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1.	Scrophulariaceae
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3.	Acanthaceae

Scrophulariaceae: Characters, Distribution and Types

Characters of Scrophulariaceae

Plants mostly herbs; leaves alternate or opposite, exstipulate; flowers zygomorphic and hypogynous, hermaphrodite; calyx gamosepalous; corolla gamopetalous; stamens four or two, if four didynamous; epipetalous; gynoecium bicarpellary, syncarpous, bilocular, axile placentation with many ovules; fruit capsule or berry; seeds endospermic

A. Vegetative characters:

Habit:

Mostly herbs (Antirrhinum) or shrubs rarely trees (Paulownia), climbers (Maurandia), root parasites (Pedicularis).Marshy Dopatrium ,Herpestis.

Root:

Branched tap root system.

Stem:

Herbaceous, or woody (Paulownia) aerial, erect.

Leaves:

Alternate, or opposite, rarely whorled (Veronica), simple; in Limnophila leaves are dimorphic, exstipulate, margin entire, unicostate reticulate, in parasitic species leaves are reduced.

Floral characters:

Inflorescence:

Cymose or racemose, it may be spike, rarely solitary axillary (Scoparia, Striga densiflora).

Flower:

Bracteate, pedicellate, or sessile (Lindenbergia), hermaphrodite, pentamerous, hypogynous, complete, zygomorphic, rarely actinomorphic, (Verbascum, Veronica).

Calyx:

Sepals 5, rarely 4 (Veronica, Scoparia), gamosepalous, imbricate or valvate aestivation, persistent; calyx teeth may be 2/5, campanulate or shortly tubular; inferior.

Corolla:

Petals 5, gamopetalous, zygomorphic petals, sometimes two petals fused (Veronica), campanulate (Digitalis), spurred (Linaria); saccate (Antirrhinum), imbricate aestivation, inferior, variously coloured.

Androecium:

Stamens 4 in Digitals, 5 in Verbascum or 2 in Veronica; when didynamous and one staminode present (Digitalis); epipetalous, polyandrous; anthers basifixed or dorsifixed, dithecous, filament short, introrse.

Gynoecium:

Bicarpellary, syncarpous, superior, bilocular, axile placentation, ovules many in each loculus; style short, simple; stigma bifid; usually nectariferous disc present below the ovary.

Fruit:

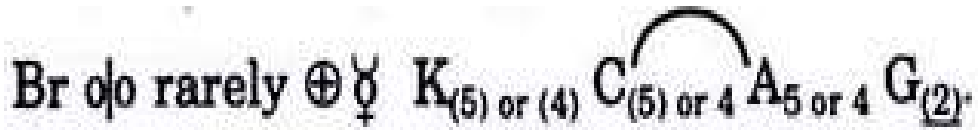
A capsule or berry.

Seed:

Endospermic.

Pollination:

Entomophilous rarely self pollination in Veronica.

Floral Formula: 

Distribution of Scrophulariaceae:

It is commonly called ‘Snapdragon family’. It includes 220 genera and 3000 species which are distributed all over the world but most abundant in temperate regions. In India it is represented by 273 species.

Economic Importance of Scrophulariaceae:

1. Medicinal:Digitalis is used in heart diseases. The leaves of Verbascum thapsus are used in asthma and pulmonary complaints. The juice of leaves of Torenia asiatica is considered a cure for gonorrhoea. The juice of Lindenbergia indica is given in bronchitis. Anticharis is used in diabetes
2. . Ornamentals:

3. Antirrhinum, Veronica, Linaria, Mimulus, Cymbalaria, Russelia, Torenia and Digitalis are cultivated for ornamental purposes.

