennial herbs with usually fleshy leaves; scarious stipules; sepals 2, persistent; petals 4-6; ovary unilocular; basal placentation.

#### 21.16.3 Selected Indian Genera

*Portulaca*, *Talinum*.

#### 21.16.4 Size, Distribution and General Information

Portulacaceae is represented by about 20 genera and 500 species (Jones and Luchsinger, 1987). Though cosmopolitan, the members are mainly distributed in western North America and southern South America. Only 7 species of Portulacaceae have so far been reported from India. Some larger genera of the family along with their number of species in bracket include *Portulaca* (purslane, 200), *Calandrinia* (red maids, 150), *Anacampseros* (70), *Talinum* (50), *Claytonia* (spring beauty, 35), *Lewisia* (20) and *Montia* (15).

#### 21.16.5 Description of the Family

**General Habit** Mostly annual, sometimes perennial herbs or suffrutescent shrubs.

**Root** Branched, tap root; fleshy in *Lewisia*.

**Leaves** Alternate or opposite; often succulent, simple; stipulate, stipules sometimes in the form of hairs or scales; exstipulate in *Claytonia*.

**Inflorescence** Usually cymose, or racemose, or solitary flowers.

**Flower** Bracteate or ebracteate, bisexual, actinomorphic, showy, complete, hypogynous or perigynous.

**Calyx** Sepals usually 2, often persistent, free or united at the base. Some regard sepals as bracteoles, and according to them the flowers have petaloid perianth.

**Corolla** 4 to 6 petals, free or united at the base; caducous; usually imbricate, but valvate in *Claytonia*; showy.

**Androecium** 4 to many, free stamens; usually 5 stamens, opposite to petals; anthers dithecal, introrse, dehiscent longitudinally; stamens 2 in *Montia* and 8–10 in *Portulaca oleracea*.

**Gynoecium** Usually tricarpellary, syncarpous, superior but partly inferior in *Portulaca*; unilocular; 2 to many campylotropous ovules on a central basal placenta; styles 2–5; stigmas 2–5 or as many as carpels.

**Fruit and Seed** Fruit usually a dehiscent capsule; rarely a nut and indehiscent. Seeds with embryo curved around the perisperm.

**Pollination and Dispersal** Pollination entomophilous and seeds are dispersed by animals or rains.

**General Floral Formula** Br or Ebr,  $\oplus$ ,  $\text{♀}$ ,  $K_2$  or (2),  $C_{4-6}$ ,  $A_{4-\infty}$ ,  $G(3)$ .

#### 21.16.6 Economic Importance

Portulacaceae is of little economic importance except of some well-known garden ornamentals, such as *Portulaca grandiflora* for its pink, red, yellow or white flowers, *P. afra* for its rose-coloured flowers, and *P. oleracea* for its showy flowers. Other ornamental plants of the family include several species of *Calandrinia*, *Talinum* and *Lewisia*. *Portulaca oleracea* is sometimes used as a pot herb and in salads and also in the ailments of kidney and urinary bladder. *P. quadrifida* proves effective in cough and asthma.

#### 21.16.7 Systematics and Phylogeny (Affinities)

Portulacaceae belongs to order Caryophyllineae (Bentham and Hooker). Cronquist (1981) discussed it under Caryophyllales. However, Thorne (1983) placed it under suborder Portulacineae of order Chenopodiales of Centrospermae.

Portulacaceae is related closely to the Cactaceae and Aizoaceae of order Caryophyllales (Hickey and King, 1988).



Recent anatomical findings of the family suggest that its 2 sepals are actually the bracts and its petals are thus the sepals.

### 21.16.8 Description of a Common Plant

1. *Portulaca oleracea* L. (Common Purslane; Fig. 21.24)

**Habit:** Herb with prostrate or ascending branches. **Stem:** Aerial, branched, succulent. **Leaves:** Simple, opposite or alternate, stipulate, sessile or subsessile, apex obtuse or truncate, entire. **Inflorescence:** Flowers solitary or in terminal clusters. **Flower:** Ebracteate, complete, hermaphrodite, actinomorphic, perigynous. **Calyx:** 2 sepals, free, antero-posterior. **Corolla:** 5 petals, free, quincuncial. **Androecium:** 8–12 stamens, usually 10, polyandrous, in one whorl, adnate, ditheous, introrse. **Gynoecium:** Tri- to pentacarpellary, syncarpous, half-inferior, unilocular, many ovules, free-central placentation; styles 3–5. **Fruit:** Capsule.

**Floral Formula:**  $Ebr, \oplus, \text{♀}, K_2, C_5, A_{8-12 \text{ or } 10}, G_{(3-5)}$

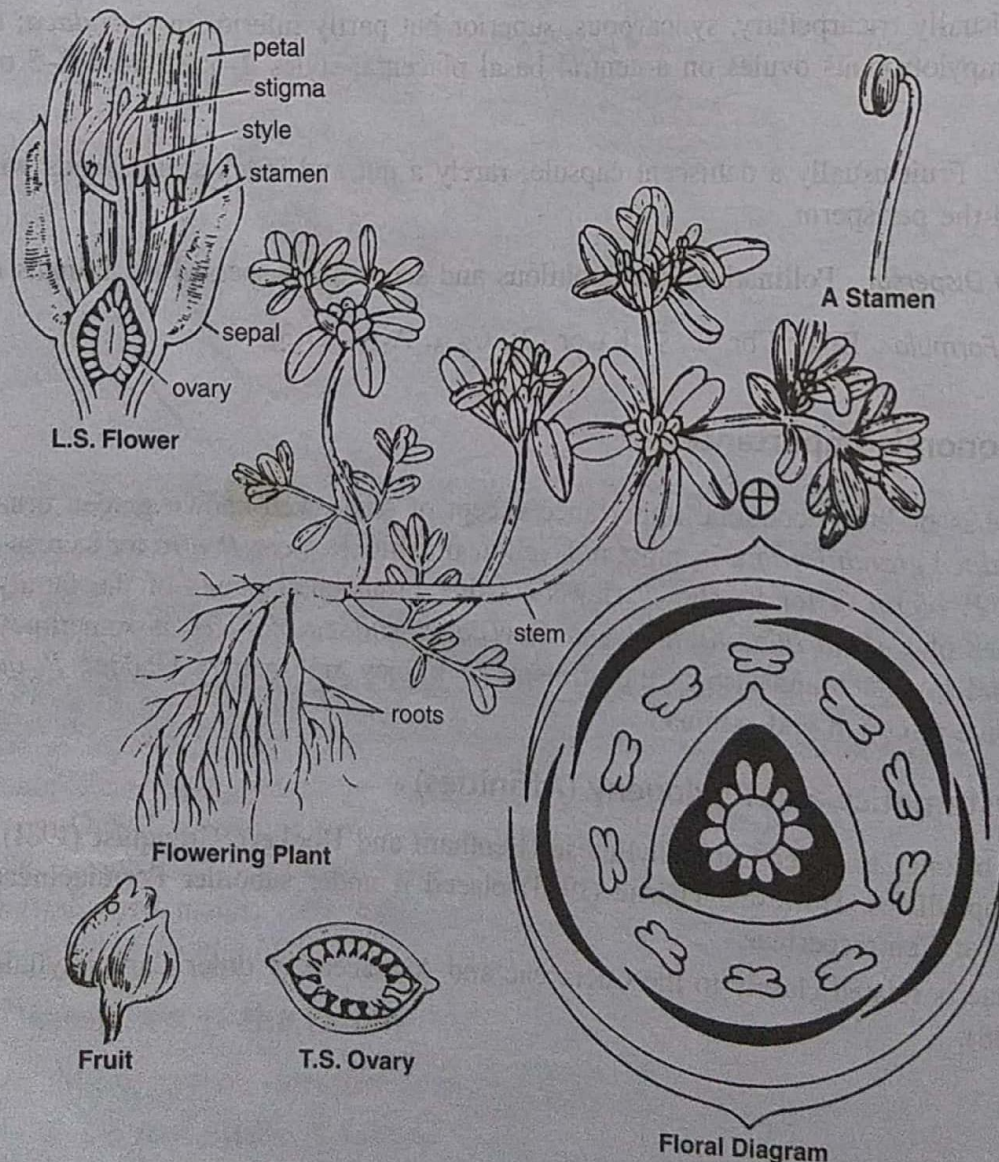


Fig. 21.24  $\blacklozenge$  *Portulaca oleracea* L.

**FLOWER:**



**OVARY:**



**L.S OF OVARY**





## ZYGOPHYLLACEAE

### Family VI. ZYGOPHYLLACEAE

There are about 200 species in 25 genera in dry districts in the warmer parts of the world, especially in salt-deserts, where they form a characteristic feature of the vegetation. They are rarely annual herbs, generally undershrubs or shrubs, with opposite, rarely alternate, generally paripinnate leaves; stipules are present. The regular bisexual flowers are terminal and solitary, or cymose. They are pentamerous, or sometimes tetramerous, with obdiplostemonous androecium (rarely 15 stamens). The stamens generally bear outgrowths at the base which unite to form an appendage standing inside the staminal ring. The ovary is generally four- or five-chambered, with one to several ovules in each chamber, pendulous from an axile placenta. The single angular or furrowed style bears a terminal stigma. Pollination is presumably effected in the majority by insect-agency. The fruit is a loculicidal or septicidal capsule or divides into indehiscent one-seeded portions; more rarely a berry or drupe. Endosperm is present or absent.

*Guaiacum officinale*, a small tree of the dry coast-area from Florida, West Indies and equatorial America, yields guaiacum-wood—used medicinally for the bitter resin contained in the heavy greenish-brown heart wood. (Fig. 136.)

