



BGS Science Academy & Research Centre

Agalagurki, Chikkaballapura
Affiliated to Bangalore University



A MANUAL OF PRACTICAL BOTANY III B.Sc. FIFTH SEMESTER

Paper-V

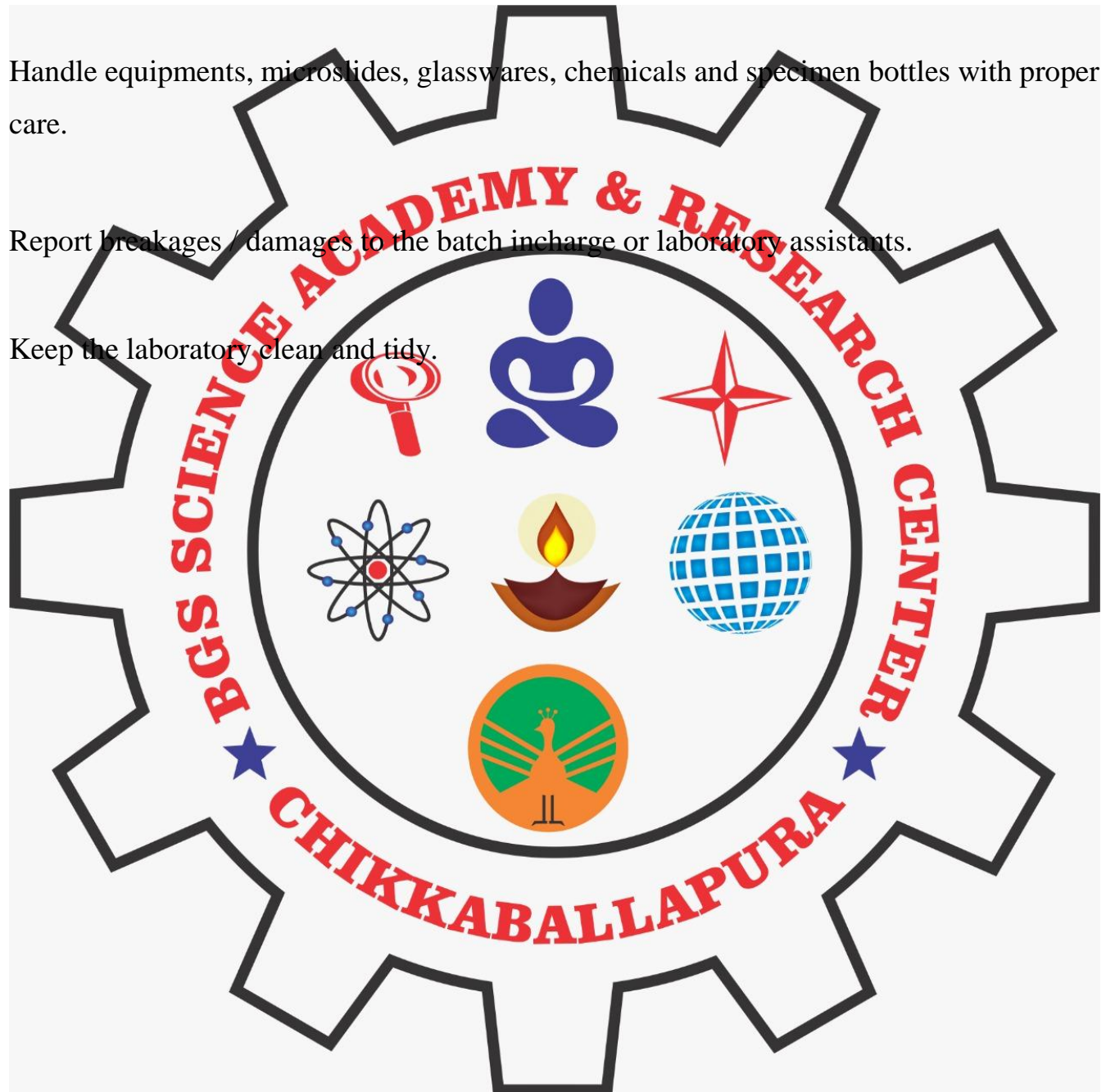
TAXONOMY AND ECONOMIC BOTANY

2019-2020

DEPARTMENT OF BOTANY

Laboratory Instructions

- Do not forget to carry laboratory apron, observation book and other required accessories.
- Handle equipments, microslides, glasswares, chemicals and specimen bottles with proper care.
- Report breakages / damages to the batch incharge or laboratory assistants.
- Keep the laboratory clean and tidy.



PRACTICAL PAPER V

TAXONOMY AND ECONOMIC BOTANY

Total Units: 13

1. Morphology of Angiosperms – Vegetative structure - Study OF Root, Stem and Leaf Modifications **1 unit**
2. Morphology of Angiosperms- Inflorescence or Flower. **1 unit**
3. Morphology of Angiosperms- Fruits (Simple, aggregate and multiple) **1 unit**
4. Methods of identification of plants with technical terms. **1 unit**
5. Study of taxonomic characters of following families (Minimum one genus from each family) **6 units**

MONOCOTS

 - I. Poaceae – *Oryza sativa, Apluda mutica*
 - II. Arecaceae – *Cocos nucifera*
 - III. Musaceae – *Musa paradisiaca*
 - IV. Orchidaceae – *Vanda roxburghii*

DICOTS

 - I. Magnoliaceae – *Michelia champaca*
 - II. Annonaceae – *Annona squamosa, Artabotrys odoratissimus*
 - III. Brassicaceae – *Brassica campestris*
 - IV. Rosaceae – *Rosa indica*
 - V. Leguminosae - Subfamilies:
 - a. Papilionatae – *Crotalaria*
 - b. Caesalpinoideae – *Cassia tora, Tamarindus Indica*
 - c. Mimosoideae- *Mimosa pudica, Acacia Nilotica*
 - VI. Rutaceae – *Murraya exotica, Toddalia asiatica*
 - VII. Euphorbiaceae – *Croton sparciflorus or bonplandianus, Euphorbia hirta*
 - VIII. Umbeliferae or Apiaceae – *Coriandrum sativum, Centella asiatica*
 - IX. Asclepiadaceae- *Calotropis procera, Asclepias curassavica*
 - X. Labiatae or Lamiaceae- *Ocimum sanctum, Leucas aspera*
 - XI. Acanthaceae- *Justicia simplex, Ruellia*
 - XII. Rubiaceae- *Hamelia patens, Ixora coccinea*
 - XIII. Cucurbitaceae- *Coccinea indica, Cucurbita maxima*
 - XIV. Compositae or Asteraceae- *Helianthus annus, Tridax procumbens*
6. Study of economically important plants covered in theory to identify with botanical names, families, parts used and economic uses. **2 units**

EDIBLE OILS - Ground nut, Coconut & Sesamum.
SUGAR AND STARCH – Sugarcane, Beet root, Potato & Tapioca.
FIBERS – Cotton, Jute & Coir.
PAPER AND PULP – Bamboo & Eucalyptus.
BEVERAGES – Coffee, Tea & Cocoa.
SPICES – Ginger, Cardamom, Clove, Cinnamon, Asafoetida, Turmeric, Saffron & Nutmeg.
TIMBER – Teak & Rosewood.
MEDICINAL & AROMATIC PLANTS – Ashwagandha, *Aloe vera*, Indian pennywort, Holy basil, Amla, Periwinkle, Margos tree, Patchouli, Mint & Lavender.
7. Herbarium techniques. **1 unit**
8. Study of local flora by arranging local collection trips.
9. Record and Submission of 6 Herbaria with field notes of plants included in theory.

PRACTICAL QUESTION PAPER - V**TAXONOMY AND ECONOMIC BOTANY**

Time: 3 hours

Max marks: 35

1. Assign the specimens **A, B & C** to their respective families giving diagnostic features.

3 X 3 = 9 marks

2. Describe **D** in technical terms; draw the floral diagram with floral formula.

6 marks

3. Identify the specimens **E, F, G, H, I & J** with their morphological, biological and economic importance.

6 X 2 = 12 marks

4. Record and Submission. (Herbaria with field notes)

5 + 3 = 8 marks

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- SCHEME OF VALUATION**
1. One Archichlamydeae, one Metachlamydeae, one Monocot (Identification ½ mark, classification 1 mark, Diagnostic features 1½ mark).
 2. Dicot plant (Technical detail 2 marks, floral diagram 2 marks, and floral formula 2 marks).
 3. Root/ Stem/ Leaf modification/ Inflorescence/ Fruit / Economic importance (Identification ½ mark, diagram ½ mark, description 1 mark, for economic importance, identification with family 1 mark, part use ½ mark, economic uses ½ mark)
 4. Class Records – 5 marks.
 5. Submission of six herbaria with field notes of family's studies, ½ marks each- 3 marks.

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5.	Study of taxonomic characters of families included in the theory (Minimum one genus from each family)- MONOCOTS I. Poaceae – <i>Oryza sativa</i> , <i>Apluda mutica</i> II. Arecaceae – <i>Cocos nucifera</i> III. Musaceae – <i>Musa paradisiaca</i> IV. Orchidaceae – <i>Vanda roxburghii</i>	21-30
6.	DICOTS I. Magnoliaceae – <i>Michelia champaca</i> II. Annonaceae – <i>Annona squamosa</i> , <i>Artabotrys odoratissimus</i> III. Brassicaceae – <i>Brassica campestris</i> IV. Rosaceae – <i>Rosa indica</i> V. Leguminosae- Subfamilies: a. Papilionatae – <i>Crotalaria</i> b. Caesalpinoideae – <i>Cassia tora</i> , <i>Tamarindus Indica</i> c. Mimosoideae- <i>Mimosa pudica</i> , <i>Acacia Nilotica</i> VI. Rutaceae – <i>Murraya exotica</i> , <i>Toddalia asiatica</i> VII. Euphorbiaceae – <i>Croton sparciflorus or bonplandianus</i> , <i>Euphorbia hirta</i> VIII. Umbeliferae or Apiaceae – <i>Coriandrum sativum</i> , <i>Centella asiatica</i> IX. Asclepiadaceae- <i>Calotropis procera</i> , <i>Asclepias curassavica</i> X. Labiatae or Lamiaceae- <i>Ocimum sanctum</i> , <i>Leucas aspera</i> XI. Acanthaceae- <i>Justicia simplex</i> , <i>Ruellia</i> XII. Rubiaceae- <i>Hamelia patens</i> , <i>Ixora coccinea</i> XIII. Cucurbitaceae- <i>Coccinea indica</i> , <i>Cucurbita maxima</i> XIV. Compositae or Asteraceae- <i>Helianthus annus</i> , <i>Tridax procumbens</i>	31-86
7.	Study of economically important plants covered in theory to identify with botanical names, families, parts used and economic uses. EDIBLE OILS - Ground nut, Coconut & Sesamum, SUGAR AND STARCH – Sugarcane, Beet root, Potato & Tapioca, FIBERS – Cotton, Jute & Coir, PAPER AND PULP – Bamboo & Eucalyptus, BEVERAGES – Coffee, Tea & Cocoa, SPICES – Ginger, Cardamom, Clove, Cinnamon, Asafoetida, Turmeric, Saffron & Nutmeg, TIMBER – Teak & Rosewood, MEDICINAL & AROMATIC PLANTS – Ashwagandha, <i>Aloe vera</i> , Indian pennywort, Holy basil, Amla, Periwinkle, Margos tree, Patchouli, Mint & Lavender.	87 - 91
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MORPHOLOGY OF ANGIOSPERMS

STUDY OF ROOT MODIFICATIONS

Root system

Root is the underground descendent, non-green organ of the plant body. It is developed from the radicle of the embryo growing negatively phototropic and positively geotropic. It is not differentiated into nodes and leaves. It bears unicelled root hairs and the tip is protected by root cap.