Lindenbergia indica

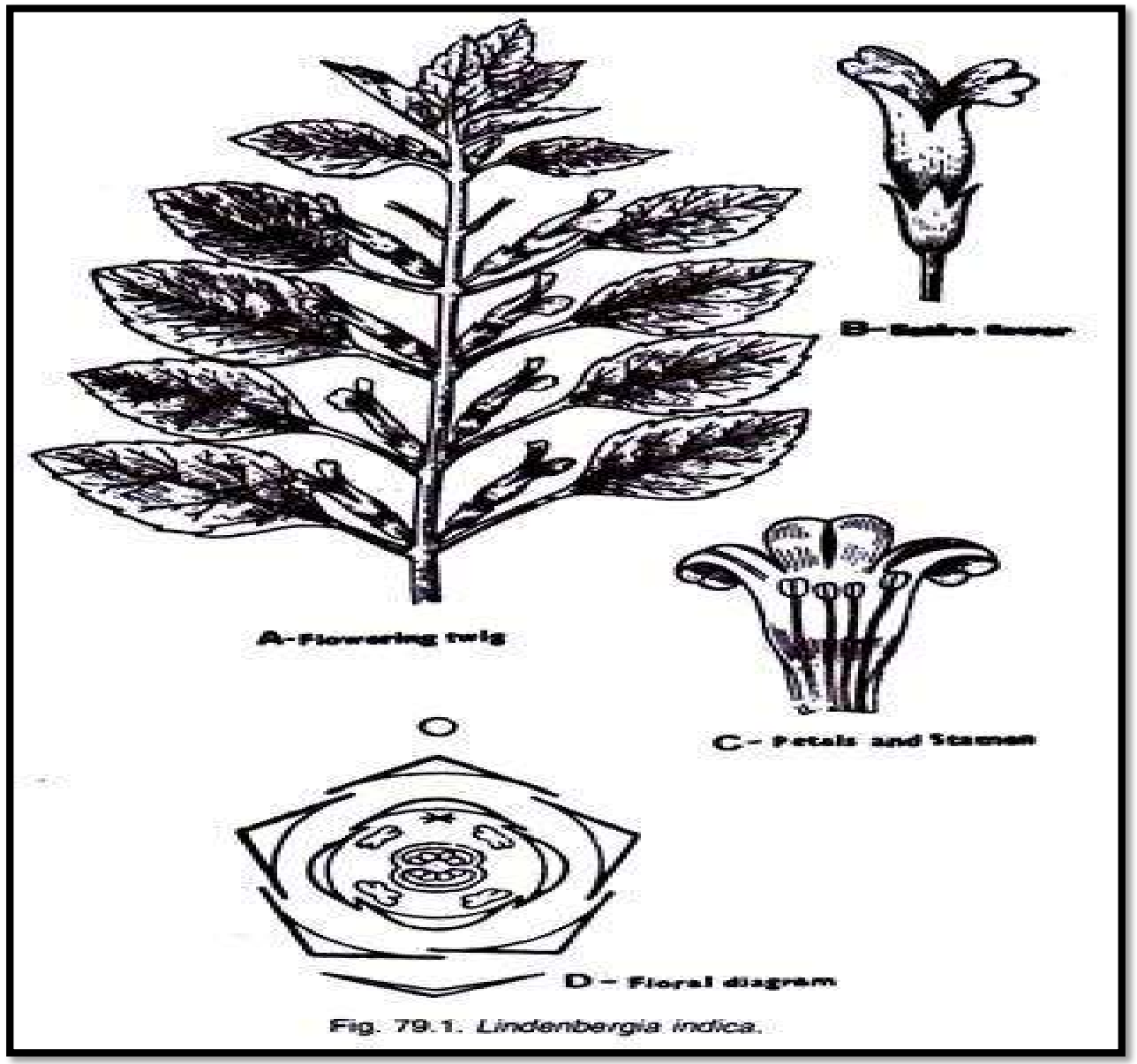


Fig. 79.1. *Lindenbergia indica.*

Habit:

An annual herb.

Root:

Tap, branched.

Leaf:

Opposite, simple, petiolate, exstipulate, ovate, dentate, hairy, unicostate reticulate.

Inflorescence:

Solitary axillary.

Flower:

Bracteate, pedicellate, complete, hermaphrodite, zygomorphic, pentamerous, hypogynous

Calyx:

Sepals 5, gamosepalous, campanulate, valvate, inferior.

Corolla:

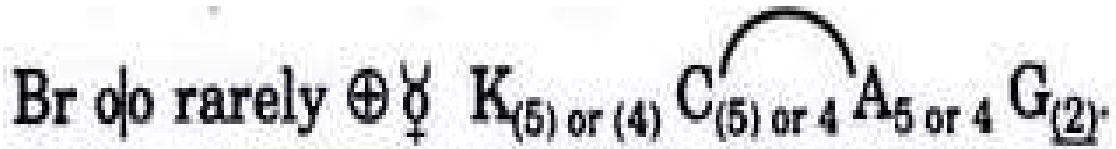
Petals 5, bilipped, 2/3, upper with 2 lobes, lower of 3 -lobes, red throat, hairy, imbricate, inferior.

Androecium:

Stamens 4, didynamous, fifth posterior stamen reduced, polyandrous, epipetalous, anthers dithecous, dorsifixed, filaments filiform, introrse.