*Tribulus terrestris*, a herb, native in dry and sandy districts in South Europe to Central Asia and in tropical and South Africa, has a thorny schizocarp which is readily carried by animals.

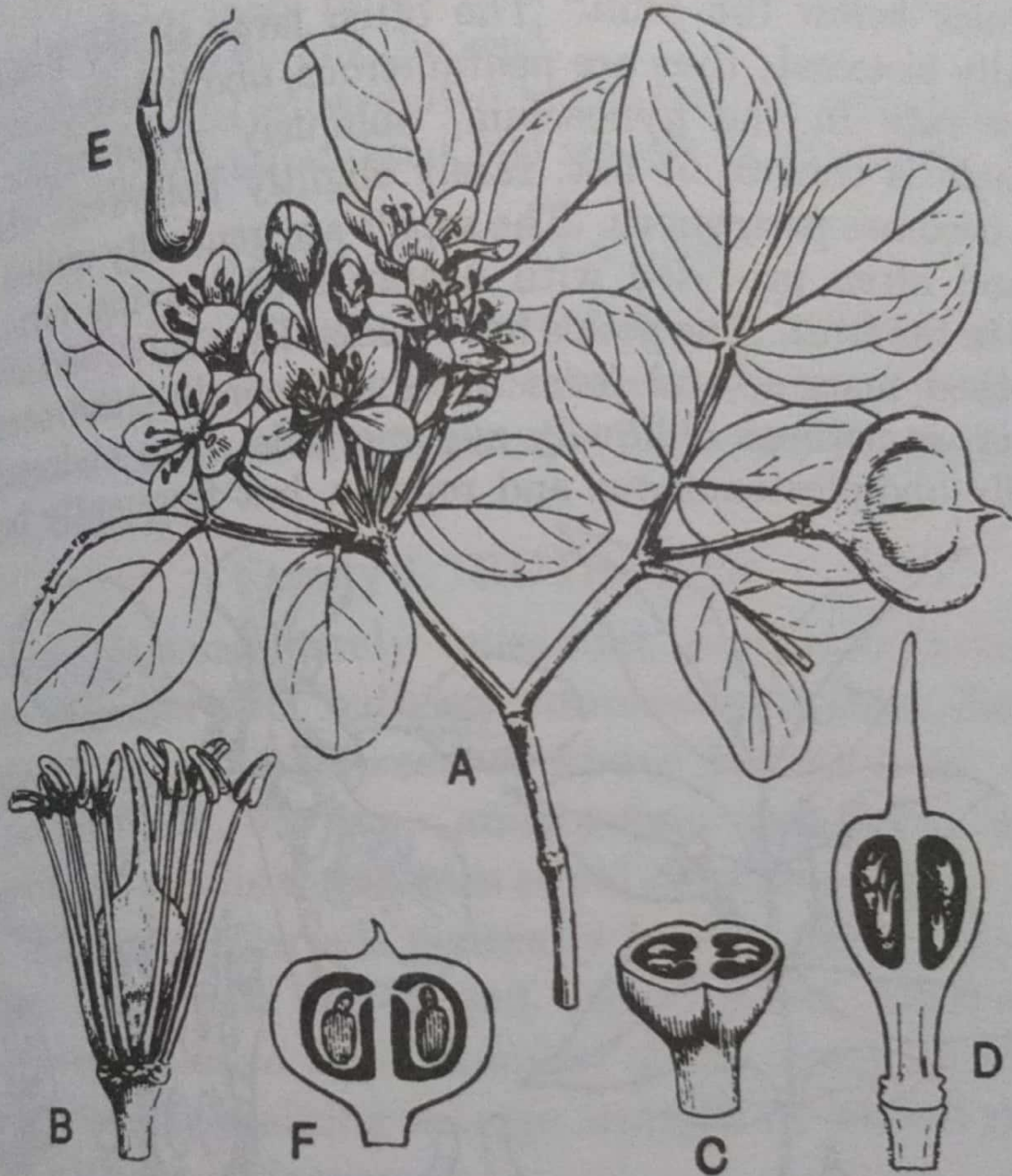


FIG. 136. *Guaiacum officinale*. A. Small shoot bearing inflorescence and one fruit,  $\times \frac{2}{3}$ . B. Flower with sepals and petals removed,  $\times 3$ . C. Ovary cut across,  $\times 4$ . D. Pistil cut lengthwise,  $\times 4$ . E. Ovule much enlarged. F. Fruit cut lengthwise, nat. size. (After Berg and Schmidt.) (From *Flor. Jam.*)



# RHAMNACEAE

## 21.28 ☼ RHAMNACEAE (BUCKTHORN FAMILY)

### 21.28.1 Systematic Position

Polypetalae, Disciflorae, Celastrales.

### 21.28.2 Field Recognition

Shrubs or trees, often armed with spines or climbing by hooks or tendrils; leaves stipulate; flowers perigynous; stamens opposite the petals; fruit drupe or capsule; seeds hard.

### 21.28.3 Selected Indian Genera

*Zizyphus*, *Helinus*, *Berchemia*, *Ventilago*.

### 21.28.4 Size and Distribution

Rhamnaceae comprises 58 genera and about 900 species. The plants of this family are cosmopolitan in distribution. Some of the larger genera of the family along with their approximate number of reported species are *Rhamnus* (150), *Phyllica* (150), *Zizyphus* (100), *Ceanothus* (55), *Frangula* (50), and *Colletia* (17).

### 21.28.5 Description of the Family

**General Habit** Mostly trees or shrubs, often climbing by their hooks (*Ventilago*) or tendrils (*Gouania*, *Helinus*) or twining stems (*Ventilago*, *Berchemia*); some thorny (*Colletia*, *Condalia*); rarely herbs.

**Leaf** Simple, stipulate, alternate or rarely opposite; stipules modify into spines in *Zizyphus*; usually pinninerved but palminerved in *Zizyphus*.

**Inflorescence** Axillary corymbs or cymose; solitary axillary in *Microrhamnus*.

**Flower** Bracteate, bisexual or rarely unisexual, actinomorphic, sometimes apetalous (*Colletia*), pentamerous or tetramerous; perigynous or epigynous; usually small; hypogynous in *Berchemia scandens*.

**Calyx** 4 or 5 sepals, free or basally connate, valvate.

**Corolla** 4 or 5 petals, free, usually concave and often clawed at the base, small, valvate; sometimes absent (*Colletia*); petals often inserted on the calyx tube to form a hypanthium.

**Androecium** Stamens as many as petals, opposite the petals (Fig. 21.39) and enclosed by them, inserted on the hypanthium or develop on the margin of intrastaminal disc; anthers ditheous; dehiscence longitudinal.

**Gynoecium** Carpels 2–4, syncarpous or free, bi- to tetralocular, ovary superior or half-inferior, one or 2 ovules in each locule, basal placentation; style simple or divided; stigma simple or bilobed.

**Fruit and Seed** Capsule (*Phyllica*, *Pomaderis*), drupe (*Rhamnus*, *Zizyphus*) or samaroid (*Ventilago*), or nut. Seeds hard, large, with straight embryo and little or no endosperm.

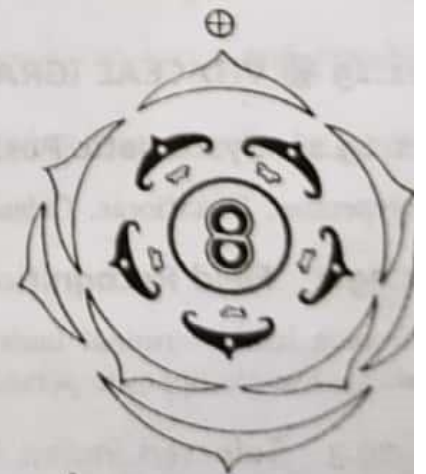


Fig. 21.39 ◈ Floral diagram of *Zizyphus jujuba*.

*Pollination and Dispersal* Pollination mostly entomophilous, and majority of the dry fruits are dispersed by wind.

*General Floral Formula*  $\text{Br, } \oplus, \text{ } \overset{\circ}{\text{f}}, \text{ } K_{4-5}, \text{ } C_{4-5}, \text{ } A_{4-5}, \text{ } G(2-4).$

### 21.28.6 Economic Importance

- *Ceanothus* (Californian Lilacs) is the most commonly grown genus for decorative purposes because of its beautiful blue, pink or white flowers. Some other ornamental plants include species of *Berchemia*, *Colletia*, *Discaria*, *Paliurus*, etc.
- *Zizyphus mauritiana* (Baer of India), *Z. nummularia* (Jhar Ber), *Z. jujuba*, *Z. vulgaris*, *Sageretia oppositifolia*, *Hovenia dulcis* (Japanese Raisin-tree) are well known for their edible fruits.
- Green and yellow-coloured dyes of commercial importance are obtained from various species of *Rhamnus*. A red dye is obtained from root bark of *Ventilago maderaspatana*.
- Cascara sagarda bark, a purgative, is obtained from *Rhamnus purshiana*.
- Gun powder is prepared from the wood of *Zizyphus mauritiana*.
- *Ceanothus americanus* (New Jersey Tea) leaves are used as a substitute of tea.
- Valuable timber is obtained from *Frangula alnus*, *Maeosopsis emini* and *Zizyphus chloroxy-lon*. Wood of *Gouania domingensis* is used for making chew-sticks.