Types of roots

Based on the origin the roots are divided into two types as follows:

Primary root: the root which is developed from the radicle of the embryo is called primary root.

Adventitious root: the roots which are developed from any part of the plant body other than the radicle of the embryo are called adventitious roots.

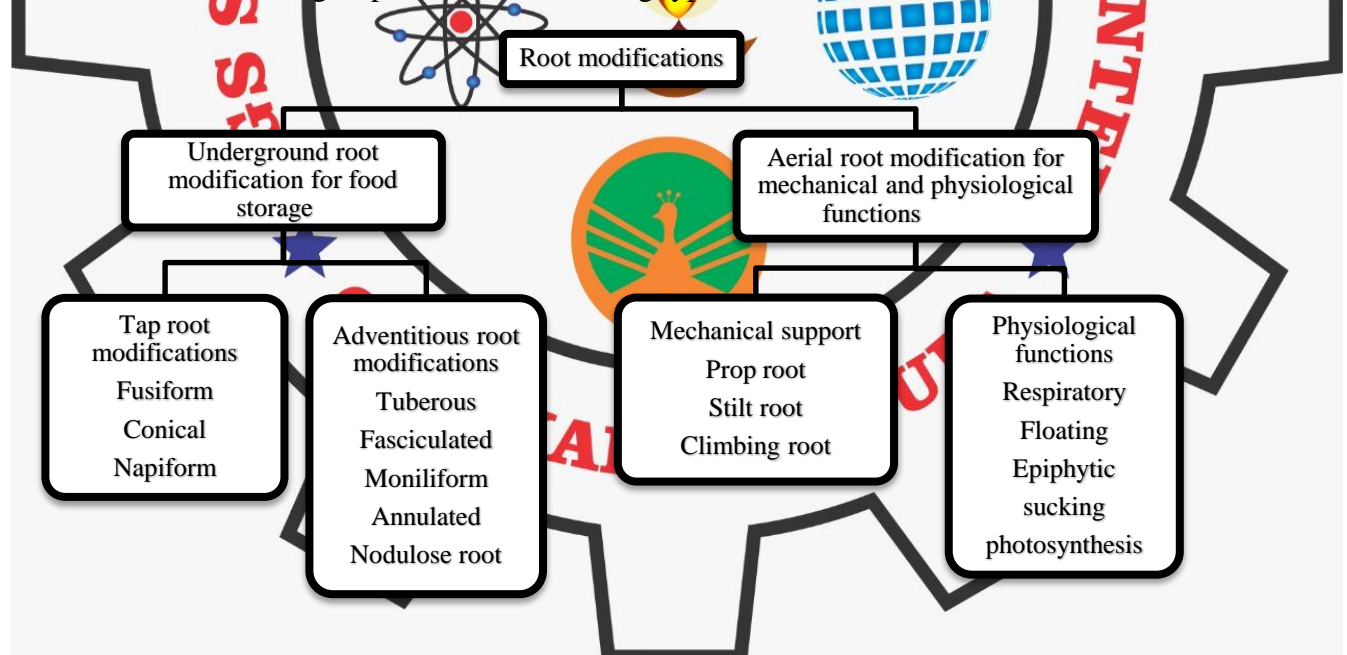
Based on the development roots are divided into two types

- Tap root:** in this type the primary root is long lived and produces number of unequal sized secondary and tertiary roots. Eg: Dicot plants.
- Fibrous root:** in the type the primary root is short lived and it is replaced by number of equally size cylindrical fibre like roots. Eg: Monocot plants

Root modifications

Any structural change which takes place in the roots to perform the special functions like food storage, floating, breathing, sucking, climbing and mechanical support, such roots are called modified roots.

Root modifications are grouped into the following types:



Underground root modification for food storage

Underground taproot modifications:-

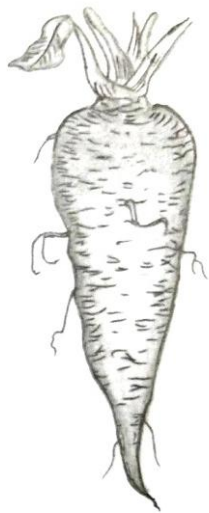
Fusiform root, Eg: Radish, Conical root, Eg: Carrot Napiform root, Eg: Beetroot

Underground adventitious root modifications:-

Tuberous root, Eg: Sweet potato Fasciculated roots, Eg: Dahlia
 Moniliform root, Eg: Bitter gourd Annulated roots, Eg: Ipecac Nodulose roots,
 Eg: Mango ginger

Underground taproot modifications:-

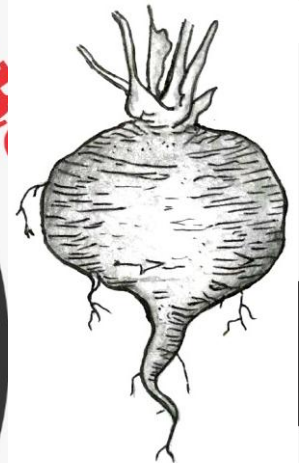
Fusiform root: it is a taproot modification for food storage, where it becomes spindle shape i.e., swollen in the middle and tapers at both ends. Eg: *Raphanus sativus* (Radish).



CONICAL ROOT
Eg: Carrot

Conical root: it is a tap root modification for food storage, where it become conical shape i.e. broader at the upper end and tapers at the lower end. Eg: *Daucus carota* (Carrot).

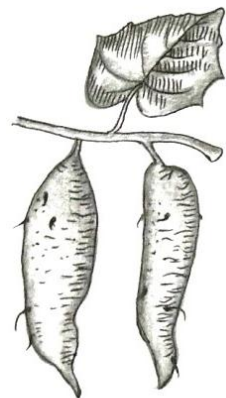
Napiform root: it is a tap root modifications for food storage, where it becomes bulged into spherical shape at the apex and abruptly tapering towards the base. Eg: *Beta vulgaris* (Beetroot).



NAPIFORM ROOT
Eg: Beetroot

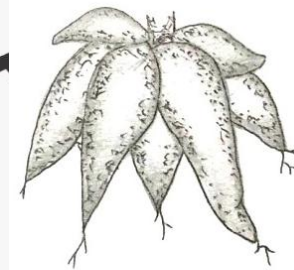
Underground adventitious root modifications:-

Tuberous root (Root tubers): in this type only one adventitious root becomes bulged irregularly due to storage of food. Eg: *Ipomea batatus* (Sweet potato)



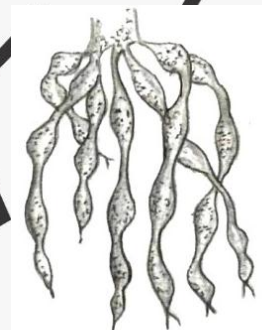
TUBEROUS ROOT
Eg: Sweet Potato

Fasciculated roots: arising from the node. The cluster of adventitious tuberous roots. In this type all the adventitious roots becomes irregularly bulged due to storage of food. Eg: *Dahlia*, *Asparagus*.



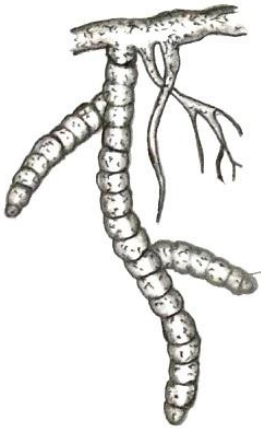
FASCICULATED ROOTS
Eg: *Dahlia*

Moniliform roots (Beaded roots): in this type the adventitious root develop alternate swellings and constrictions to give appearance of beaded thread due to storage of food. Eg: *Momordica charantia* (Bitter gourd), Grasses, *Vitis*, *Dioscorea*.



MONILIFORM ROOTS
Eg: Bitter Gourd

Annulated roots: in this type the adventitious roots appear as if number of discs placed one above other due to storage of food. Eg: *Psychotria* (Ipecac).

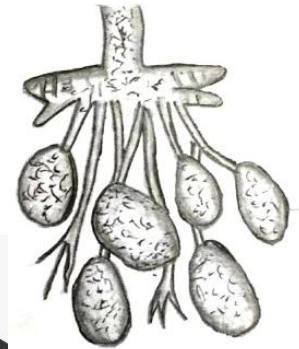


ANNULATED ROOTS
Eg: Ipecac

Nodulose roots: in this type the adventitious roots bulges at the tips like nodules due to storage of food. Eg: *Curcuma amada* (Mango ginger).