Gynoecium:

Bicarpellary, syncarpous, superior, bilocular, axile placentation, many ovules in each loculus, style simple, stigma bifid.

Flower formula- 

Cruciferae (Brassicaceae):

There are about 350 genera and 2500 species in the family.The members of this family are cosmopolitan in their distribution but majority of them are common in north temperate regions. Some species are sub-arctic. A large number of important vegetable crops as well as many garden and wild flowers are included in this family.

Habit-

Mostly the plants are annual, bienninal or perennial herbs. Sometimes they are small shrubs. Majority of the species, of Brassica are annual, biennial or sometimes perennial herbs. The species of Raphanus may be annual or biennial herbs.

However, majority of the plants are annuals of a life cycle of only a few weeks. Usually the biennials, e.g., Turnip (Shalgam) develop swollen tap roots which store enough of nourishment. Farsetia is a small branched undershrub.Habit

Root:

Usually tap and branched. The tap root modifications-fusiform root, e.g., Raphanus sativus, napiform root, e.g., Brassica rapa, are also found. Such roots become swollen and store nourishment in them.

Stem:

Usually tap stem is herbaceous. However, in B. oleracea var. caulorapa (knol khol, Ganth-Gobhi). The stem becomes corm like and very much thickened, which is eaten as vegetable. In Raphanus sativus (Radish, Muli), the stem becomes very much condensed.

Leaves:

The leaves are simple, alternate, exstipulate and, possess simple or branched hairs. They are usually radial or cauline, sub-sessile or sessile, lyrate. When radical they are found in rosettes, e.g., Raphanus sativus.

Sometimes the bulbils develop in the axils of the upper leaves which act as vegetative structures for propagation.

Inflorescence

The inflorescence is generally of racemose type and very often may be a raceme, a corymb or corymboraceme. Bracts and bracteoles are absent. They may be present only in rare cases.

Flower: Mostly the flowers are ebracteate, pedicellate, regular (actinomorphic), hermaphrodite, complete, cruciform and hypogynous

Calyx: The calyx is polysepalous and consists of four sepals. The sepals are arranged in two whorls of two each. The lateral inner sepals are sometimes pouched at the base, which serve as nectar containers. The aestivation is imbricate.

Corolla is polypetalous and cruciform. It consists of four petals. The petals are found in one whorl. They are alternate to the sepals. Each petal is usually differentiated into a narrow claw and a broad expanded limb. In Iberis amara (candytuft) the flowers become zygomorphic by the enlargement of the two outer petals. In Senebiera sp., the petals are represented by four minute lobes.Petals absent in Coronopus.

Androecium:

The outer two stamens are short whereas the inner four are long. This condition of the stamens is known as tetradynamous condition and considered to be characteristic of the family.

Nectaries are developed as small green glands at the base of the two short stamens. In Senebier

Usually the androecium consists of six stamens arranged in two whorlsa, there are only two stamens; the anthers are bilobed; basifixed and

Gynoecium:

It consists of two carpels (bicarpellary), syncarpous. The ovary is superior, unilocular but becomes bilocular because of the development of the false septum or replum from the ingrowths of the parietal placentas. The placentation is parietal. Many anatropous or campylotropous ovules develop from the parietal placentas. The style is short with two lobed stigmas.

Fruit:

The fruit is either siliqua or silicula. Sometimes the fruit is lomentum (lomentaceous siliqua) as in Raphanus sativus.

Floral Formula: ⊕ ♀ K 2 + 2, C 4, A 2 + 4, G (2).

Bentham & Hooker (1862)	Engler & Prantl (1931)	Hutchinson (1959)
Phanerogams	Phanerogams	Angiospermae
Dicotyledones	Dicotyledoneae	Dicotyledones
Polypetalae	Archichlamydeae	Herbaceae
Thalamiflorae	Rhoeadales	Cruciales (Brassicales)
Parietales	Cruciferae	Cruciferae or
Cruciferae		Brassicaceae

Economic Importance of Family – Cruciferae (Brassicaceae):

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

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

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

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

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

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

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

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

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

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

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

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

11. Capsella bursa-pastoris; (Eng.-Shepherd’s purse)-A common weed. Found throughout temperate India particularly in Northern Western Himalayas. The plant is of medicinal value.

12. Cheiranthus cheiri; (Eng.-Wall flower; Verna.-Todrisurkh)-A herb, native of South Europe. Grown as an ornamental. The seeds are useful in dry bronchitis, fevers and injuries to the eyes. The flowers are used in paralysis and impotency.