### 21.28.7 Systematics and Phylogeny (Affinities)

Bentham and Hooker placed Rhamnaceae under order Celastrales of series Disciflorae. But majority of the other taxonomists place it under order Rhamnales (Takhtajan, 1969; Cronquist, 1981; Thorne, 1983). Rhamnaceae shows affinity with Vitaceae from the standpoint of floral construction. However, it differs from Vitaceae by its small petals, receptacle, endocarp and always simple leaves. Some believe Rhamnaceae to be close to Celastraceae but the main distinction between the two is the presence of antipetalous stamens in Rhamnaceae.



## SAPINDALES

### 21.30 SAPINDALES

#### 21.30.1 General Characteristics

1. Usually woody shrubs or trees.
2. Leaves usually compound and exstipulate.
3. Flowers small, often irregular, pentamerous and hypogynous.
4. Stamens definite, usually inserted on a prominent receptacular or extrastaminal disc.
5. Ovary tricarpeal, syncarpous, superior, usually trilobular.
6. Ovules pendulous with the dorsal raphe and micropyle upward or erect with ventral raphe and micropyle downward.

Sapindales includes Sapindaceae, Anacardiaceae and Sabiaceae according to Bentham and Hooker. Engler and Diels treated Sapindales as composed of 11 suborders and 23 families, of which some major ones are Buxaceae, Anacardiaceae, Celastraceae, Salvadoraceae, Sapindaceae and Sabiaceae.

Only Sapindaceae and Anacardiaceae are treated in this text.

### 21.31 SAPINDACEAE (SOAPBERRY FAMILY)

#### 21.31.1 Systematic Position

Polypetalae, Disciflorae, Sapindales.

#### 21.31.2 Field Recognition

Usually trees or shrubs with pinnately compound leaves; flowers small, pentamerous and hypogynous; sepals imbricate; petals glandular; an extra-staminal disc is usually present; ovary tricarpeal, syncarpous.

#### 21.31.3 Selected Indian Genera

*Litchi*, *Sapindus*, *Acer*, *Aesculus*, *Dodonaea* and *Schleichera*.

#### 21.31.4 Size, Distribution and General Information

A family of about 155 genera and over 2220 species, Sapindaceae are distributed mainly in tropical and subtropical regions of the world. About 25 genera and 75 species of this family have been reported from India, mainly from tropical Eastern Himalayas and Western Peninsular India. *Sapindus saponaria* (soapberry tree) provides the common name 'Soapberry family' to this family. *Litchi chinensis* (Litchi), *Acer saccharinum* (Sugar Maple), *Paullinia* (Guarana) and *Cardiospermum* (Balloon vine) are other famous genera of the family.

#### 21.31.5 Description of the Family

**General Habit** Trees or shrubs, rarely herbs, sometimes tendrill-bearing vines (*Cardiospermum*) or lianas (*Serjania*, *Paullinia*); tendrils being the flowerless branches of inflorescence.

**Leaves** Usually alternate, pinnately compound and exstipulate; very rarely opposite (*Acer*, Fig. 21.41A); simple (*Cardiospermum*); small and deciduous stipules present in climbing species; often contain resin or latex cells.

**Inflorescence** Flowers minute and usually arranged in racemose to paniculate unilateral cymes or a thyrus; plants commonly polygamodioecious (i.e. bear apparently bisexual but functionally unisexual flowers); metamorphosed sterile branches of inflorescence become coiled like watch-spring and appear like tendrils.

**Flower** Minute, bracteate or ebracteate, bracteolate (*Acer*), bisexual or unisexual, actinomorphic (*Litchi*, *Aphania*, *Sapindus*) or obliquely zygomorphic (*Cardiospermum*, *Erioglossum*), pentamerous or rarely tetramerous, hypogynous.

**Calyx** 5 sepals, poly- or gamosepalous, imbricate or rarely valvate; sometimes only 4 sepals due to the fusion of 3rd and 5th sepals.

**Corolla** 5 petals, sometimes 3, or even absent (*Schleichera*), polypetalous, valvate (*Acer*) or imbricate (*Sapindus*); petals equal or unequal-sized and often bear scale-like or hairy appendage at the base.

**Androecium** Stamens 8 (*Acer*) or 10 (*Sapindus*, Fig. 21.41E), free and inserted inside a prominent receptacular or extrastaminal disc; only 5 stamens in *Turpinia*, and numerous stamens in *Deinbollia*; filaments often hairy; zygomorphic flowers often have eccentric androecium; anthers 2-celled, basifixed or versatile and introrse. In between petals and stamens is often present an annular disc.

**Gynoecium** Tricarpellary, syncarpous; ovary superior; trilocular with one or two or rarely more ascending ovules in each locule, axile placentation; style simple or divided; rarely the placentation is parietal.

**Fruit and Seed** Fruits may be dry or fleshy and highly variable from capsule, berry, nut, drupe, samara, or schizocarp in different genera. Seeds are non-endospermic with a curved embryo; often arillate.

**Pollination and Dispersal** Pollination is by insects such as flies, bees, etc. Dispersal takes place by wind, birds or other animals.

**General Floral Formula**  $\text{Br or Ebr, } \oplus, \text{ } \overset{\circ}{\text{♀}}, \text{ } K_5, C_5 \text{ or zero, } A_8 - 10, G(3).$



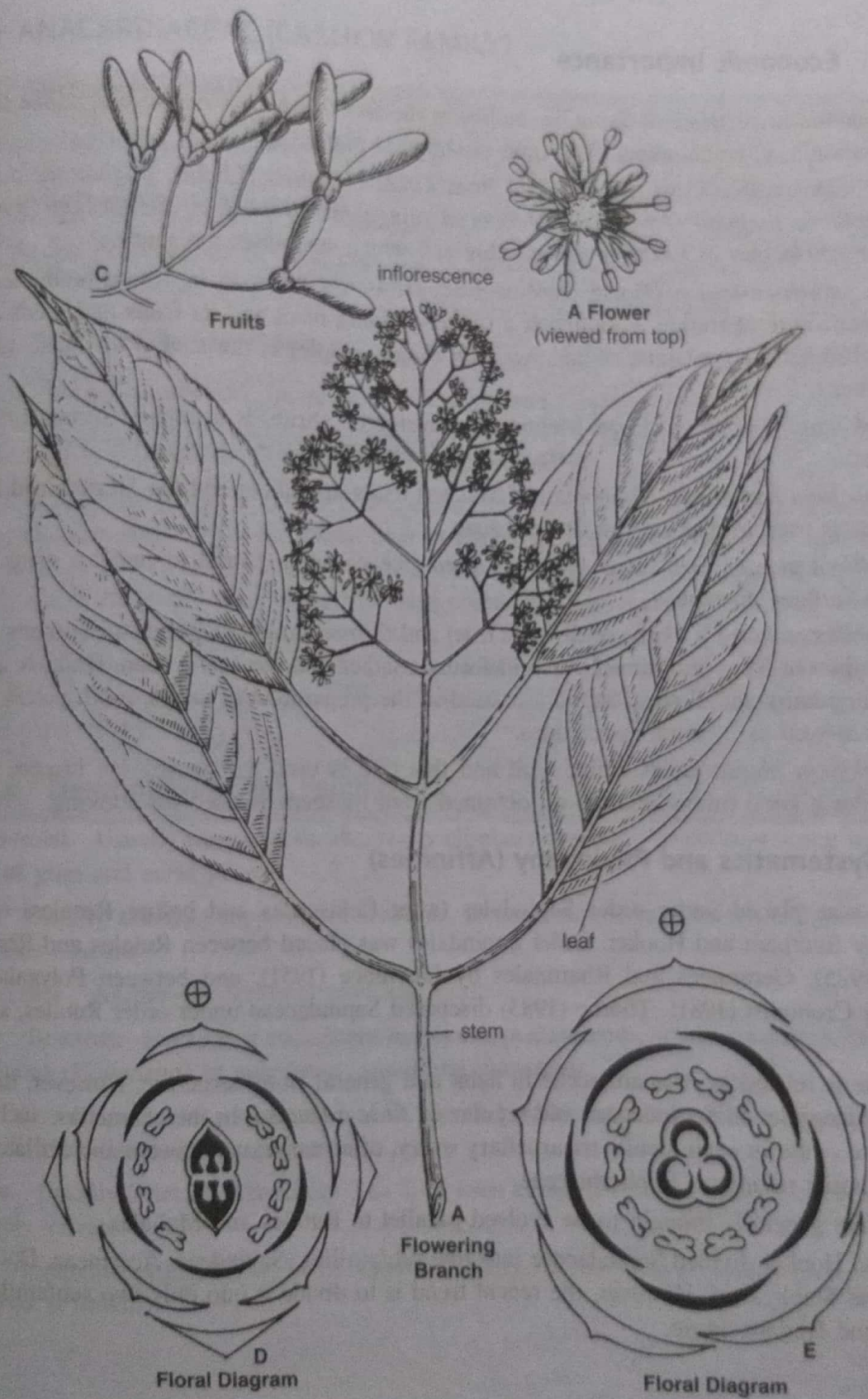


Fig. 21.41 A-D: *Acer oblongum* Wall, ex D, C.; E: Floral diagram of *Sapindus*.

### 21.31.6 Economic Importance

The economic importance of Sapindaceae lies in the fact that it provides several edible fruits, e.g. Litchi; saponin, guarana, akee, plus some ornamental plants.