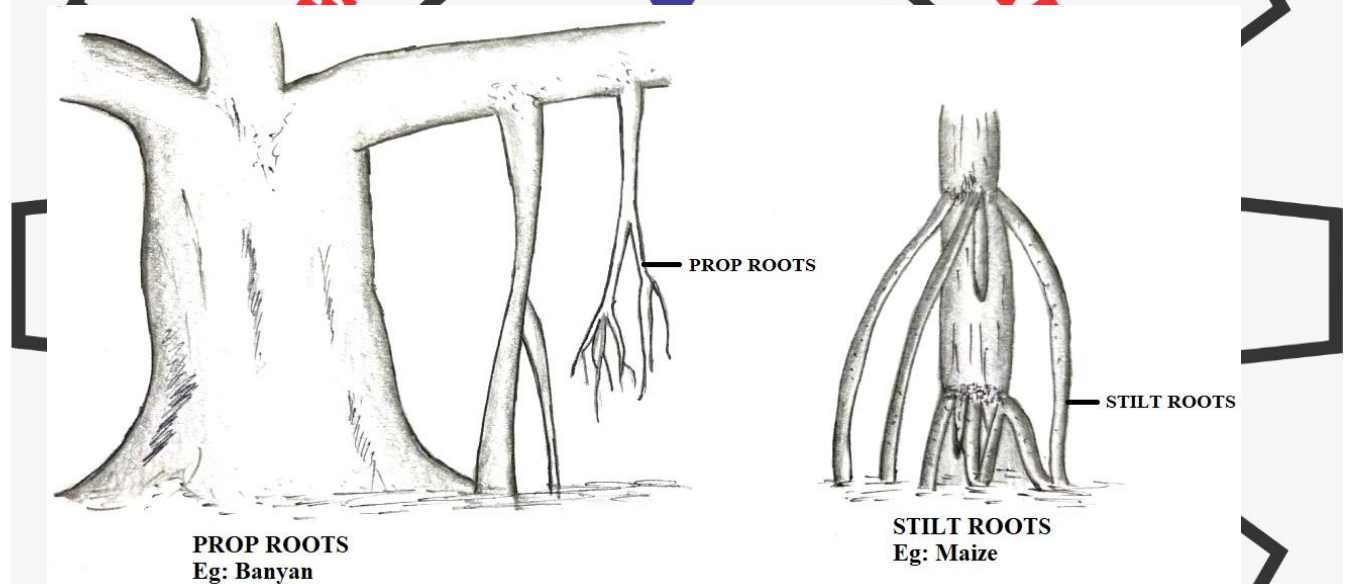
Aerial adventitious root modifications

Prop roots: these are the strong, woody, modified aerial adventitious roots developed from the horizontal branches of the tree. These grow vertically downwards into soil and give mechanical support to the branches. Eg: *Ficus bengalensis* (Banyan).



NODULOSE ROOTS
Eg: Mango Ginger

Stilt roots: these are the modified aerial adventitious roots developed from the lower most node of the stem. These grow obliquely into the soil and gives mechanical support to the plants. Eg: *Zea mays* (Maize), Sugarcane, Screw pine (*Pandanus foetidus*), and some mangrove plants.



PROP ROOTS
Eg: Banyan

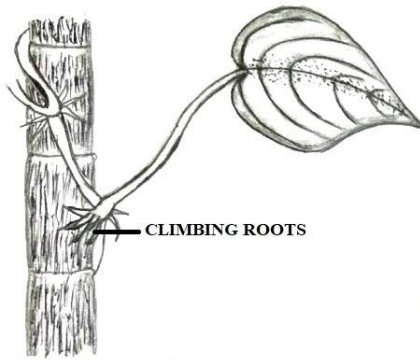
STILT ROOTS
Eg: Maize

Climbing roots: these are the modified aerial adventitious roots developed from the nodes of the weak stemmed plants. These roots produce sticky substance, which attached the roots to the support and help to climb up. Eg: *Piper longum* (Black pepper) *Ficus pumila*.

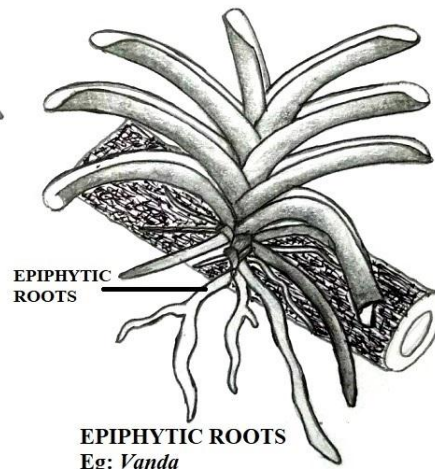
Clinging roots: found in epiphytic plants (orchid) to cling the plant on the stem of other plant.

Aerial or Epiphytic roots: these are developed in the epiphytes. These roots hang freely in the air, which contain a spongy tissue called velamen on their surface. This tissue helps in the absorption of moisture from the atmosphere. Eg: *Vanda*.

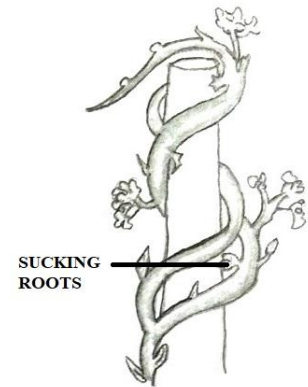
Sucking or haustorial (Parasitic) roots: these are also called haustoria developed in the parasitic plants. These roots penetrates into the host plant body and suck the food materials. Eg: *Cuscuta* (Dodder).



CLIMBING ROOTS
Eg: Betel

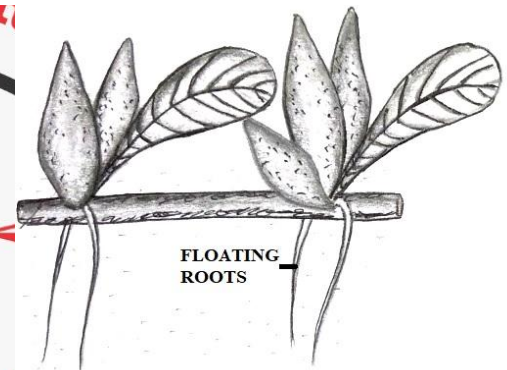


EPIPHYTIC ROOTS
Eg: *Vanda*



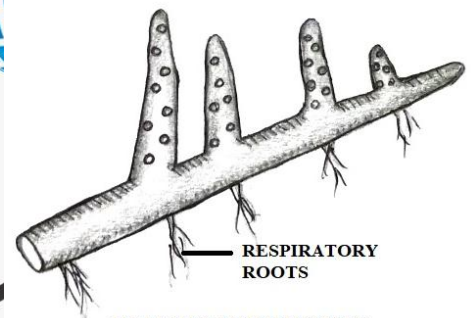
SUCKING ROOTS
Eg: *Cuscuta*

Floating roots: these are also called as respiratory roots. These are developed from floating branches of hydrophytes. The floating roots are small, spindle shaped roots with spongy aerenchyma tissue. These help in the plant to float on the surface of the water and also perform the respiration. Eg: *Jussiaea repens*, *Pistia stratiates*.

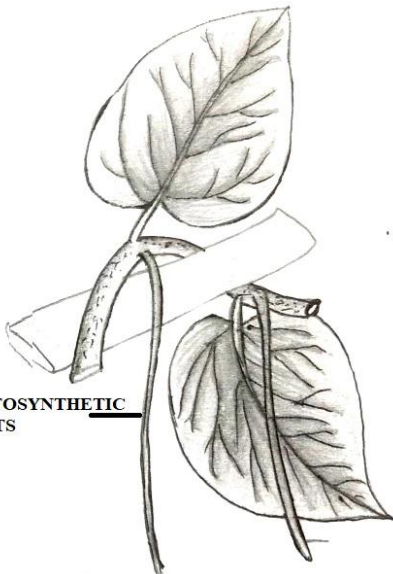


FLOATING ROOTS
Eg: *Jussiaea*

Respiratory roots: these are also called pneumatophores. These are negatively geotropic vertically growing roots developed in the plants growing in the water logged saline soil, where O_2 concentration is less. Some of the lateral roots come above the soil surface and developed minute air pores called lenticels or breathing pores through which roots respire. Eg: *Rhizophora*, *Avicennia* etc.



RESPIRATORY ROOTS
Eg: *Rhizophora*



PHOTOSYNTHETIC ROOTS
Eg: *Tinospora*

Photosynthetic or Assimilatory roots: in some plants|| adventitious roots arises from the aerial nodal regions of the stem.

They are hair like cylindrical and green in colour these are modified roots to carry out photosynthesis. Eg. *Tinospora cardifolia*.

Root buttresses: found in some large trees to provide additional support by producing plant like roots arising from the base of trunk, as found in *Ficus*, *Terminalia* etc.

STUDY OF STEM MODIFICATIONS

Introduction

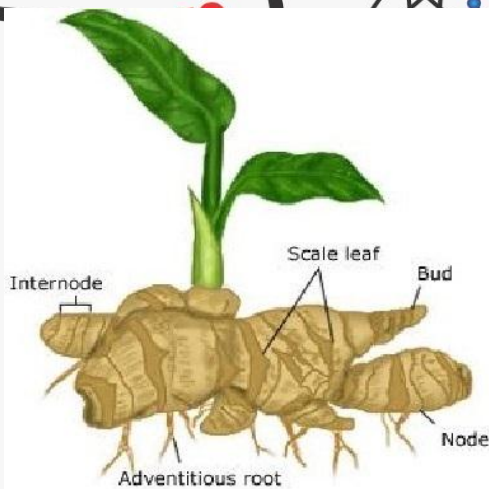
Stem is usually an aerial organ of the plant body developed from the plumule growing positively phototropic and negatively geotropic, consists of nodes, internodes, axillary buds and leaves. The main functions of it are conduction of water and minerals from root to other parts and exposing them to sunlight. In some plants stem involved to carry out special functions other than the normal functions through their modifications are called stem modifications. It may be modified for storage of food, vegetative propagation, perennation, photosynthesis, climbing, protection etc.

The stem modifications are classified under 3 headings namely:

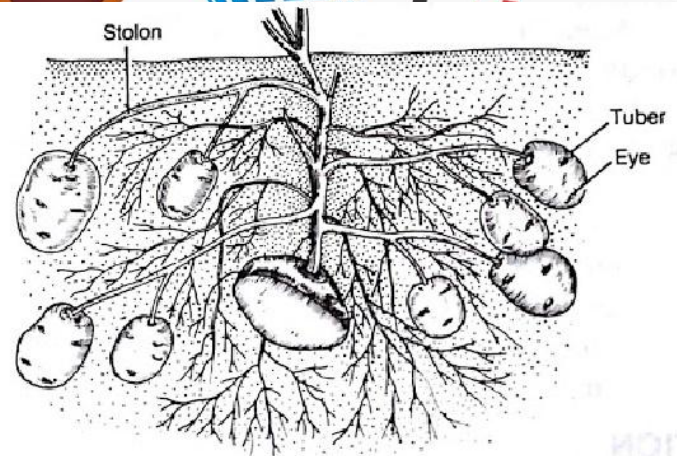
1. Underground stem modifications
2. Sub aerial stem modifications
3. Aerial stem modifications

In some plants growing in the soil there itself modifies for special functions are known as underground stem modifications. Underground stem modifications are of the following types modified for storage of food, vegetative propagation and perennation.