13. Eruca sativa (Verna.-Tara)-A herb, native of South Europe but grown mainly in Northern India. The oil, obtained from the seeds, is used for burning purposes and the and is used as fodder.

14. Iberis amara (Eng.-Rocket candytuft)-A common ornamental herb. The plants are used medicinally in rheumatism and gouts. Seeds are used medicinally in asthma and bronchites.

15. Mathiola incana (Eng.-Stock; Verna.-Todri safed)-A herb, native of Europe. Grown as an ornamental. The seeds are used for extraction of an oil, which yields methyl. The seeds mixed with wine are given as an antidote to poisonous bites. They are also used as tonic in stomach complaints.

16. Lepidium sativum; (Eng.-Garden cress; Verna.-Halim)-A common cultivated herb. The young as well as the ripened seeds are used as vegetable and pulse. The leaves and tender shoots are largely eaten for liver complaints. The plant is also used in the treatment of asthma, cough and bleeding piles.

17.Nasturtium officinale; Syn. N. fontanum (Eng.-Water-cress; Verna.-Brahmi Sag)-A small herb cultivated in Bengal, Orissa and the Punjab. It is used as a vegetable.

18. Raphanus sativus; (Eng.-Radish; Verna.-Mull)—A herb, cultivated in Uttar Pradesh, the Punjab, Maharashtra, etc. The roots, young leaves and the fruits are used as vegetable.

19. Raphanus sativus var. candatus (Eng.-Rat-tail radish; Verna.-Sengri)-The fruits are used as vegetable. The fruits are also used for making pickle.