- Delicious edible fruits are obtained from *Litchi chinensis* (Litchi), *Blighia sapida* (Akee), *Euphoria longana* (Anshphal), *Melicocca bijuga* and *Nephelium lappaceum* (Rambutan). The edible part of Litchi is sweet pulpy aril which surrounds the seed.
- *Acer hippocastanum* (Horse chestnut tree) fruits are given to horses as well as used for manufacture of starch; *A. indica* is a timber-yielding plant and its fruits and seeds are used in rheumatic complaints; *A. saccharinum* (Sugar maple) is the source of maple sugar and timber.
- *Dodonaea viscosa* (Villayati Mehndi), an evergreen shrub, is a popular ornamental hedge plant.
- *Nephelium lappaceum* (Rambutan of Malaya) fruits are edible and the fat obtained from its seeds is used in making candles and soap.
- *Paullinia cupana* (Guarana) seeds are used like cacao in Brazil to make a drink having high caffeine content.
- *Sapindus mukorossi* (Ritha or Soapnut tree) and *S. saponaria* (Soapberry tree) fruits contain saponin. On being moistened, saponin forms a lather and used as a soap. Ritha is used for washing hairs and clothes. Saponin is used in the preparation of soaps, tooth pastes, shampoos as well as in some insecticides.
- *Schleichera oleosa* yields edible fruit and this tree is used for rearing lac insects. It also provides a good timber and the oil obtained from its seeds is used for cooking.

### 21.31.7 Systematics and Phylogeny (Affinities)

Sapindaceae was placed under order Sapindales (after Celastrales and before Rosales) of series Disciflorae by Bentham and Hooker. Order Sapindales was placed between Rutales and Rhamnales by Rendle (1925), Geraniales and Rhamnales by Lawrence (1951), and between Polygalales and Geraniales by Cronquist (1981). Thorne (1983) discussed Sapindaceae under order Rutales, suborder Sapindineae.

Sapindaceae is related to Anacardiaceae in habit and general floral structure. However, the flowers are mostly irregular in Sapindaceae and regular in Anacardiaceae. In the characters, such as the presence of one ovule in each locule, tricarpeal ovary, often unisexual flowers and arillate seeds, family Sapindaceae resembles Euphorbiaceae.

Sapindales are generally thought to be evolved parallel to Rutales and Meliales.

Bentham and Hooker divided Sapindaceae into five subfamilies (Sapindeae, Acerineae, Dodoneae, Meliantheae and Staphyleae). However, the recent trend is to divide it into only two subfamilies viz. Sapindoideae and Dodonaeideae.



## COMBRETACEAE

### 21.41 COMBRETACEAE (COMBRETUM FAMILY)

#### 21.41.1 Systematic Position

Polypetalae, Calyciflorae, Myrtales.

#### 21.41.2 Field Recognition

Trees or shrubs, often lianous; leaves simple, exstipulate; tubular receptacle along with adnate tubular base of calyx form hypanthium; ovules 4–6 in a single locule, all ovules suspended from the locule apex by slender funiculi.

#### 21.41.3 Selected Indian Genera

*Combretum*, *Lumnitzera*, *Quisqualis*, *Terminalia*.

#### 21.41.4 Size, Distribution and General Information

Combretaceae contains about 20 genera and 600 species distributed mainly in the tropical and subtropical countries of the world. 8 genera and about 45 species of this family have been reported from India, chiefly from Assam and West Bengal. *Combretum* and *Terminalia* are two largest genera of the family. *Lumnitzera littoria* is found as a mangrove plant in Sundarban and other tidal forests of India.

#### 21.41.5 Description of the Family

**General Habit** A family of exclusively arborescent taxa, consisting of tall trees (*Terminalia*), or woody twiners of lianas, such as *Combretum* and *Quisqualis*.

**Stem** Solid with large mucilaginous sacs and abundant tannin.

**Leaves** Simple, alternate or sometimes opposite (*Quisqualis*); exstipulate; margin entire.

**Inflorescence** Racemose, or paniculate, or simple or branched spikes (*Quisqualis*, Fig. 21.56); rarely racemose heads (*Anogeissus*).

**Flower** Bracteate, bisexual (rarely unisexual); actinomorphic but occasionally zygomorphic; pentamerous; epigynous; tubular floral receptacle along with the adnate tubular base of calyx form a hypanthium; rarely flowers are tri- to octomerous.

**Calyx** Usually 5 sepals, fuse to form a tube; sometimes 4 or 8 sepals; valvate, rarely imbricate.

**Corolla** Usually 5 or as many petals as sepals, free; located alternately with sepals; valvate, imbricate, or twisted (*Quisqualis*); petals absent in *Terminalia* (Fig. 21.57).

**Androecium** Usually 10 or twice as many as the petals, arranged in 2 alternate whorls; stamens of the outer whorl are antisepalous; sometimes only 4 or 5 stamens; filaments inflexed in bud; anthers ditheous, versatile, dehiscing longitudinally.

**Gynoecium** Carpels 4–5 or less, syncarpous; ovary inferior, unilocular; angular or ribbed, with as many angles or ribs as calyx lobes; ovules 2–6, anatropous, pendulous from the top of the locule; style slender and solitary; stigma pointed or capitate; ovary is surrounded by nectariferous disc.



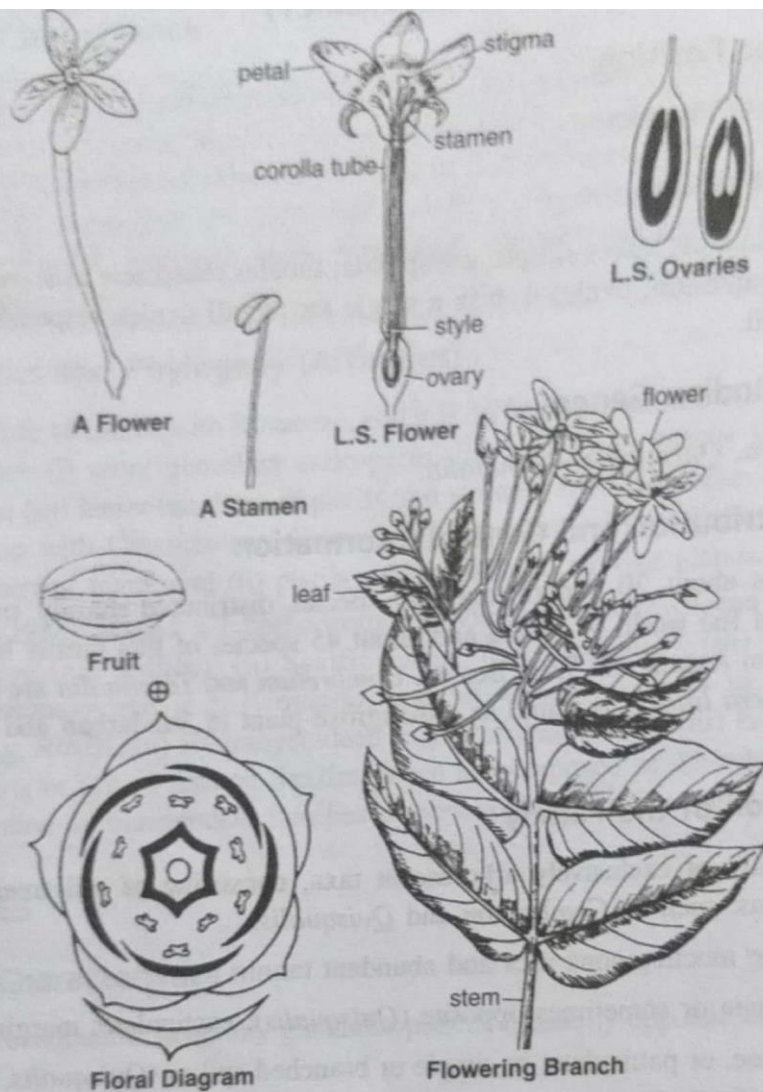


Fig. 21.56  $\blacklozenge$  *Quisqualis indica* L.

**Fruit and Seed** Fruit leathery, one-seeded drupe; often winged. Seed non-endospermic; embryo with folded or convolute cotyledons.

**General Floral Formula**  $\text{Br } \oplus, \text{ } \overset{\circ}{\underset{\circ}{\text{K}}}_{(5)}, \text{ } \overset{\circ}{\underset{\circ}{\text{C}}}_5, \text{ } \overset{\circ}{\underset{\circ}{\text{A}}}_{5+5}, \text{ } \overline{\text{G}}_{(4-5)}$ .

### 21.41.6 Economic Importance

Family is of little importance for domestic purposes.

- **Ornamental Value:** Favourite ornamental plants of this family include *Bucida buceras* (black-olive tree), few species of *Combretum* which are scandant shrubs, *Quisqualis indica* (Rangoon creeper), and *Terminalia arjuna* (Arjun).



- **Timber:** Valuable timber used in construction work is obtained from *Anogeissus acuminata*, *A. latifolia*, and several species of *Terminalia*, such as *T. alata*, *T. bialata*, *T. catappa*, *T. ivorensis* (indigo timber), *T. myriocarpa*, *T. paniculata*, *T. procera* and *T. tomentosa*.

- **Medicinal Value:** (i) Bark of *Terminalia arjuna* is highly valued as a cardiac tonic; (ii) *Terminalia bellirica* ("Bahera" or Belleric myroblans) and *T. chebula* ("Hararh" or black myroblans) are the two constituents of "Triphala", the famous Ayurvedic Indian preparation along with *Phyllanthus emblica* ('Aamla') of family Euphorbiaceae as its 3rd constituents; (iii) Leaves of *Calycopteris floribunda* are used in dysentery and malarial fever; (iv) Leaves of *Combretum acuminatum* are anthelmintic while that of *C. roxburghii* are used in malarial fever.

- **Tanning and Dyeing:** The bark and fruits of *Terminalia alata*, *T. arjuna*, *T. catappa*, *T. chebula*, *T. ivorensis* and *T. citrina* are used for tanning and dyeing purposes.

- **Edible Nut:** Nuts of *Terminalia catappa* (Indian almond) are edible.