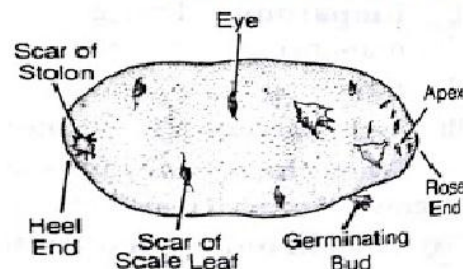
1. **Rhizome:** it is a thick, fleshy (due to storage of food, non green, branched growing horizontally just below the soil surface. It consists of nodes and internodes, small thin scaly leaves and buds at nodal regions. It bears terminal bud at the tip and adventitious roots on the lower surface. Ex: Ginger (*Zingiber officinale*), Turmeric



RHIZOME
Eg: Ginger



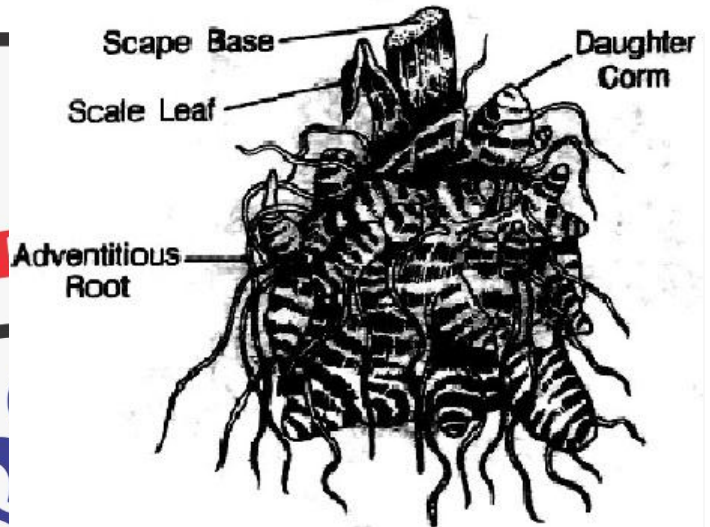
POTATO PLANT WITH TUBERS



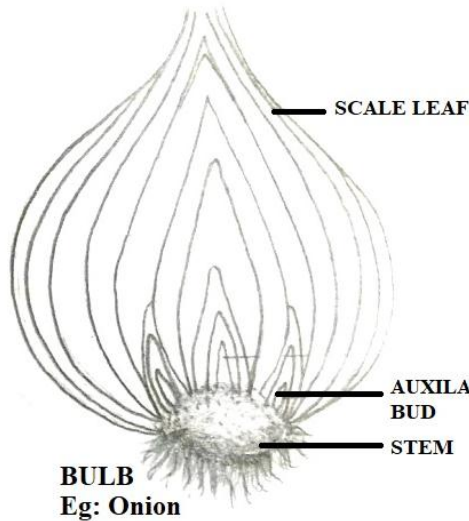
ONE TUBER ENLARGED

2. **Stem tuber:** it is developed from the lower most branches of the stem present inside the soil. It is a thick, fleshy, bulged consists of axillary buds at the axil of scale leaves and appear in the form of eyes. On separation each eye develops into a new plant. Ex: Potato (*Solanum tuberosum*), *Cyperus rotundus*.

3. **Corm:** it is a thick, fleshy, bulged, compressed from top to bottom to form spherical shaped structure. It is the lower most part of the stem present inside the soil consists of nodes and internodes. It bears small thin scale leaves and axillary buds at the nodes. The adventitious roots are present on under surface of the corm. Ex: *Amorphophallus complanatus*, *Gladiolus Colocasia*.



CORM
Eg: *Amorphophallus*



BULB
Eg: Onion

4. **Bulb:** it is a rounded modified underground stem. Here the stem is highly condensed to disc like stem consists of few axillary and terminal buds on the upper surface and adventitious roots on lower surface. On separation of buds each one develops into new plant. The concentrically arranged fleshy leaves contain foods. Ex: (*Allium cepa*).

II. Sub aerial stem modifications:

Plants in which the stem grows horizontally just below or above soil surface and modified for special functions are known as sub aerial stem modifications, these modification help for vegetative propagations.

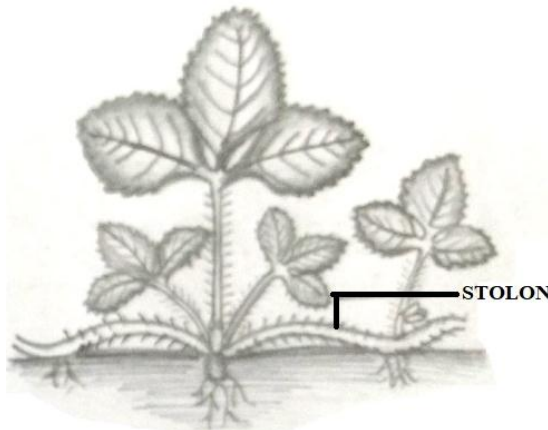
1. **Runner:** it is a long slender sub aerial stem arising from the axils of the leaf of the mother plant. It grows on the soil surface and consists of number of nodes, internodes and adventitious roots. On separation of each node with roots develop into new plant. Ex: *Oxalis*.

2. **Stolon:** it is a long or short stout sub aerial stem arising from the base of the stem of the mother plant. As first it grows below the soil surface, then on the soil surface, thus it makes arches like



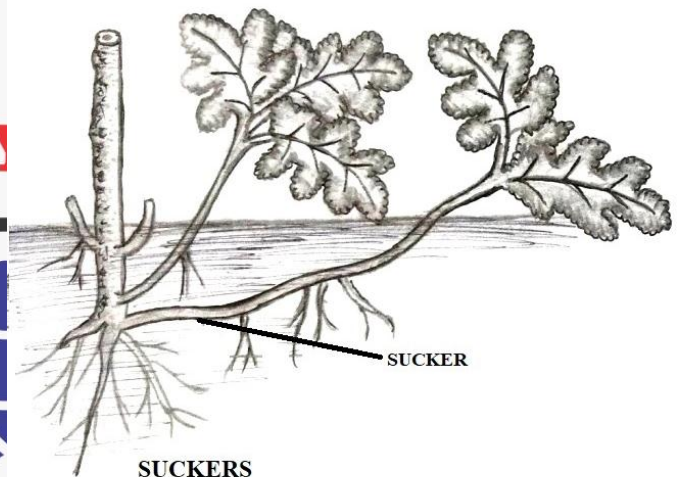
RUNNER
Eg: *Oxalis*

growth of the stem. In each nodal region it produces adventitious roots into the soil and leaves towards aerial side. Later these tips develops into daughter plants. Ex: strawberry.



STOLON
Eg: Strawberry

3. Sucker: it is a long or short stout, rigid sub aerial stem arising from underground part of the stem of mother plant. It grows obliquely below the soil surface and its tip come up and develops into a daughter plant. Each sucker contains its own roots at the base and terminal bud at the apex. On separation sucker develops into a new plant. Ex.



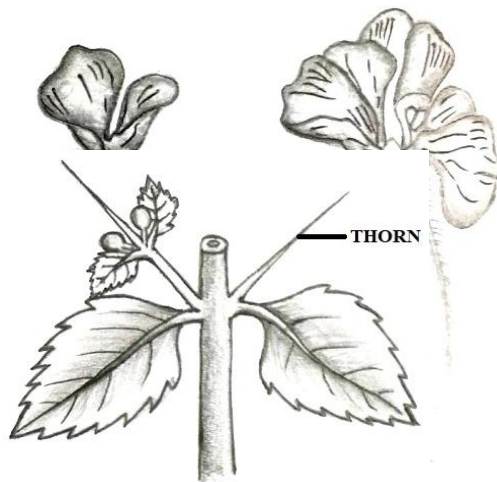
SUCKERS
Eg: *Chrysanthemum*

Chrysanthemum, Musa.

4. Offset: it is a short stout fleshy sub aerial stem arising from the leaf axils of mother plant. It consists of only one internode and grows horizontally for a short distance on the surface of the water, then its tip develops into a daughter plant. Ex: *Pistia stratiotes, Eichhornia crassipes.*

III. AERIAL STEM MODIFICATIONS

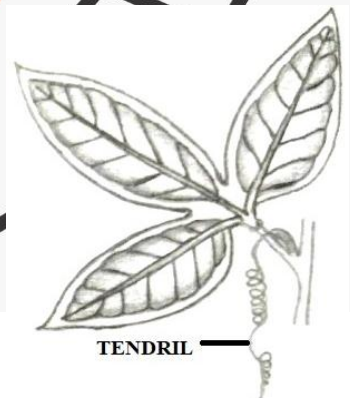
The plants in which the stem grows above the surface of the soil and there itself modified to carry out special functions are known as aerial stem modifications. In some plants the aerial stem and its parts undergoes the following modifications to perform the special functions.



STEM THORN
Eg: *Durantha*

1. Stem tendril: it is the axillary or terminal bud modification, meant for climbing purpose. It is a long, slender, wiry coiled sensitive green structure. Ex: *Passiflora*.

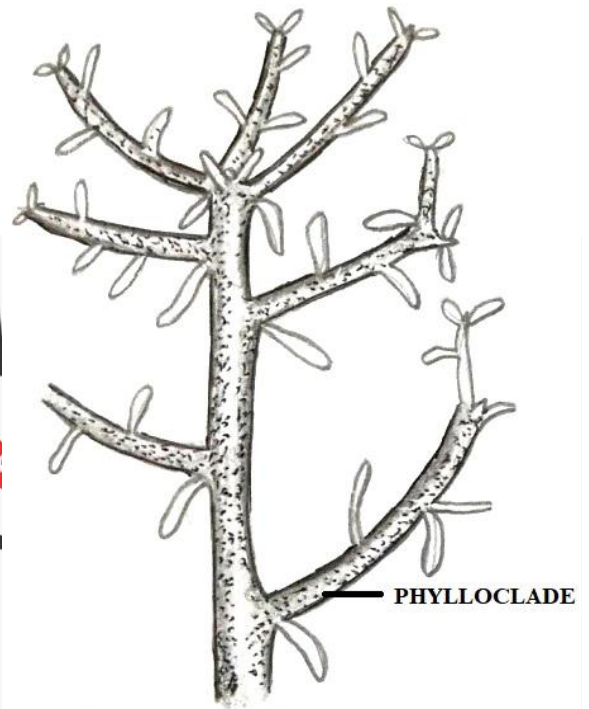
2. Stem thorn: it is the axillary or terminal bud modification meant for protection. Thorns are straight, hard, woody, pointed structure. Ex: *Canthium, Durantha.*



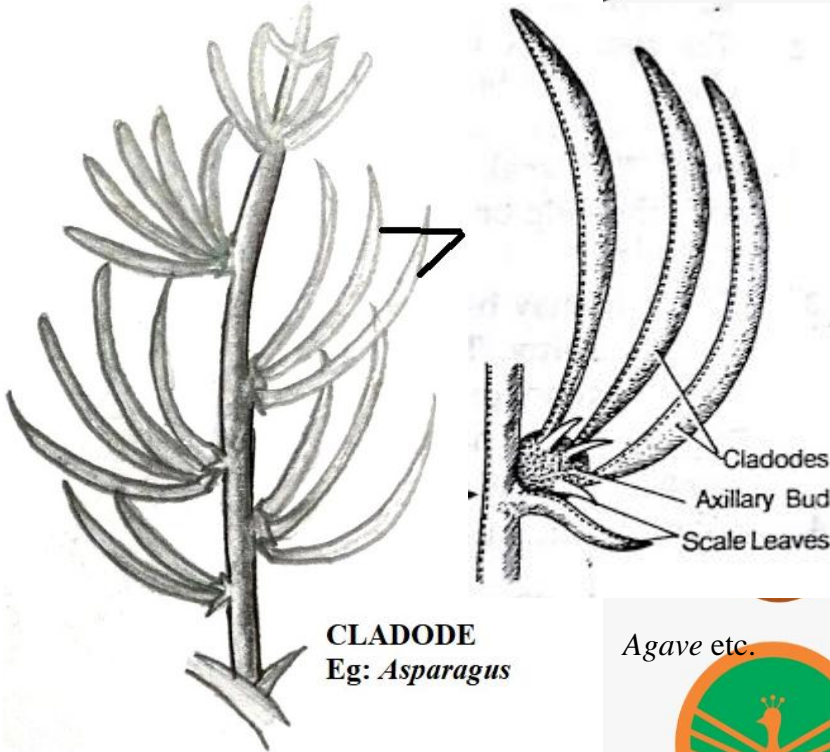
STEM TENDRIL
Eg: *Passiflora*

3. **Phylloclade or Cladophyll:** it is the modified aerial stem for photosynthesis, storage of food and to avoid the transpiration. It is a green, flat, cylindrical structure differentiated into number of nodes and internodes. Leaves are modified into spines or small leaves. Ex: *Opuntia*, *Euphorbia tirucalli*.