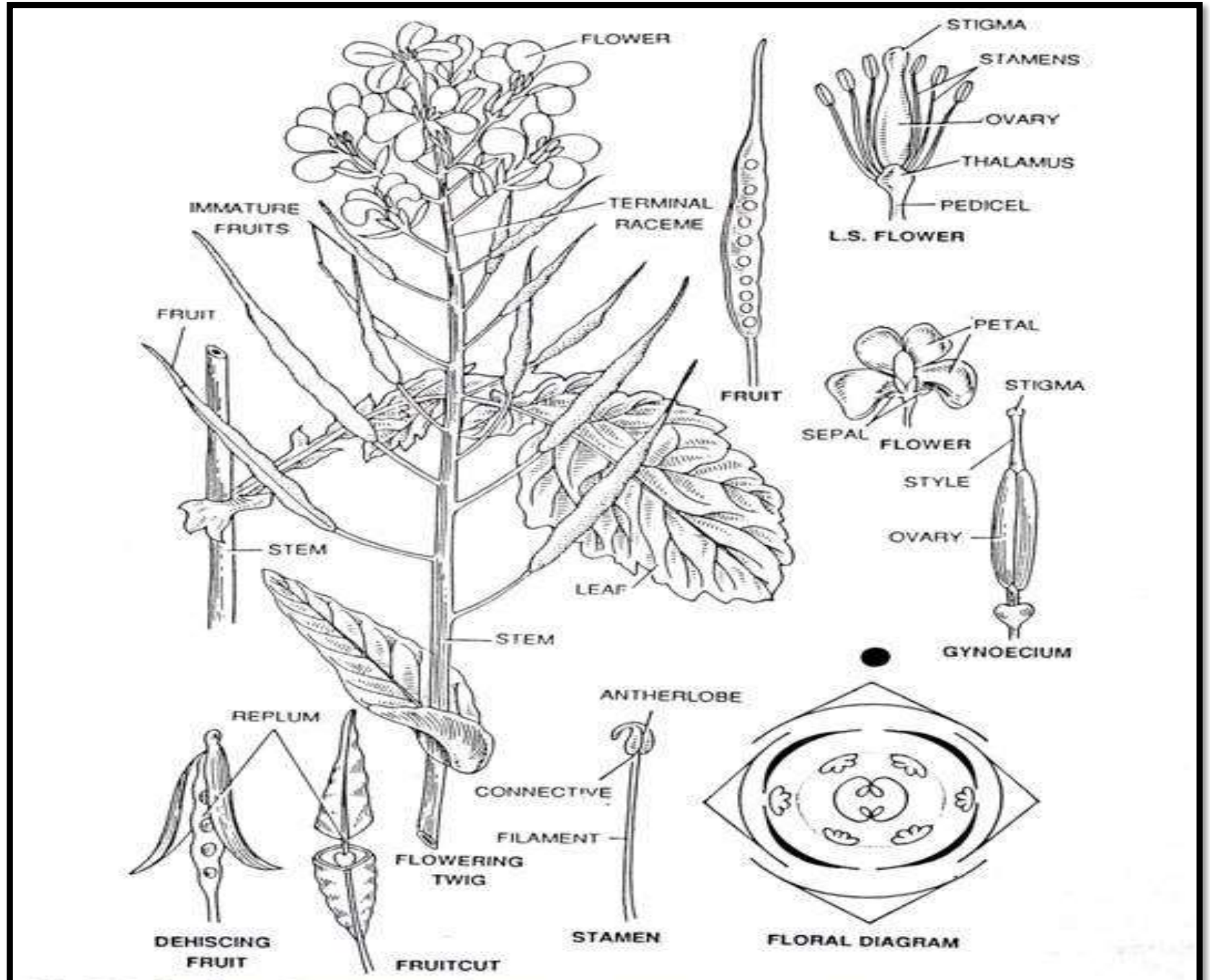


Fig. 22.1. Cruciferae (Brassicaceae). *Brassica campestris* Linn.; Eng. Yellow mustard; Verna. **Sarson.**

Iberis amara Linn.; Eng. Candytuft:

Habit:

Annual ornamental herb, cultivated.

Stem:

Herbaceous, erect, aerial, branched, green, solid, rough surface.

Leaf:

Cauline and ramal, alternate, sometimes opposite, sessile, exstipulate, simple, margin somewhat dissected, acute, glabrous, unicostate reticulate.

Inflorescence:

Racemose, corymb.

Flower:

Ebracteate, pedicellate, complete, irregular (zygomorphic), hermaphrodite, tetramerous, hypogynous, white, cyclic.

Calyx:

4, polysepalous, in two whorls of 2 each, imbricate, petaloid, boat shaped.

Corolla:

4, polypetalous, valvate, 2 anterior petals large, 2 posterior petals small, each petal consists of a claw and limb, cruciform.

Androecium:

6, free stamens (polyandrous), tetradynamous -2 outer lateral short, remaining 4 antero-posterior long, dithecous, dorsifixed, introrse.

Gynoecium:

Bicarpellary, syncarpous, ovary superior, unilocular when young, at maturity becomes bilocular because of the development of talse septum, parietal placentation, style long, stigma globular.

Fruit:

Silicula.