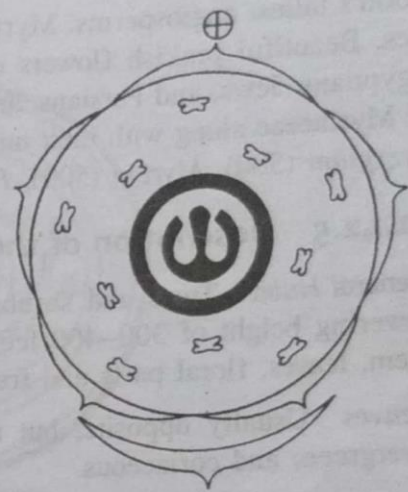


Fig. 21.57 ◊ Floral diagram of *Terminalia bellirica*.

#### 21.41.7 Systematics and Phylogeny (Affinities)

Bentham and Hooker placed Combretaceae under order Myrtales, series Calyciflorae and subclass Polypetalae. Most of the other taxonomists (Takhtajan, 1969; Cronquist, 1981; Thorne, 1983) also placed Combretaceae under order Myrtales. From the affinities point of view, Combretaceae is closely related to Myrtaceae and Rhizophoraceae, and to some other families of Myrtales to some extent.

## PASSIFLORAE

27G/750sp

### Distribution:

\*Tropic and Subtropic

\* Madagascar, Eastern & Western tropical Africa & South-east Asia Habit:

\*Trees, Shrubs, Lianas & Climbers

\*Woody, Cylindrical, Hairy

### Vegetative Characters:

\*Leaf- Hairy & Glabrous, petiolate, Stipulate, Simple or Palmately compound, Alternate, Wavy and Acute tip

### Inflorescence:

\*Cyme, Axillary

### Flower:

\*Pedicelate, Bracteate- 3,

Leafy, glandular and Persistent, Bisexual,

Actinomorphic, Pentamerous, Hypogynous, Prominent disc Calyx:

\*5, Free, Valvate aestivation. Corolla:

\*5 to 10, Many thread like outgrowths called corona are attached at the base, Coloured and showy \*5, Dithecous, Attached with Gynoecium, Gynandrophore. Gynoecium:

\*Tricarpellary, Syncarpous, Unilocular, Parietal placentation with many ovules, Stigma trifid capitate.





## LS OF FLOWER



## L.S OF FLOWER BUD:



**GYNOECIUM**



**C.S OF OVARY**



**L.S OF OVARY**

## Fruit:

\*Berry or Capsule, Edible.

### Economic Importance:

- \*Ornamental, Medicinal use
- \*Other genus- ADENIA
- \*Thorny succulent, Shows xerophytic adaptation
- \*Fruit and Tuber used as Herbal remedies
- \*Plant used for Snake bite

## EBENACEAE

### Family II. EBENACEAE

Generally dioecious; flowers rarely bisexual or polygamous, 3- to 7-merous, regular. Calyx persistent, more or less deeply cut. Corolla gamopetalous; segments with generally contorted aestivation, equal in number to those of the calyx. Stamens attached to the corolla-tube and isomerous with its segments, or twice as many or still more numerous; staminodes generally present in the female flower. Pistil rudimentary or absent in the male flowers, superior in the female and bisexual; ovary with 2 to 16 chambers, containing one or two anatropous pendulous ovules in each chamber; styles two to eight, free or united at the base; stigmas small, entire or two-lobed. Fruit fleshy or leathery, generally indehiscent, often few-chambered and one- to few-seeded by abortion. Endosperm copious, cartilaginous, often

ruminate; embryo axile straight or slightly curved. Woody plants; leaves generally alternate, more rarely opposite or whorled, entire, usually leathery, exstipulate. Flowers axillary, solitary or

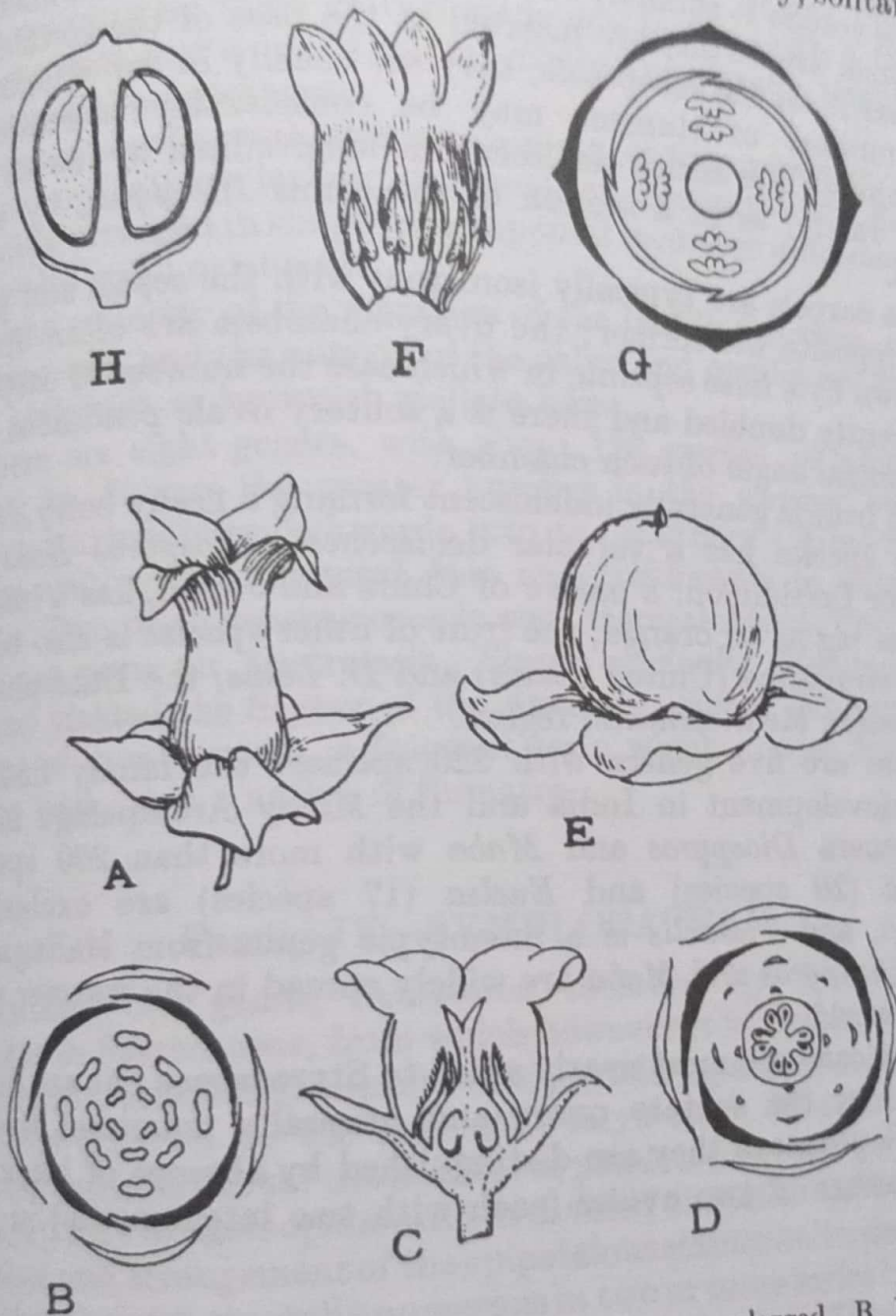


FIG. 215. *Diospyros*. A-E. *D. Kaki*. A. Male flower, enlarged. B. Diagram of male flower. C. Female flower cut vertically, enlarged. D. Diagram of female flower. E. Fruit with persistent calyx, reduced. F. Male flower of *D. tetrasperma*; corolla cut open shewing stamens;  $\times 3$ . G. Diagram of male flower. H. Fruit of same cut vertically, shewing seeds with copious endosperm and slightly curved apical embryo. (A-E after Le Maout and Decaisne.)

in small cymose inflorescences, of fewer flowers in the female plants; bracteoles typically present.

Genera 5; species 320. Tropical and subtropical.

The adult stem is characterised by an extraordinarily hard and heavy heart-wood, generally black in colour, more rarely green or



red; ebony is the heart-wood of various species of *Diospyros*. Cauliflorous inflorescences occur in some species of *Diospyros* and *Maba*.

The corolla is tubular, bell-shaped or rounded; the stamens, all or near it on the receptacle, they are usually in two whorls, but the number of stamens may be considerably increased by branching. The anther-dehiscence is longitudinal by lateral slits, more rarely, as in a section of the genus *Diospyros*, by apical pores.

The carpels are typically isomerous with the sepals and petals and opposite the former; the ovary-chambers are often divided into two by a false septum, in which case the number of carpels is apparently doubled and there is a solitary ovule pendulous from the central angle of each chamber.

The fruit is generally indehiscent forming a fleshy berry, but in a few species has a valvular dehiscence. *Diospyros Kaki*, the Kaki or Persimmon, a native of China and Japan, has a luscious fruit as big as an orange; the fruit of other species is also edible, as *D. virginiana* (United States) and *D. Lotus*, the Date-plum of the eastern Mediterranean region.

There are five genera with 320 species; the family finds its chief development in India and the Malay Archipelago in the two genera *Diospyros* and *Maba* with more than 200 species. *Royena* (20 species) and *Euclea* (17 species) are exclusively African, and *Tetraclis* is a monotypic genus from Madagascar. Both *Diospyros* and *Maba* are widely spread in the warmer parts of the world.

Ebenaceae are most nearly allied to Styracaceae but are distinguished by the septate ovary and generally unisexual flowers. From Sapotaceae they are distinguished by absence of latex and the presence of two ovules (each with two integuments) in each carpel.