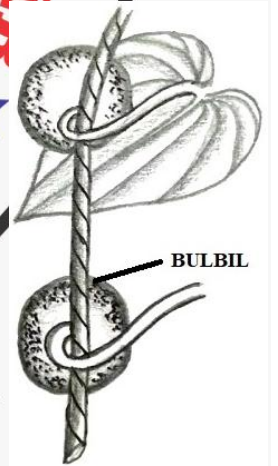
4. **Cladode:** it is a modified lateral branch of stem meant for photosynthesis. It is green flat cylindrical leaf like structure with one or two internode. The leaves are reduced to minute scales or spines. Ex: *Asparagus*.



PHYLLOCLADE
Eg: *Euphorbia tirucalli*



5. **Bulbil:** it is a modified axillary vegetative or flower bud meant for vegetative propagation. It is a bulged fleshy structure. When it detaches from the mother plant develops into new plant. Ex: *Dioscorea*,



BULBIL
Eg: *Dioscorea*



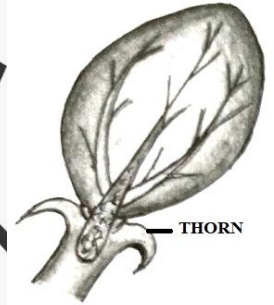
STUDY OF LEAF MODIFICATIONS

Leaf is a green, flat, expanded structure borne on the stem at the node as a lateral outgrowth. It bears an axillary bud at its axil. It is a chief organ for photosynthesis and transpiration in function.

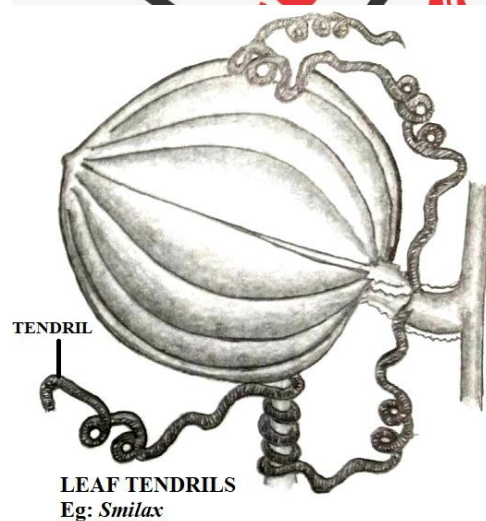
Leaf Modifications

In some plants, leaves involved to carry out special functions other than the normal ones through the modified structure are called leaf modifications. Leaves are modified for different functions such as protection, climbing, phyllode, reproduction and insectivorous purpose. The following are some important leaf modifications.

- 1. Spines:** spines are stiff with pointed tips formed by the modification of a whole leaf or a part of it. Development of spines is a xerophytic character, spines protect the plants from herbivorous animals. In *Zizypus* and *Acacia* stipules are modified into spines. Ex. *Opuntia*, *Pineapple*.
- 2. Leaf Tendrils:** tendrils are long slender sensitive structures which coils round the support in climbers. Tendrils are modified from whole leaf or part of a leaf. In case of *Smilax* the stipules are modified into tendrils. In *Gloriosa* the leaf apex, in *Pisum* terminal leaf lets are modified into tendrils. Tendrils are modified for climbing purpose in weak stemmed plants.

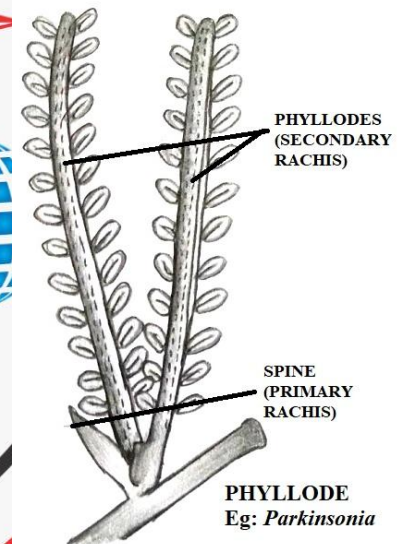


LEAF THORN
Eg: *Zizypus*



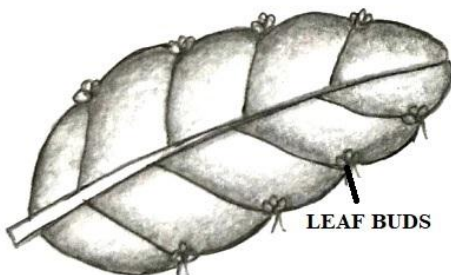
LEAF TENDRILS
Eg: *Smilax*

- 3. Phyllode:** phyllode is a modified expanded structure and carry out photosynthesis. In *Parkinsonia* secondary rachii of a bicomponent leaf modified into a phyllodes. The primary rachis is modified into a spine.



PHYLLODE
Eg: *Parkinsonia*

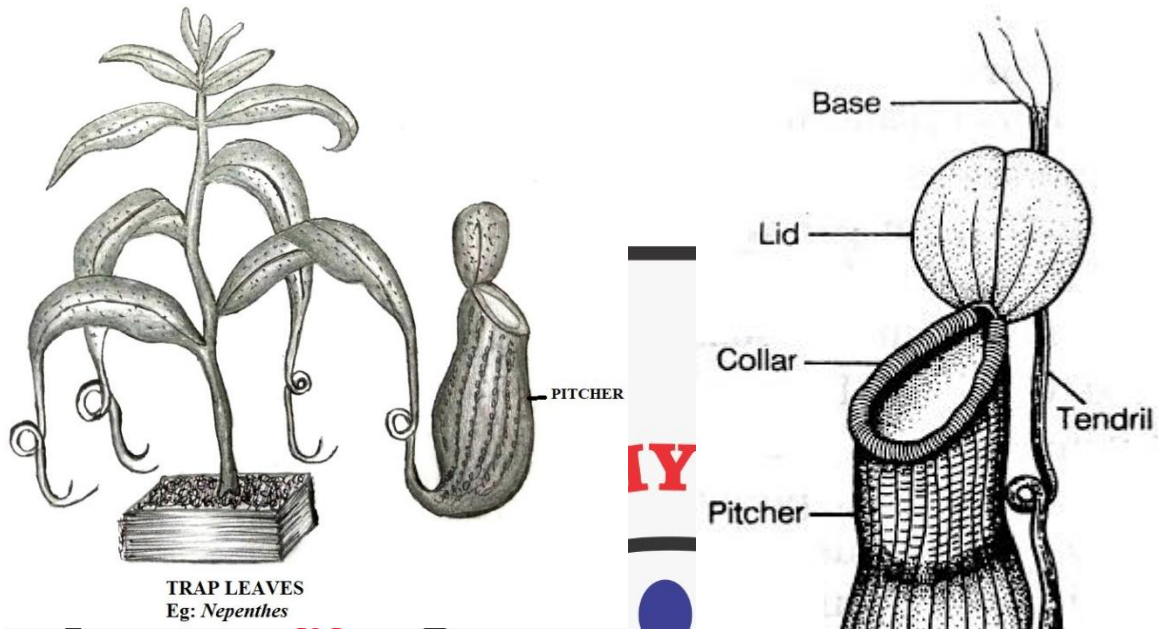
- 4. Leaf buds (Epiphyllous buds):** leaf buds are formed on leaves for reproductive purpose. These buds develop in the notches along the margin