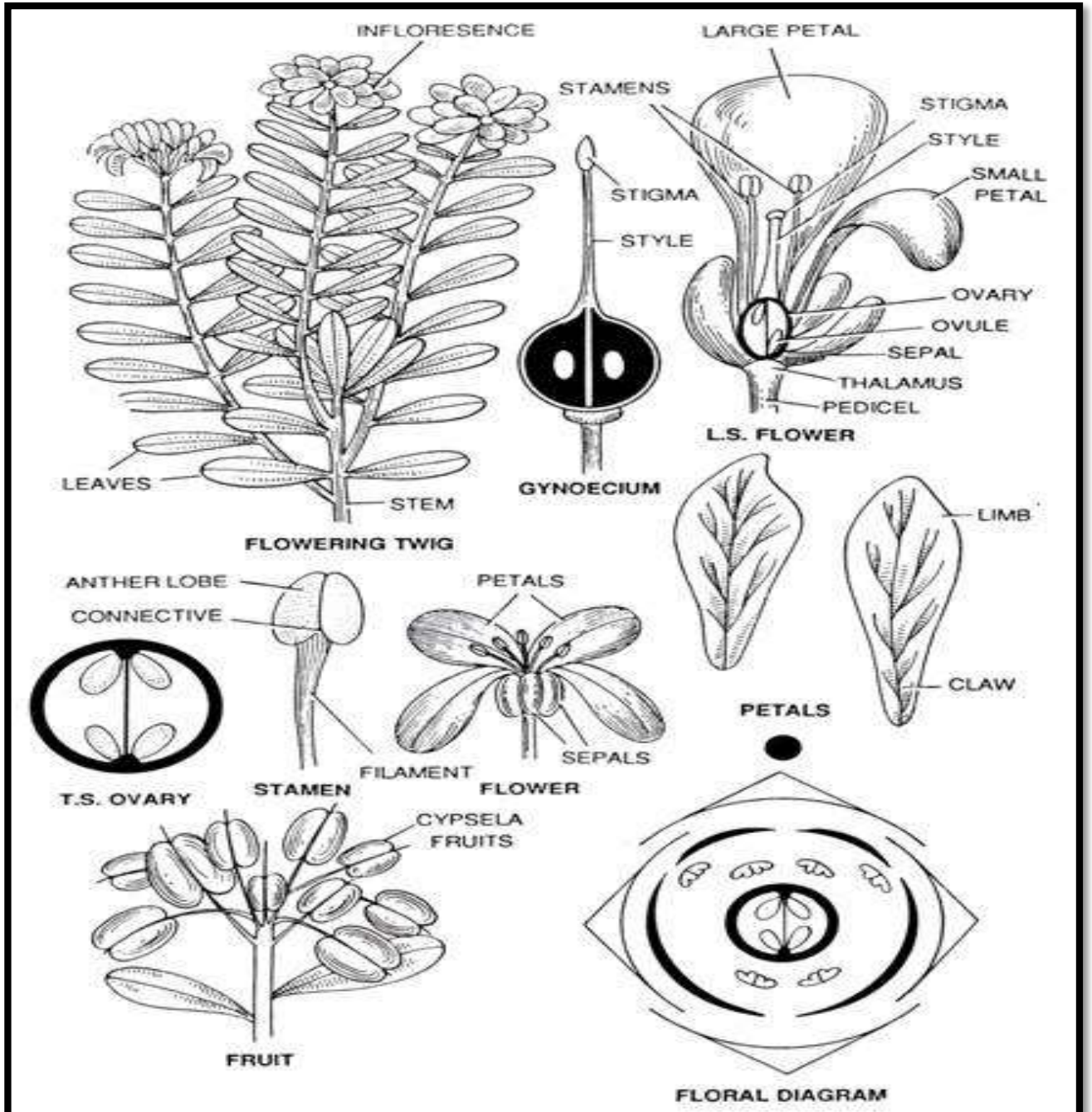


Fig. 22.3. Cruciferae (Brassicacae). *Iberis amara* Linn.; Eng., candytuft.

Acanthaceae:

There are about 240 genera and 2,200 species in this family.

Distribution:The members of this family are mostly found in tropical to subtropical forests especially in the damp and marshy places.

Habit:

Usually they are herbs or shrubs. Trees are rarely found. Some are however xerophytic, such as, Barleria, Blepharis, Acanthus, etc. Some plants are climbing in habit, e.g., Mendoncia, Thunbergia and other allied plants.

Thunbergia alata is a herbaceous twiner; Peristrophe bicalyculata, Andrographis paniculata, Runzia parviflora, Ruellia prostrata, Justicia simplex, Hemigraphis sp; Haplanthus sp., etc., are typical examples of herbs. Several plants are undershrubs, e.g., Barleria cristata, Ruellia tuberosa, Justicia betonica, Strobilanthes coloratus, Eranthemum pulchellum, etc.

Leaves:The leaves of usual mesophytes are simple, usually opposite decussate, entire, exstipulate, thin and delicate. In xerophytes the leaf blade is more or less spiny.

The characteristic anatomical feature of the family is the presence of cystoliths in the epidermal cells of leaves and stems. Sometimes double cystoliths are found. The cystoliths are calcium carbonate crystals.

Inflorescence:

The inflorescence is of cymose type. The dichasial cyme passes into monochasial one in the higher branching. Sometimes the flowers are found to be arranged in the short axillary clusters. Spikes and racemes are also frequently found. Bracts and bracteoles generally well developed and often brightly coloured.

These bracts, etc., add to the beauty of the inflorescence. In Mendoncia sp., and Thunbergia sp., the bracteoles are orange and form an involucre around the corolla tube. The flowers of Dicliptera sp., are found to be arranged in axillary peduncled cymes. The flowers of Phialacanthus griffithi are arranged in typical.

The flowers of Strobilanthes discolor are found to be arranged in panicled cymose heads whereas in Strobilanthes anisophyllous these are arranged in cymose heads. In the species of Barleria, the flowers are either solitary or arranged in short spikes, or pairs.

In the species of Thunbergia the flowers are found to be arranged either in cymose or in racemose types of inflorescence. This way, there is great variation in the types of inflorescence in various members of the family.

Flower: The structure of flower is very uniform. The flowers are bracteate; bracteolate, hermaphrodite, complete, zygomorphic (irregular) and hypogynous. Usually the flowers are tetramerous or pentamerous, but generally there is a reduction to 4 or 2 in the androecium, and there are two carpels in the gynoecium.
Calyx: It consists of five, sometimes four or rarely three sepals. Usually they are gamosepalous. In Thunbergia the sepals are reduced to narrow beam. In this case large bracteoles serve the purpose of protection. The aestivation is either contorted or imbricate

Androecium:

Usually there are 4 didynamous stamens. In certain cases only two stamens are found. Very rarely the number of fertile stamens reaches to five, e.g., Pentstemonacanthus. In the cases where there are only four stamens, the fifth posterior stamen reduces to a staminode or disappears completely.