## RUBIACEAE

### 21.54 RUBIALES

#### 21.54.1 General Characteristics

1. Leaves are usually simple and opposite decussate.
2. Flowers are arranged in cymose inflorescences, generally dichasial cymes.
3. Flowers gamopetalous, usually actinomorphic but sometimes also zygomorphic.
4. Stamens epipetalous and inserted in the corolla tube.
5. Ovary bicarpellary, syncarpous, with 1 to many ovules in each locule; inferior ovary.

Bentham and Hooker included only two families in Rubiales. These are Rubiaceae and Caprifoliaceae. Engler and Diels, however, also included 3 more families along with Rubiaceae and Caprifoliaceae. These are Adoxaceae, Dipsacaceae and Valerianaceae.

Only Rubiaceae and Caprifoliaceae are treated in this text.

### 21.55 RUBIACEAE (COFFEE FAMILY OR MADDER FAMILY)

#### 21.55.1 Systematic Position

Gamopetalae, Inferae, Rubiales.

#### 21.55.2 Field Recognition

Herbs (mostly in north temperate regions), shrubs or trees; leaves stipulate, opposite or whorled; flowers tetra- or pentamerous; stamens alternipetalous and as many as corolla lobes; usually bicarpellary; ovary inferior.

#### 21.55.3 Selected Indian Genera

*Cinchona*, *Coffea*, *Gardenia*, *Ixora*, *Mussaenda*, *Oldenlandia*, *Rubia*.

#### 21.55.4 Size, Distribution and General Information

A family of about 500 genera and 6500 species, Rubiaceae are chiefly distributed in tropics, but some are distributed in temperate or even arctic (*Galium*) regions. About 75 genera and 275 species have been reported from India, chiefly in tropical and subtropical eastern Himalayas. Some of the largely represented genera with their approximately reported species (Hickey and King, 1988) include *Psychotria* (700), *Galium* (400), *Ixora* (400), *Gardenia* (250), *Mussaenda* (200), *Asperula* (200), *Cephaelis* (180), *Rondeletia* (120), *Coprosoma* (90), *Guettarda* (80), *Rubia* (60), *Coffea* (40) and *Cinchona* (40). Two most important plants of the family are *Coffea arabica* (coffee-yielding plant) and species of *Cinchona* (quinine-yielding plant).

#### 21.55.5 Description of the Family

**General Habit** Mostly trees (*Cinchona officinalis*) or shrubs (*Mussaenda luteola*, *Hamelia patens*); however, those in north temperate regions are mostly herbs (e.g. species of *Galium*, *Oldenlandia*); sometimes hook climber (*Uncaria*) or vines.

**Leaves** Simple, entire; opposite decussate or whorled; stipulate, stipules usually interpetiolar and rarely intrapetiolar, sometimes foliaceous (*Galium*) and become as large as the leaf blades so that the leaves appear whorled; or sometimes reduced to glandular setae (*Pentas*).

**Inflorescence** Basically a dichasial cyme, dichasia sometimes grouped into globose heads (*Adina*, *Nauclea*); rarely flowers solitary (*Gardenia*, *Randia*).

**Flower** Bracteate, sometimes bracteolate; bisexual; usually actinomorphic, rarely slightly zygomorphic; penta- or tetramerous; usually epigynous, only rarely perigynous (*Synaptantha*) or very rarely hypogynous (*Gaertnera*).

**Calyx** 4 or 5 sepals, polysepalous, valvate; rarely greatly reduced sepals (*Morinda*); in *Mussaenda* one of the sepals of some flowers becomes enlarged and bright coloured (Fig. 21.68).

**Corolla** 4 or 5 petals, gamopetalous; usually salverform, rotate, or infundibular; valvate (*Ixora*, *Mussaenda*), twisted (*Gardenia*) or imbricate (*Rondeletia*).

**Androecium** 4 or 5 stamens, epipetalous, inserted in the corolla tube or at its mouth; alternate with the corolla lobes; anthers 2-celled, basifixed, introrse, dehiscing longitudinally.

**Gynoecium** Usually bicarpellary, syncarpous, inferior ovary; bilocular, with 1 to many anatropous ovules in each locule; axile placentation; style simple or bifid; stigma capitate; epigynous disc often present; 5 carpels in *Gardenia* and *Hamiltonia*; ovary half-inferior in *Synaptantha*, or even rarely superior in *Gaertnera*.

**Fruit and Seeds** Fruit a capsule (*Cinchona*, *Oldenlandia*), berry (*Mussaenda*), schizocarp (*Galium*), or even drupe. Seeds with a small straight or curved embryo in endosperm; sometimes winged.

**General Floral Formula**  $\text{Br}, \oplus, \overset{\circ}{\underset{\circ}{\text{K}}}_{4 \text{ or } 5}, \overset{\text{C}}{\text{C}}_{(4) \text{ or } (5)}, \overset{\text{A}}{\text{A}}_{4 \text{ or } 5}, \overset{\text{G}}{\text{G}}_{(2)}$ .

## 21.55.6 Economic Importance



- **Ornamental Plants:** Some of the common ornamental plants grown in gardens and roadsides include *Anthocephalus cadamba* (Kadam), *Cephalanthus occidentalis*, *Galium verum* (Ladies Bedstraw), *Gardenia jasminoides* (Jasmine), *G. lucida*, *Hamelia patens*, *Hamiltonia suaveolens* (Padera), *Ixora arborea*, *I. coccinia*, *Morinda tinctoria*, *Mussaenda frondosa*, *M. luteola*, *Pentas lanceolata* and *Rondeletia*.
- **Coffee:** Coffee, the most popular nonalcoholic, caffeine-containing beverage of the world, comes mainly from roasted and powdered seeds of *Coffea arabica*. Other coffee-producing species are *C. liberica* and *C. robusta*.
- **Quinine:** This famous drug, used throughout the world in the treatment of malaria, comes from the bark of several species of *Cinchona*, such as *C. calisaya*, *C. ledgeriana* and *C. officinalis*.
- **Other Medicinal Plants:** (i) *Cephaelis ipecacuanha* (Ipecac) roots are used against amoebic dysentery and pyorrhoea, (ii) *Gardenia gummifera* provides gum used as a carminative stimulant, (iii) *Randia tinctoria* fruit pulp is emetic and anthelmintic, (iv) *Paederia foetida* is used in indigestion and stomach troubles.



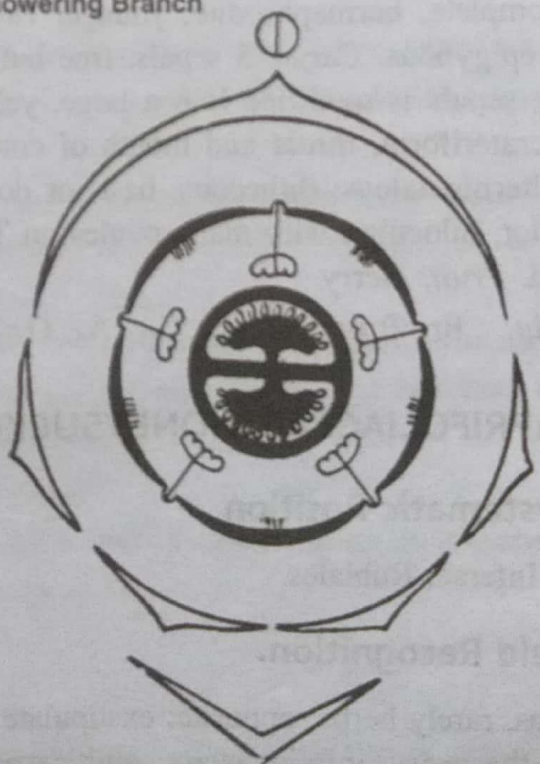
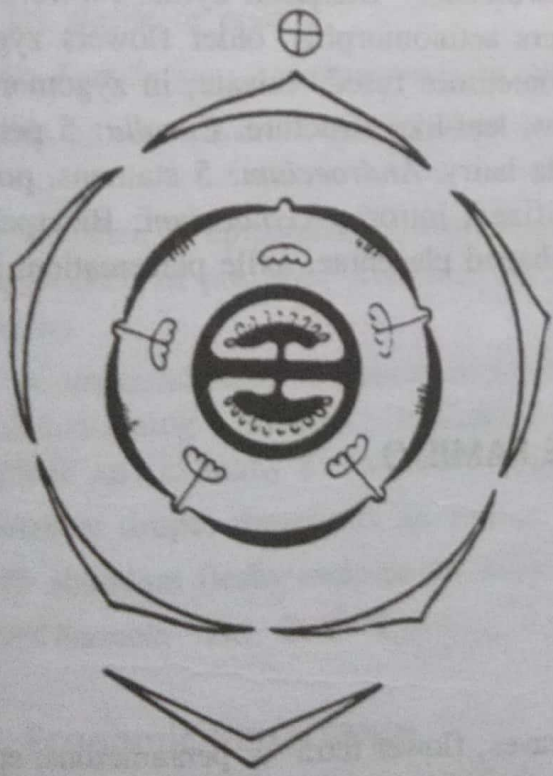
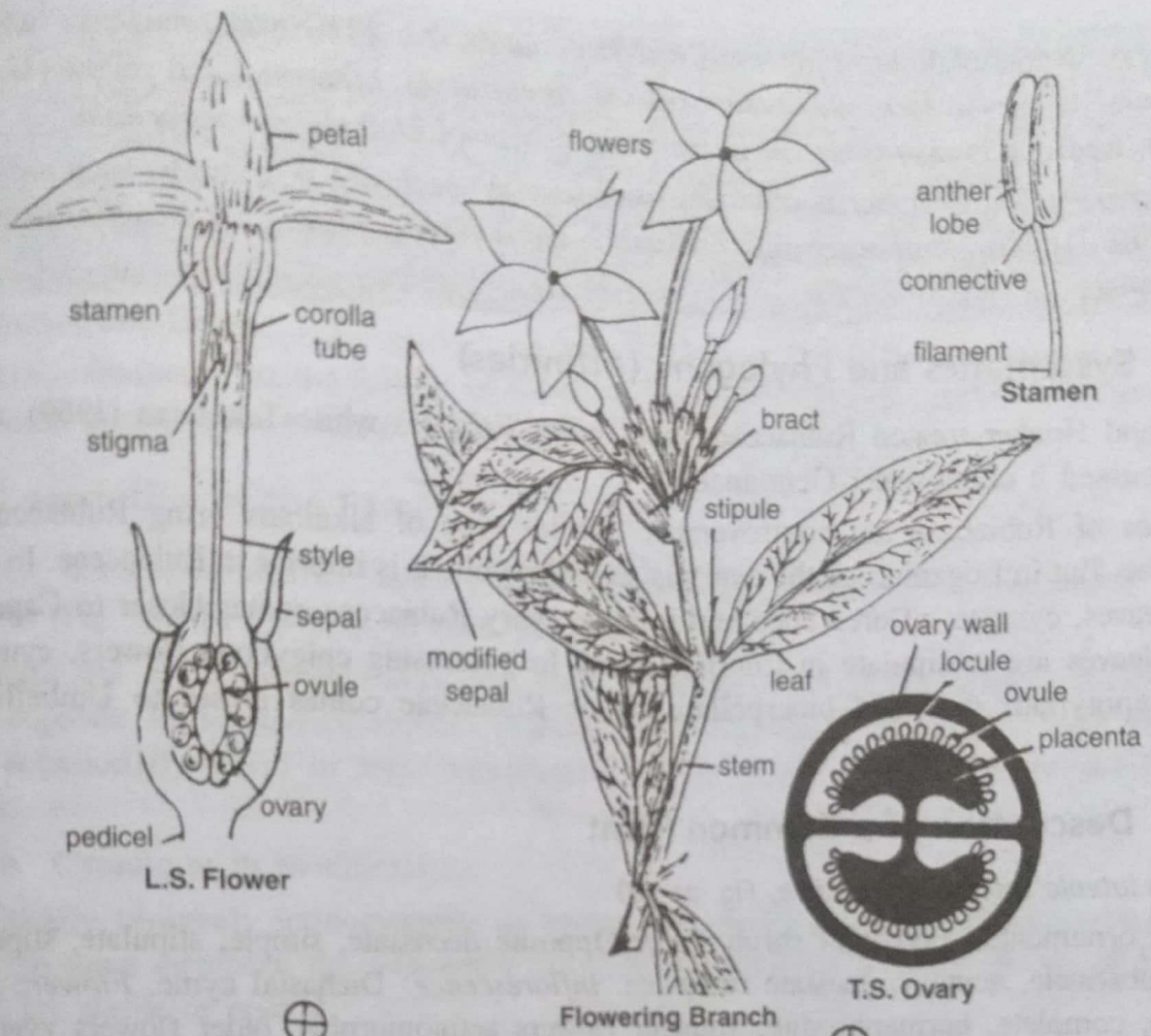