LEAF BULBILS
Eg: *Bryophyllum*

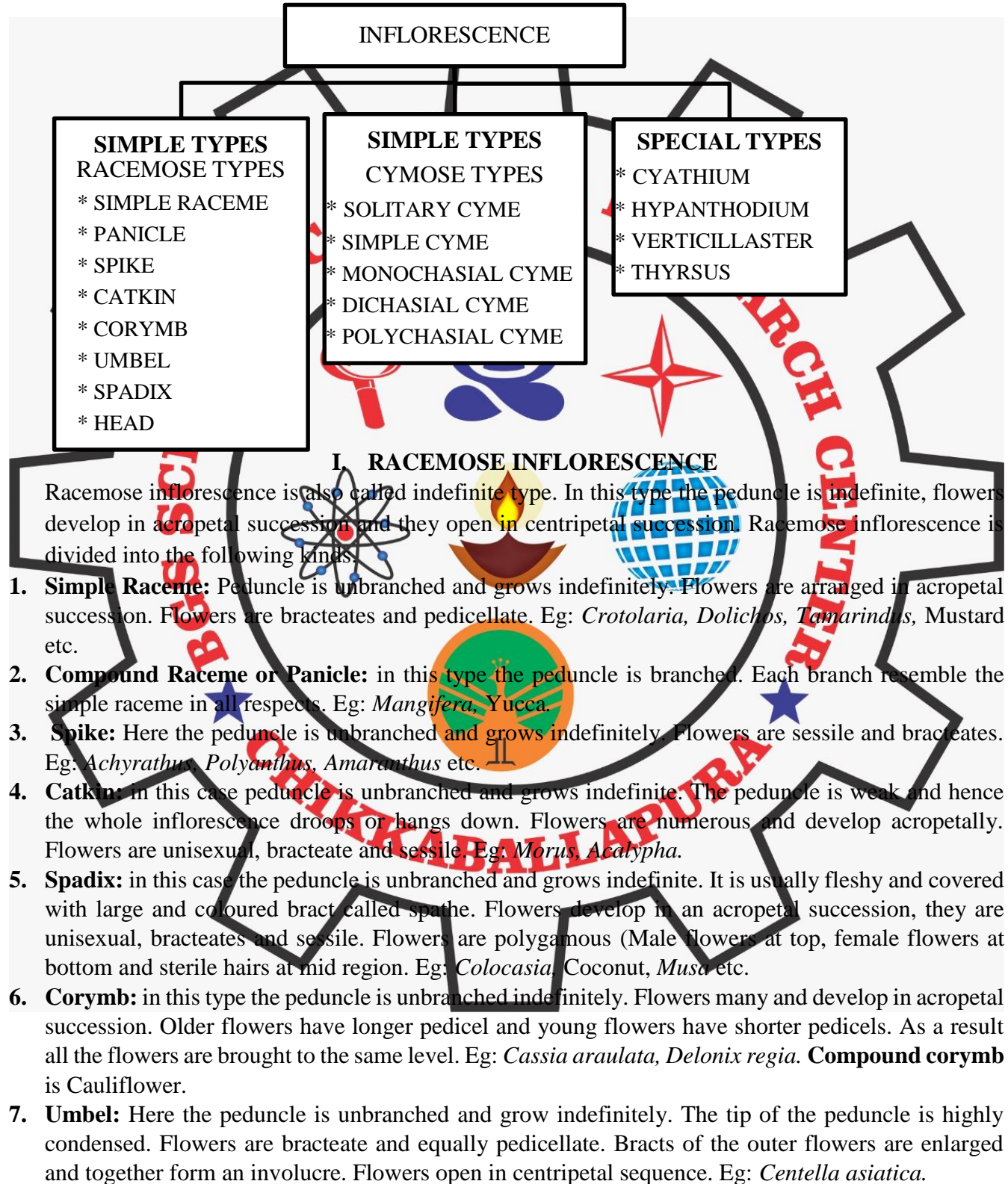
As they grow detaches from the mother leaves, each one grow into a new plant, leaf buds are modified from leaves meant for vegetative propagation. Ex: *Bryophyllum*, *Begonia*.

- 5. Trap leaves:** In some plants which are growing in soil deficient with nitrogen, leaves are modified into insect trapping structures to fulfil nitrogen deficiency. These plants are called insectivorous or carnivorous plants. In plants like *Nepenthes*, *Utricularia* and *Drosera* some of the leaves are modified into pitchers, bladders and spatulate trap leaves respectively.

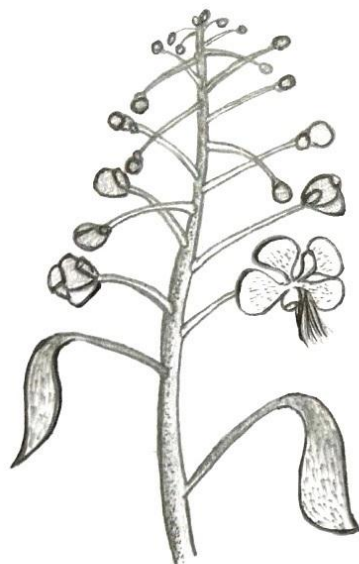


STUDY OF INFLORESCENCE

A group of flowers borne on a common axis is called inflorescence. The common axis bearing the flowers called peduncle. Stalk of the individual flower is called pedicel. Flowers develop on the peduncle in the axils of bracts. Inflorescence is classified based on the nature of peduncle, arrangement and sequence of opening of flowers into 3 types.



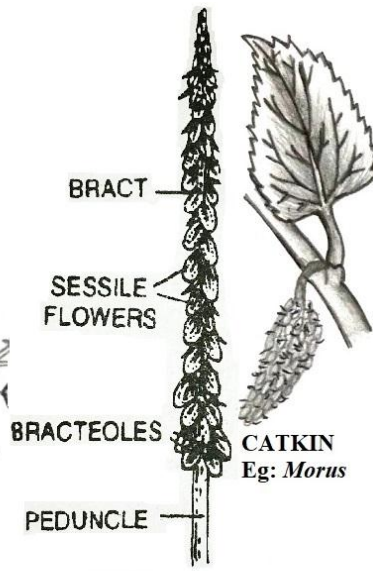
- 8. **Compound Umbel:** in this type peduncle is branched. Each branch resembles the simple umbel. Eg: *Coriander, Foeniculum, Daucus carota* etc.
- 9. **Head or Capitulum:** here the peduncle is highly condensed and disc like. Many small sessile flowers called florets develop compactly over this discoid peduncle. The florets open in centripetal order and they surrounded by an involucre of bracts. Eg: Sunflower.



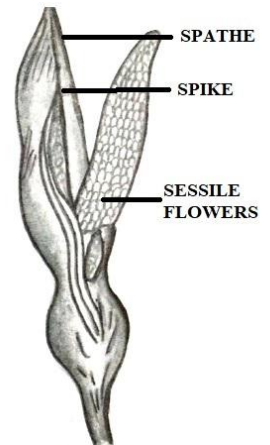
SIMPLE RACEME
Eg: *Crotalaria*



PANICLE
Eg: Mango



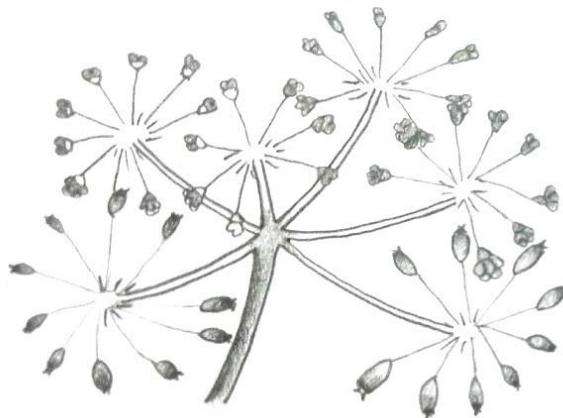
SPIKE
Eg: *Achyranthus*



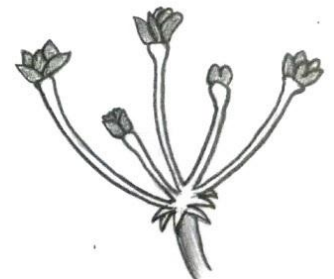
SPADIX
Eg: *Colocasia*



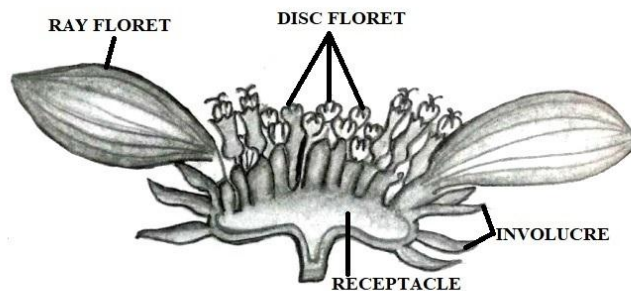
CORYMB
Eg: *Delonix*



COMPOUND UMBEL
Eg: *Coriander*



SIMPLE UMBEL

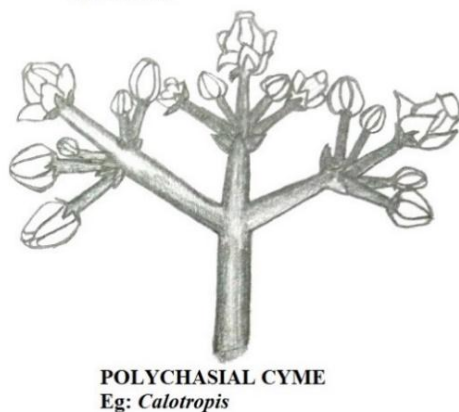
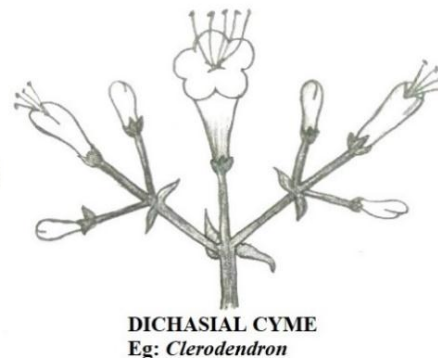


HEAD IN LONGITUDINAL SECTION

II. CYMOSE INFLORESCENCE

It is also called definite inflorescence. It shows the following characters. The growth of the peduncle is definite. Flowers develop in basipetal succession and open in centrifugal sequence. The following types are cymose inflorescence.

- 1.Solitary Cyme:** it is an inflorescence having only one flower. The tip of the peduncle ends in a flower, peduncle is unbranched and definite. Eg Cotton, Hibiscus etc.
- 2.Simple Cyme:** here the growth of peduncle is definite because it terminates in a flower. Below flower two branches develop laterally in the axis of opposite bracts and ends in flowers. There is no further growth of the inflorescence. Hence the simple cyme altogether consists of three flowers of which the central one is the oldest. Eg: Jasmine, *Bougainvillea* etc.
- 3.Monochasial Cyme:** Here the peduncle ends in a flower. Below this flower only one lateral branch develops from the axis of a bract. This branch also ends with a flower. Same process is continued since only one branch develops from below each flower, it is called monochasial cyme. It is of two types namely Helicoid cyme and scorpioid cyme. In helicoid cyme all the successive flowers bearing lateral branches are produced to the same side. Eg: *Hamelia patens*, *Drosera*. In Scorpioid cyme all the successive flowers bearing lateral branches are produced alternately towards both sides in zig – zag fashion. Eg: *Heliotropium indicum*, *Ranunculus*, *Rhipidium* etc.
- 4.Dichasial Cyme:** In this type the growth of peduncle is definite because it terminates in a flower. Below this flower two branches develop laterally in the axis of opposite bracts. These branches also end in a flower. Same type of growth is continued. Eg: *Clerodendron*.
- 5.Polychasial Cyme:** in this type the growth of the peduncle is definite because of the formation of a flower at tip. Below this flower three branches develops laterally in the axil of bracts. These branches also end in flowers. Same type of growth is continued. Eg: *Calotropis*, *Nerium* etc.