In the Imbricatae group of the family, there are only two stamens. In such cases, firstly the posterior stamens reduce to staminodes or disappear completely. However, in Brillantaisia the anterior pair of stamens reduces to staminodes.

The filaments are generally quite free and project out from the mouth of the corolla tube. The stamens of Thunbergia, are however short and remain inside the corolla tube. The stamens are inserted in the corolla, i.e., epipetalous. The anthers may be two or one celled.

Gynoecium:

The gynoecium consists of two carpels, syncarpous. The ovary superior, bilocular, two or more ovules are found in each loculus. The Placentation is axile. The style is long and slender and projects out from the mouth of the corolla tube. There are two small stigmas; the posterior stigma is usually reduced.

Fruits: Usually the fruit is bilocular capsule, which dehisces loculicidally. In Mendoncia the fruit is drupe

Seed: In Nelsonia, the seeds are small and many. In Nelsonia and Thunbergia, the funicle of the seeds forms a papilla, the seeds are rounded. In the Acanthus and allied genera, e.g., Ruellia, the funicle of the seeds forms a hook-like projection, known as jaculator, in which the seed rests. These hook-like jaculators make the fruits burst and the seeds become dispersed in different directions. The seeds a exalbuminous.

Floral Formula: ⊕ ♂ K (4–5), $\overline{C(4-5)}$, A 4 or 2, G(2).

Bentham and Hooker(1862)	Engler and Prantl(1931)	Hutchinson(1959)
Phanerogams	Phanerogams	Angiospermae
Dicotyledones	Dicotyledoneae	Dicotyledones
Gamopetalae	Sympetalae	Herbaceae
Bicarpellatae	Tubiflorae	Personales
Personales	Acanthaceae	Acanthaceae
Acanthaceae		

Economic Importance of Family-Acanthaceae:

The family is of little economic value. Some plants are used as hedge plants and some are ornamental. Some plants medicinal properties.

A list of few important plants is given below:

1. Adhatoda vasica**,** Syn. Justicia adhatoda; Eng.-Malabar nut; Verna.-Arusa, Adulasa-An Ayurvedic drug is obtained from its leaves, which is used in cough, chronic bronchitis and rheumatism. The twigs and leaves are used as green manure. The plant is also used as an antiseptic and insecticide. This is an evergreen shrub commonly found in Northern India.
2**.** Barleria alba; This is a shrub grown as an ornamental.
3. Barleria cristata; This is an ornamental small shrub. The juice of the leaves is given in cough.
4. Barleria prionitis; Verna.-Katsareya-A plant with medicinal properties. The dried bark is given in the cough.
5. Barleria trigosa; Verna.-Nila kusum-The root is used as a remedy of severe cough.

6. Andrographis paniculata; Verna.-Kiryat. The leaves possess medicinal properties. The plants are grown as ornamental herbs.

7. Ruellia prostrate; the plants possess medicinal properties. They are used as a remedy in ear troubles.

8. Ruellia tuberose; This is herb or a small shrub, grown as an ornamental.
9. Justicia betonica; An undershrub, grown as hedge plant.
10. Thunbergia alata; It is a herbaceous twiner; grown as an ornamental, as it flowers throughout the year.
11. Thunbergia coccinea; This is grown as an ornamental.
12. Thunbergia fragrans; Grown in the gardens as ornamental.
13. Thunbergia grandiflora; Verna.-Kukua lata-This is an ornamental; the leaves are edible.