Fig. 21.68 *Mussaenda luteola* Dilile.

- *Dyes:* Roots of *Rubia tinctoria* (Madder) contain dye alizarin and purpurin, while that of several species of *Morinda* contain red (*M. tinctoria*, *M. bracteata*) and yellow (*M. citridora*) dye. Red dye is also obtained from the root bark of *Oldenlandia umbellata*.
- *Timber:* Useful timber is obtained from several species of this family, such as *Adina cordifolia* (Haldu), *Anthocephalus cadamba*, *Ixora ferrea*, *Mitragyna parviflora* and *Randia spinosa*.

### 21.55.7 Systematics and Phylogeny (Affinities)

Bentham and Hooker treated Rubiaceae under order Rubiales while Takhtajan (1969) and Thorne (1983) discussed it under order Gentianales.

Affinities of Rubiaceae are controversial. Similar type of alkaloids bring Rubiaceae close to Loganiaceae. But in Loganiaceae the ovary is superior while it is inferior in Rubiaceae. In possessing opposite leaves, cymose inflorescence and inferior ovary Rubiaceae comes closer to Caprifoliaceae. However, leaves are exstipulate in Caprifoliaceae. In possessing epigynous flowers, cymose inflorescence, epigynous disc and bicarpellate ovary, Rubiaceae comes closer to Umbelliferae and Cornaceae.



## OLEACEAE

### Family I. OLEACEAE

Flowers bisexual, rarely unisexual, regular, conforming to or derived from the formula  $S_4(\text{or } 5), P_4(\text{or } 5), A_2, G(2)$ . Calyx small, rarely absent; petals united, sometimes free or absent, aestivation imbricate or valvate, rarely contorted; stamens epipetalous. Ovary bilocular with generally two pendulous or ascending anatropous ovules in each chamber; style simple, stigma bilobed. Fruit various, containing one or a few seeds. Endosperm present or absent; embryo straight.

Woody plants with generally opposite simple or imparipinnate leaves without stipules, and terminal or axillary compound racemose inflorescences.

Genera 22; species about 400. Temperate, subtropical and tropical regions.

The plants are shrubs, as *Syringa* (Lilac) and *Ligustrum* (Privet); sometimes climbing as *Jasminum*, or trees, as *Olea* (Olive) or *Fraxinus* (Ash). Several buds are sometimes found one above the other in a single leaf-axil (accessory buds) in floral as well as in vegetative shoots, as in *Syringa* and *Fraxinus*.

The scales of the winter-buds, where these are found, represent the whole leaf, as in *Syringa*, or the leaf-base only, as in *Fraxinus*; in *Syringa* additional protection is afforded by a resinous excretion.

Extrafloral nectaries are described in various species. Peltate hairs are very common in the family, as is also the

occurrence of small crystals of calcium oxalate. The flowers are small, generally in a compound raceme as in *Syringa*, *Ligustrum*, *Fraxinus*; in *Fraxinus* the dense inflorescences of small polygamous flowers appear before the leaves from lateral or terminal buds on last year's shoots. In the Chinese genus *Forsythia*, cultivated in shrubberies, and in *Jasminum nudiflorum* (China), common in gardens, the bright yellow flowers, which also appear before the leaves, stand one to three together at the end of short scale-bearing shoots. Each

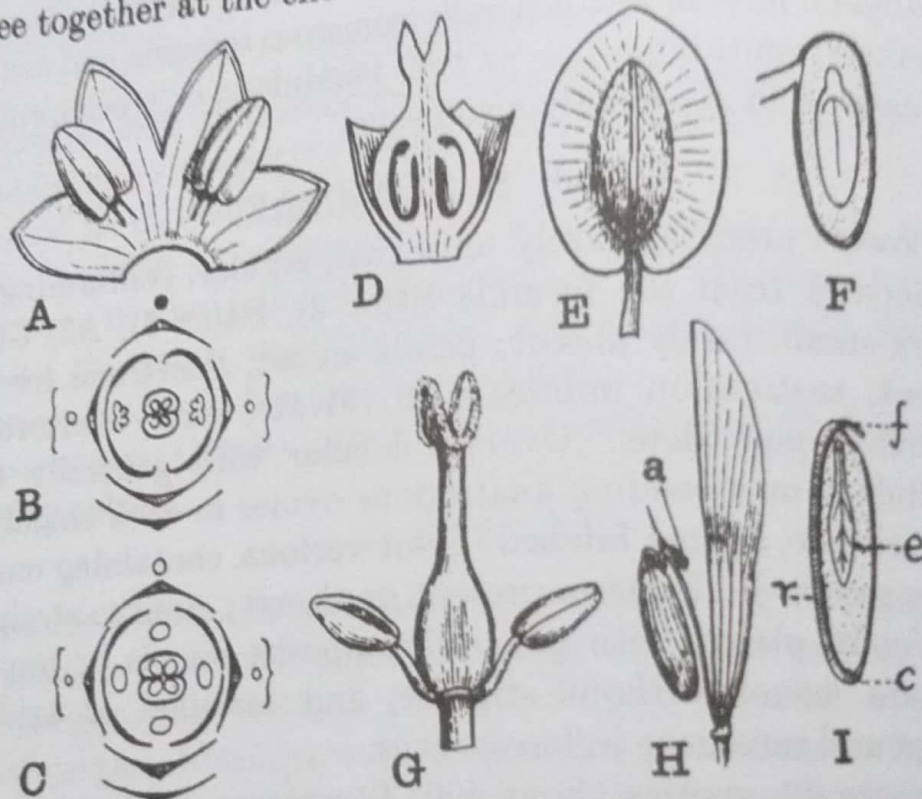


FIG. 216. A, B, D-F. *Olea europaea*. A. Corolla with stamens opened out,  $\times 5$ . B. Floral diagram. D. Calyx and ovary in vertical section,  $\times 8$ . E. Drupe, the fleshy coat partly cut away to show the stone, slightly reduced. F. Seed, slightly enlarged, in vertical section. C. Floral diagram of *Tessarandru fluminensis*. G-I. *Fraxinus excelsior*. G. Bisexual flower, enlarged. H. Samara, with half removed and the seed pulled out. The seed is borne on the long placental axis, on the top of which are seen the aborted ovules, a. I. Seed in vertical section,  $\times$  about  $1\frac{1}{2}$ ; c, chalaza; r, raphe; f, funicle; e, embryo embedded in endosperm. (A, D-F after Knoblauch; B, C after Eichler.)

flower stands in the axil of a bract and a pair of bracteoles are typically present; but both bracts and bracteoles are often very caducous. The flowers are generally bisexual, but *Fraxinus* is polygamous or dioecious, as also are species of *Olea*.