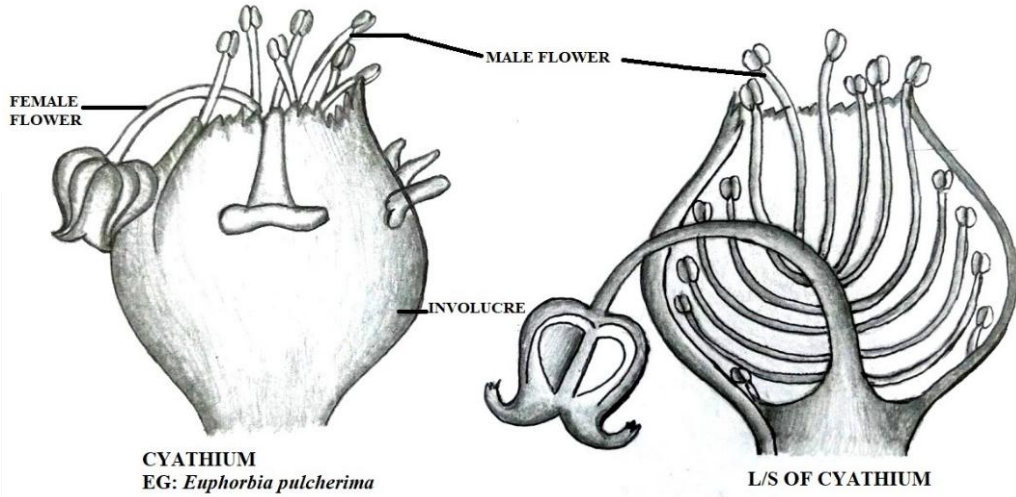


III. SPECIAL TYPE OF INFLORESCENCES

In some inflorescence the arrangement and opening of flowers are peculiar. They cannot be included under any type of inflorescence hence they are called as special types of inflorescences. The following are special types of inflorescence.

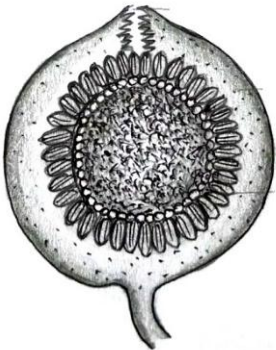
1. **Cyathium:** this is a special type of inflorescence. It is highly reduced and looks like a small flowers. In this case an involucre of bracts fuses to form a deep cup like structure called cyathium cup. Nectaries are present at the rim of the cup. Many unisexual male flowers arranged in 5 bundles in scorpioid manner around a single female flower. All flowers are naked. Eg: *Euphorbia*.
2. **Hypanthodium:** This is a special type of inflorescence. Here the receptacle is fleshy and forms hollow ball like structure with an apical opening. Three type of sessile flowers develop on the inner surface of the receptacle. The female flowers are towards the base, male flowers are towards the orifice or ostiole, and the short styled sterile female flowers (gall flowers) are in between. Eg: *Ficus* sps.
3. **Verticillaster:** This is a special type of inflorescence. Vertical means false whorl. The two cymose inflorescence develop from the axils of opposite leaves. Each inflorescent starts as a dichasial cyme. Its branches grow further in monochasial scorpioid manner. The two inflorescence together form a false whorl around the node. Eg: *Leucas*.
4. **Thyrus:** is also called mixed inflorescence because of having both racemose and cymose characters. In this case peduncle grows indefinitely, flowers in clusters are arranged acropetally, these are racemose characters. In each cluster there are six flowers arranged in the form of two simple cymes. This is a cymose character. Eg: *Ocimum*.



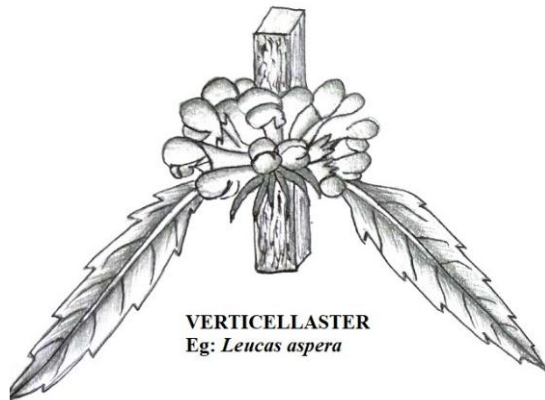


CYATHIUM
EG: *Euphorbia pulcherima*

L/S OF CYATHIUM



L/S OF HYPANTHIDIUM



VERTICILLASTER
Eg: *Leucas aspera*



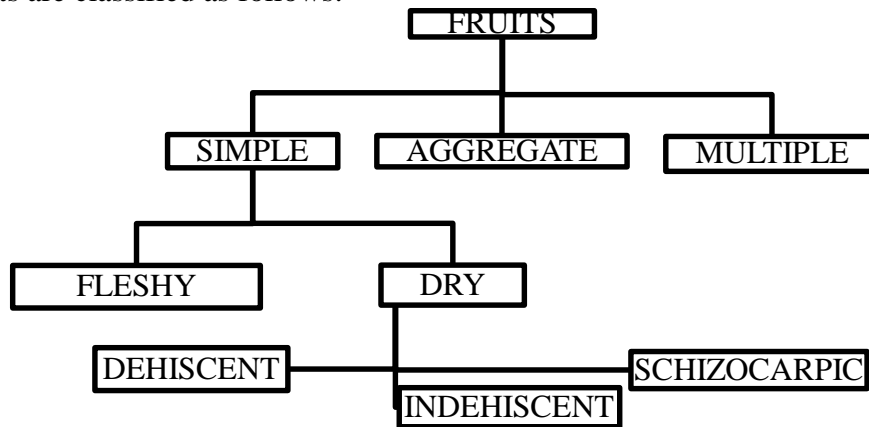
THYRSUS
Eg: *Ocimum sanctum*



STUDY OF FRUITS

Development of fruit or ripened ovary is a characteristic feature of angiosperms. Fruit is a product of sexual reproduction in angiosperms. It may be defined as a product of fertilization that develops from the ovary.

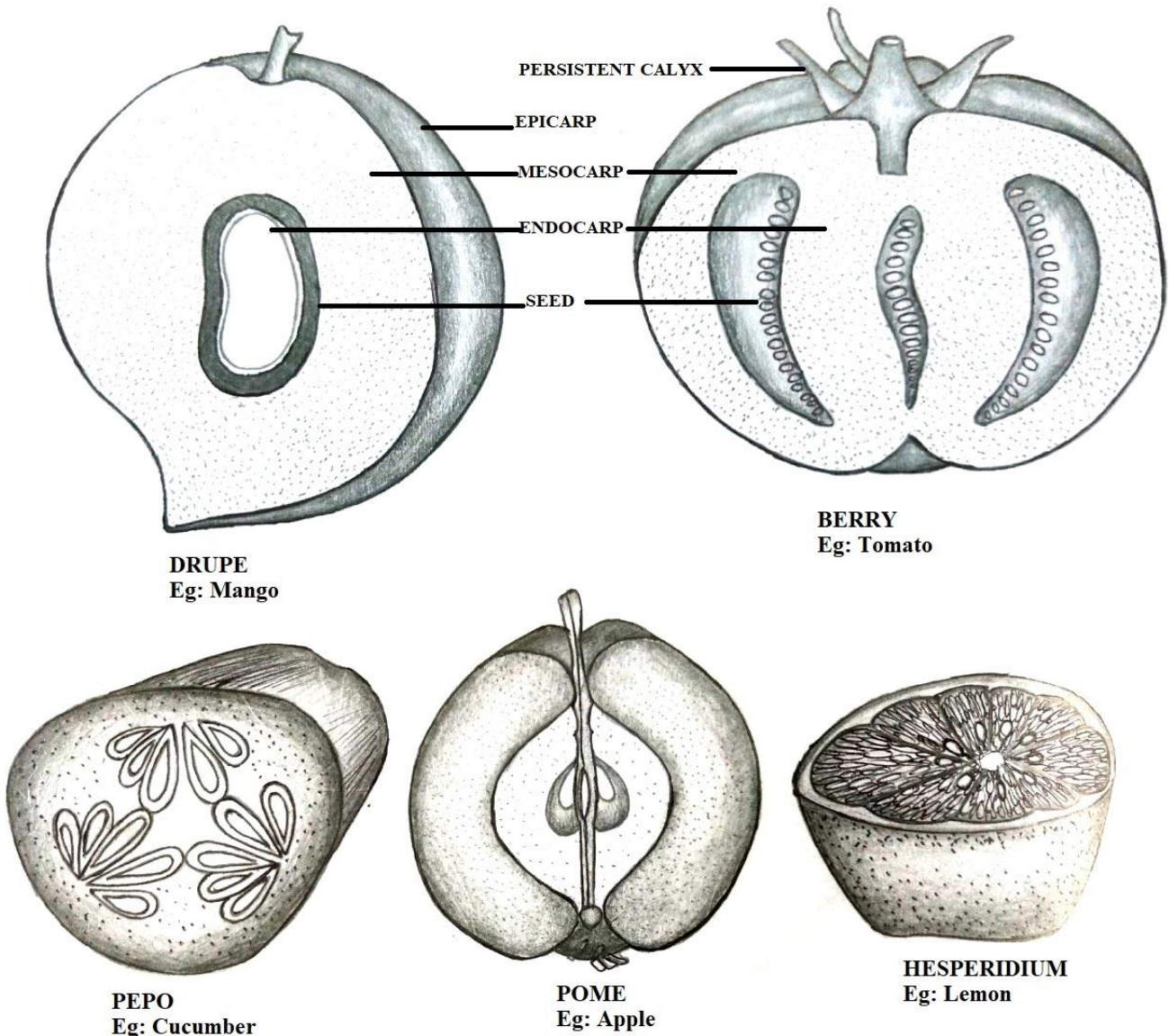
Fruits are classified as follows:



A. SIMPLE FRUITS: A fruit that develops from a monocarpellary or multicarpellary syncarpous ovary of a flower is called simple fruit. Depending on the nature of the pericarp (Pericarp or rind is used for the fruit wall, derived from the mature ovary wall. The pericarp is sometimes divisible into layers : Endocarp, Mesocarp and epicarp), simple fruits are divided into fleshy fruits and dry fruits.

i. Fleshy Fruits: Fruits with fleshy pericarp at maturity are called fleshy fruits. The fleshy pericarp consist of 3 layers i.e., outer Epicarp, middle mesocarp and inner endocarp. Fleshy fruits do not break to liberate their seeds. Seeds come out only after the decay of the fruit wall. Different types of fleshy fruits are:

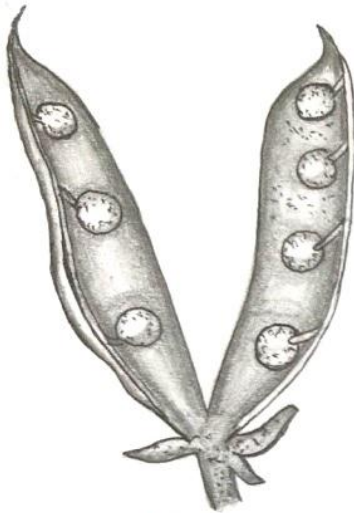
- i. Drupe:** It is a fleshy fruit develops from a superior ovary or an inferior ovary. The epicarp is thin, mesocarp may be fleshy or juicy or fibrous, endocarp is hard and stony and encloses the seed. Eg: mango, Coconut, *Zizypus*, *Terminalia* etc.
- ii. Berry:** it is a fleshy fruit develops from a superior ovary or an inferior ovary. The epicarp is usually membranous mesocarp. Endocarp and placenta are fleshy. Seeds are the only hard structures in berries. Eg: Tomato, Brinjal, Grapes etc.
- iii. Pepo:** This develops from inferior ovary which is unilocular or falsely trilocular having parietal placentation. The seeds remain attached to placenta. The outer ring is very hard as in Cucurbits.
- iv. Pome:** it is a fleshy fruit develops from an inferior, multicarpellary, syncarpous ovary. The thalamus develops into a large fleshy edible false fruit. True fruit is thin and cartilaginous. It is folded inwards to form many compartments. Eg. Apple, Pear etc.
- v. Hesperidium:** This is a fleshy fruit develops from multicarpellary, syncarpous ovary. Epicarp is thick, leathery and glandular. Mesocarp is fibrous and the endocarp is membranous and folded inwards to form 8 to 12 locules. Edible juicy hairs are multicellular out growths developed from the inner surface of carpel walls. Seeds are present on the axile placenta. Eg: Lemon, Orange etc.