14. Aechnanthera wallichii; The lower surface of the leaves is used in making a kind of cloth by natives.

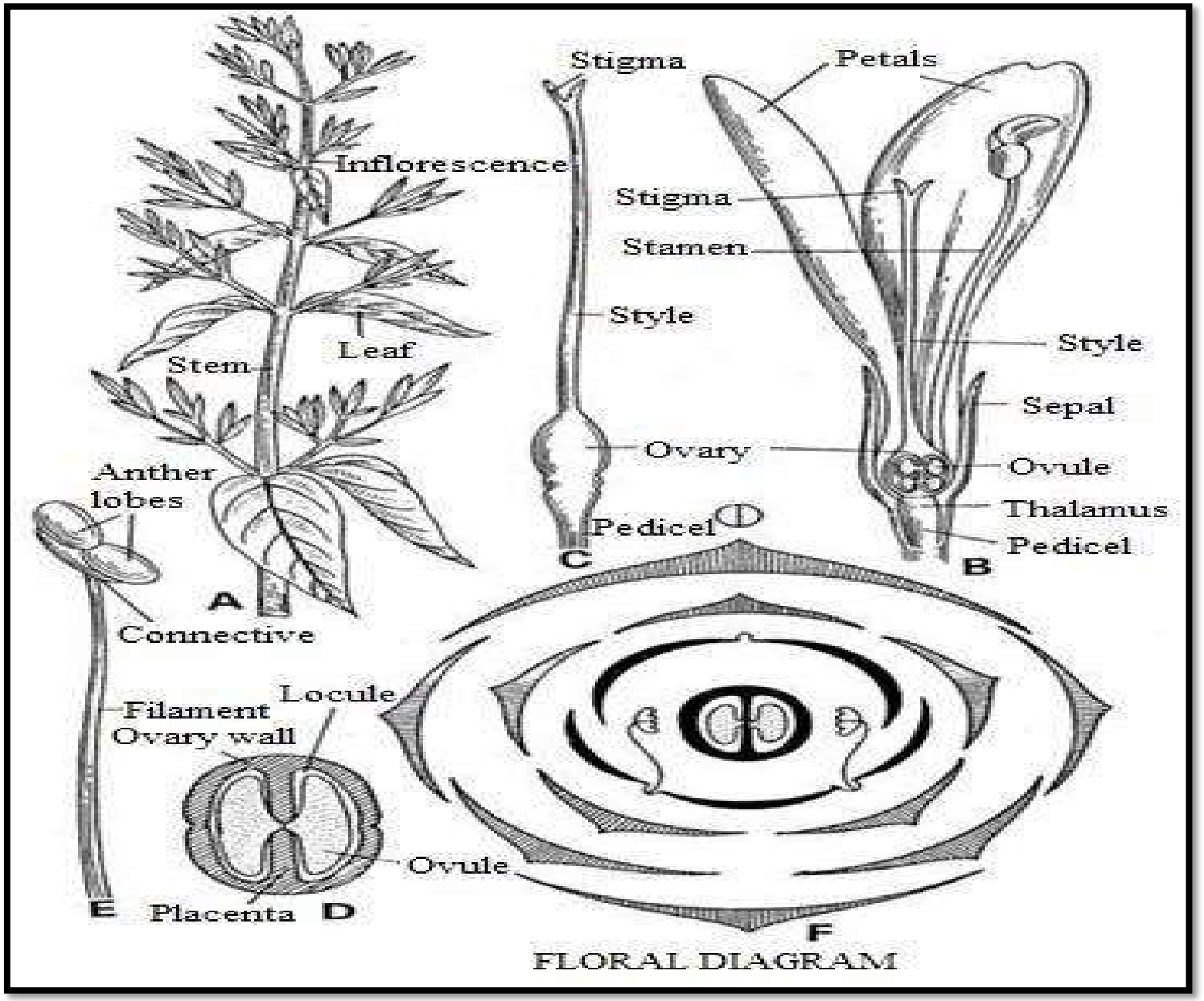
Peristrophe bicalyculata Nees:

Habit- A perennial wild herb.

Stem-aerial, erect, angular, branched, solid, pubescent, green, herbaceous. Leaf-cauline and ramal, opposite decussate, simple, exstipulate, petiolate, ovate, acute, hairy, unicostate reticulate. Inflorescence-cymose, branched or panicled cyme.

Flower-bracteate, two bracts (anterior and posterior), bracteolate, 4 bracteoles, bracts and bracteoles persistent, pedicellate, bisexual, complete, zygomorphic, pentamerous, hypogynous, cyclic.

Calyx-5, polysepalous, valvate. Corolla-5, gamopetalous, bilabiate 2/3, valvate, purple. Androecium-2, polyandrous, epipetalous, filaments long, dithecous, basifixed, introrse. Gynoecium-2, bicarpellary, syncarpous, superior, bilocular, 2 ovules in each locule, axile, style filiform stigma bifid. Fruit-capsule,


Inflorescence
Leaf
Stem
A
Anther lobes
Connective
Filament
E
Stigma
Style
Ovary
Pedicel
C
Petals
Stigma
Stamen
Style
Sepal
Ovule
Thalamus
Pedicel
B
Locule
Ovary wall
Ovule
Placenta
D
F
FLORAL DIAGRAM