The calyx is absent in *Fraxinus excelsior* (fig. 216, G) and other species of the genus; when present it is usually tetramerous, the sepals being median and transverse; when a fifth



sepal is present, as in species of *Jasminum*, it is either anterior or posterior; the aestivation is valvate. The petals are isomerous and alternate with the sepals; aestivation may be valvate (*Syringa*) or imbricate (*Jasminum*); in *Fraxinus* the petals are free or united in pairs by the insertion of the stamens at their base. Sections of *Fraxinus* and *Olea* are characterised by apetalous, as, for instance, in *F. excelsior*. Occasionally more than five sepals and petals are present, as in *Jasminum* (*J. nudiflorum* has six); the number rarely exceeds six. The most general

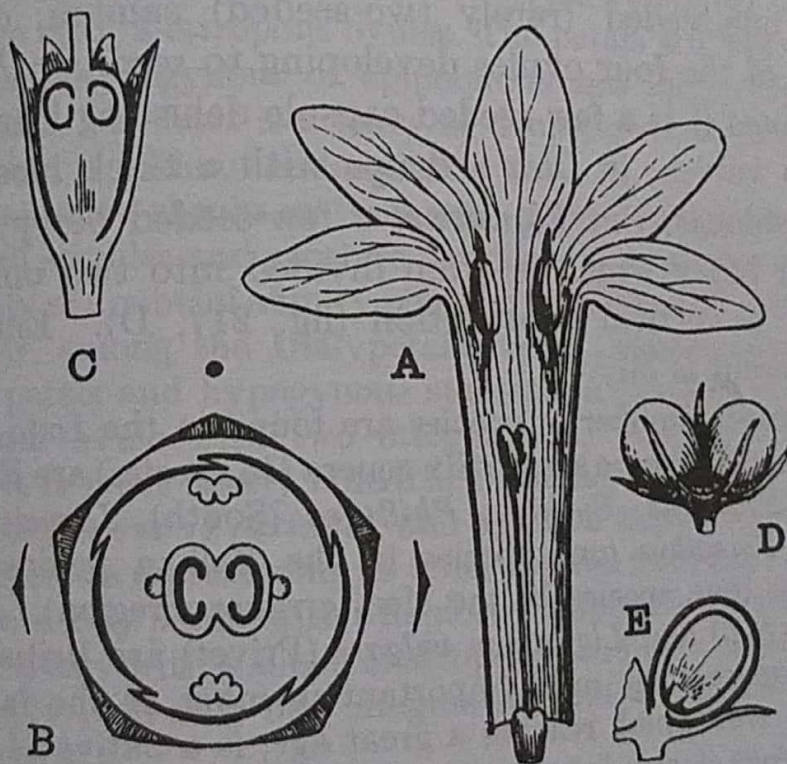


FIG. 217. A-C. *Jasminum azoricum*. A. Corolla cut open and pistil. B. Floral diagram, the stamens are median. C. Calyx and ovary in longitudinal section. D. Fruit of *J. floribundum*. E. One half of same cut longitudinally to show seed and embryo. A and C enlarged. (After Eichler and Engler.)

form of corolla is a tube with more or less spreading limbs (*Syringa*, *Ligustrum*, *Olea*, *Jasminum*). The two stamens are generally transverse, but sometimes median (fig. 217, B); both positions are found in the same genus; occasionally there are four, as in the monotypic American genera *Hesperella* and *Tessarandra* (fig. 216, C), where they alternate with the petals; three or five may also occur. The anthers dehisce laterally by a longitudinal slit. The two carpels alternate with the stamens and are therefore usually median; a three- or four-chambered ovary sometimes occurs. There are generally two ovules in each chamber, pendulous or ascending from the



axile placenta; sometimes only one is present, while in *Forsythia* and other genera there are from four to ten.

Many species are visited by insects, which are attracted by the colour and smell of the flower and presence of nectar, and various adaptations occur favourable to cross-pollination. Thus long- and short-styled flowers are known in species of *Jasminum* and in *Forsythia*. Both Lilac and Privet are homogamous and, in the absence of insect-visits, self-pollinated. Ash is wind-pollinated. In *Fraxinus* the fruit is a dry, indehiscent one-seeded (rarely two-seeded) samara, only one (or two) of the four ovules developing to seed. In *Forsythia* and *Syringa* it is a few-seeded capsule dehiscing loculicidally into two valves; in *Olea* a drupe with a thick mostly one-seeded endocarp; in *Ligustrum* a few-seeded berry; in *Jasminum* a berry which is often divided into two one-seeded lobes by a vertical constriction (fig. 217, D). Endosperm when present is oily.

**FLOWER:**





## **BORAGINACEAE**

- Bicarpellatae – 100 genus
- Polemoniales – 2000 species
- **Distribution**: Tropical and temperate especially in Mediterranean
- **Habit**: Annual or perennial bristly herbs. Perrenating by rhizomes.

Heliotropium – annual herb

Cynoglossum, Arnebia - perennial herbs

Rhabdia – shrub

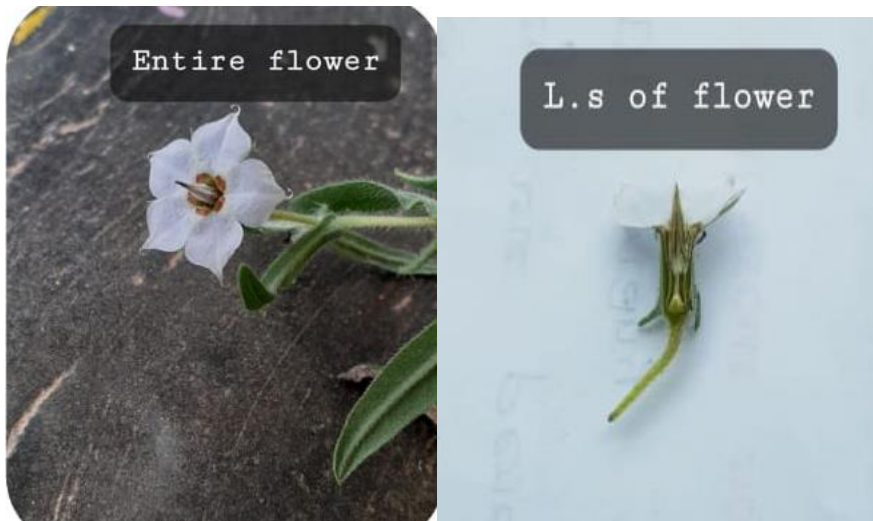
Cordia – tree

Tornefortia – climber



- **Vegetative characteristics**: Scorpioid (helicoid) cyme – due to fusion of flower stalk with inflorescence (Heliotropium) Cordia – Dichotomous cyme present in clusters, axillary, solitary (Trichodesma), raceme (Cynoglossum) bracts arranged opposite the flowers
- **Floral characteristics**

**Flower:** Bracts complete, bisexual, zygomorphic, hypogynous,



**Calyx:** five, gamopetalous or free, forming bell shaped structure, imbricate or valvate accrescent in the fruit

**Corolla:** five petals united into tubular/ rotate (trichodesma) corona in **corolla** , imbricate

Pulmonaria – petal has tuft of hairs opposite to it

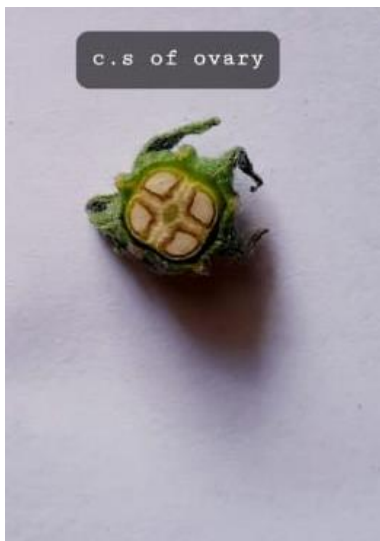




**Androecium**: Stamens five, as many as corolla, epipetalous, alternating with petals. Inserted or **exserted**, introse and longitudinal dehiscence

**Gynoecium**: Superior, seated on disc, secreting nectar, bicarpellary, bilocular, axile placentation each locule is divided into two Ovary will be tetralocular, each locule containing single ovule

so ovary looks four lobed. Style becomes gynobasic . Ovary may retain the shape when it becomes four celled and style is at the apex (**Ehretia**). Simple style maybe forked at the tip. Capitate stigma



- **Fruit**: Drupe, Deeply four parted and one seeded, nutlets
- **Seed**: Erect embryo

- **Formula:** Br,
- Common plants: Heliotropicum indicum, Cardia dichotoma, C. myxa, Coldenia procumbens, Cynoglossum procumbens, Ehretia serrata, E. acuminata, Trichoderma indicum
- Economically important plants
  1. Cardia myxa, C. crenata, C. vesita, Ehretia acuminata – cultivated for edible fruits
  2. Wood of Ehretia acuminata, Cardia macleodie used for carts and agricultural implements
  3. Heliotropicum indicum used for boils and swellings
  4. Leaf of Coldenia procumbens – applied for rheumatic swellings
  5. Leaves of Ehretia leavis eaten as a substitute to betel leaf
  6. Borago and cynoglossum – ornamental plants
  7. Arnebia hispidissima – purple dye extracted from root
  8. Alkanna trictoria – yields a red dye. Used for wine, oils and pomades (scented ointment). It is also medicinal
  9. Borago officinale – used for flavouring beverages