2. **-Dry Fruits:** Fruits which have dry hard pericarp at maturity are called dry fruits. Dry fruits are divided into Dry dehiscent, Dry indehiscent and schizocarpic fruits.

I. Dry Dehiscent Fruits: Pericarp of these fruits breaks in different fashions to liberate the seeds. Following are the different types of dehiscent fruits.

- Legume:** This is a dry dehiscent fruit develops from a superior monocarpellary, unilocular ovary. The mature fruit breaks vertically both along ventral and dorsal sutures. As a result the pericarp is divided into 2 equal halves. Eg: Bean, Pea etc.
- Follicle:** This is a dry dehiscent fruit which breaks vertically along the ventral suture from the centre. It develops from a superior, unilocular ovary of a single carpel. Eg: *Calotropis*, *Vinca* etc.
- Siliqua:** This is a dry dehiscent fruit develops from a superior, bicarpellary, syncarpous, unilocular ovary. The ovary becomes bilocular due to the development of a false septum. The pericarp breaks vertically into two equal halves from base upwards. The seeds remain attached to the replum. Eg: Mustard, Iberis, Senebiara etc.



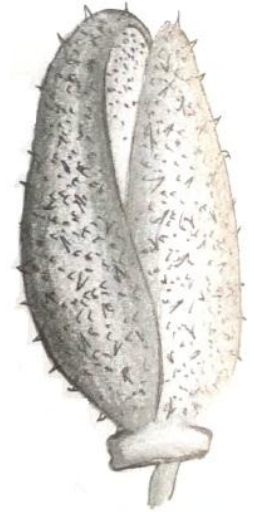
LEGUME
Eg: *Pisum*



FOLLICLE
Eg: *Calotropis*



SILIQUE
Eg: Mustard



CAPSULE
Eg: *Datura*

- d. Capsule:** this is a dry dehiscent fruit develops from a superior, multicarpellary, syncarpous ovary depending on the mode of breaking of the pericarp. Capsules are divided into – Septifragal capsule in which the pericarp breaks up into four valves, placental axis is not distributed. Eg: *Datura* etc.
- Septicidal Capsule: In which pericarp breaks along the septa and also at the placental axis. Eg: *Aristolochia*.
 - Loculicidal capsule: In which the pericarp breaks vertically along the middle of each locule. The placental axis also breaks. Eg: *Gossypium, Abelmoschus*, etc.
 - Poricidal capsule: In which the pericarp does not break but small pores are formed in the pericarp. Seeds come out of the capsule through pores. Eg: Poppy.

II. Dry Indehiscent Fruits:

Pericarp of these fruits does not break. Seeds germinate usually only after the decay of the pericarp. Dry indehiscent fruits are mostly single seeded. These are five types:

a. Caryopsis: it develops from a superior monocarpellary ovary having a single ovule. The seed coat and the fruit wall are inseparably fused. Hence these fruits look like seeds are called grains. Eg: Maize, Paddy, Jowar etc.

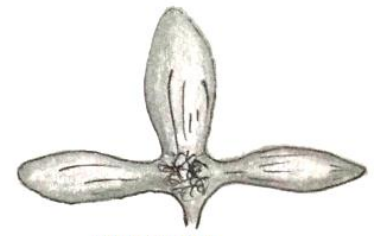
b. Cypselia: It develops from an inferior, bicarpellary,



CARYOPSIS
Eg: Maize



CYPSELA
Eg: Sunflower



SAMARA
Eg: *Hiptage*



NUT
Eg: *Anacardium*



ACHENE
Eg: *Mirabilis*



UTRICLE
Eg: *Amaranthus*

syncarpous, unilocular ovary having single ovule on basal placenta. The seed is freely placed in the fruit. Thalamus fused with the pericarp. Eg: Sunflower, *Tridax* etc.

- c. **Samara (Key fruit):** Winged dry indehiscent fruit is called samara. It develops from superior ovary with single seed. The wing may be produced from different parts of the flower. In *Hiptage* wings are formed from the pericarp.
- d. **Nut:** It develops from a superior ovary having one or more carpels. It has hard pericarp. Single seed is present in the fruit. Eg: *Anacardium*, *Quercus*.
- e. **Achene:** it develops from a superior, monocarpellary ovary having a single ovule. The seed is free from the pericarp. Eg: *Mirabilis*, *Ficus* etc.
- f. **Utricle:** It is similar to an achene, but the seed occupies a very small part of the fruit. Eg: *Amaranthus*.

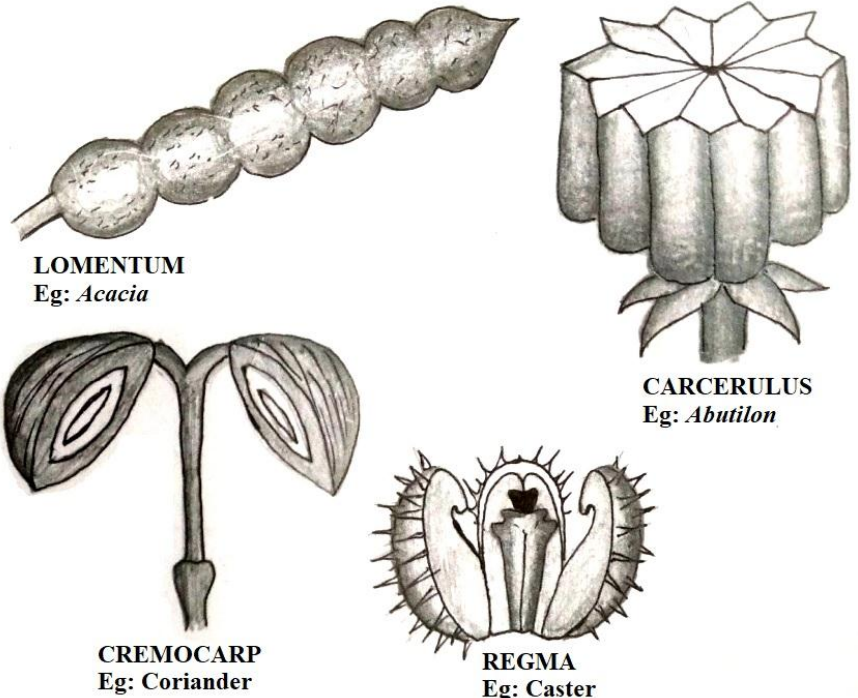
III. Dry Schizocarpic Fruits:

Schizocarpic fruits show the characters of both dehiscent and indehiscent fruits. The entire fruit breaks up into small one seeded units called mericarps or cocci usually seeds liberate only after the decay of the pericarp. The different types of schizocarpic fruits are:

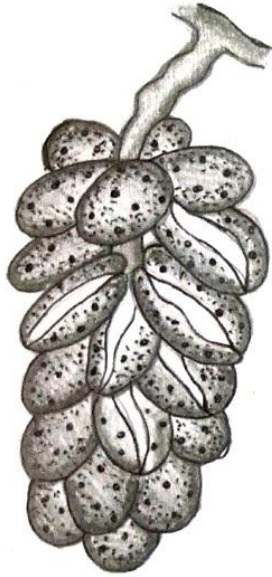
- a. **Lomentum:** this develops from the monocarpellary unilocular ovary. The fruit is constricted between the seeds which are arranged in a row. At maturity the fruit breaks between the seeds. As a result many one seeded mericarps are formed. Eg: *Acacia*, *Mimosa* etc.
- b. **Carcelurus:** this develops from inferior bicarpellary, syncarpous ovary. The pericarp splits along septa and fruit breaks into as many mericarps as there are carpels. Single seed remain within each mericarps. Eg: *Abutilon*.
- c. **Cremocarp:** this is developed from inferior, bicarpellary, syncarpous, bilocular ovary. The mature fruit breaks up vertically into 2 mericarps. The mericarps are attached to the tip of a branched carpophore. Eg: *Coriander*, *Fennel*.
- d. **Regma:** This is developed from a superior, tricarpellary, syncarpous, trilocular ovary. At maturity the fruit breaks up into three one seeded mericarps. Eg: *Caster*, *Euphorbia*, *Croton* etc.

B. Aggregate fruits: fruits which develops from a multicarpellary, apocarpous gynoecium of a flower is described as aggregate fruit. Here each individual carpel develops into a small fruit called fruitlet. Thus many fruitlets are formed from the same flower. All the fruitlets remains free and are collectively called etaerio or aggregate of fruits. Depending on the fruitlet nature aggregate fruits are classified into.

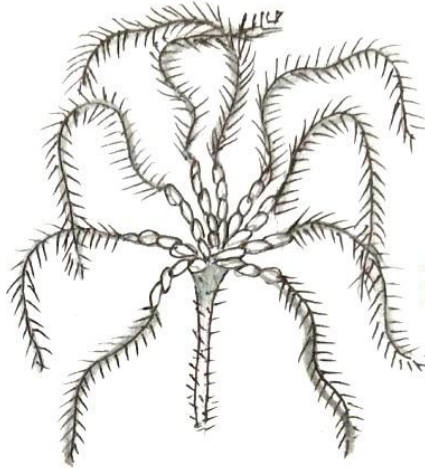
1. **Aggregate of follicles** – Eg. *Michelia*.
2. **Aggregate of Achenes** – Eg: *Naravelia*.
3. **Aggregate of Drupes** – Eg: *Rubus*.



4. Aggregate of Berries – Eg: *Annona*.



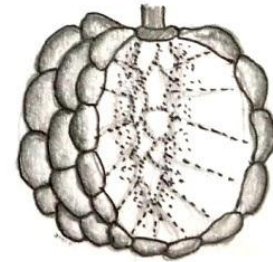
AGGREGATE OF FOLLICLES
Eg: *Michelia*



AGGREGATE OF ACHENES
Eg: *Naravelia*



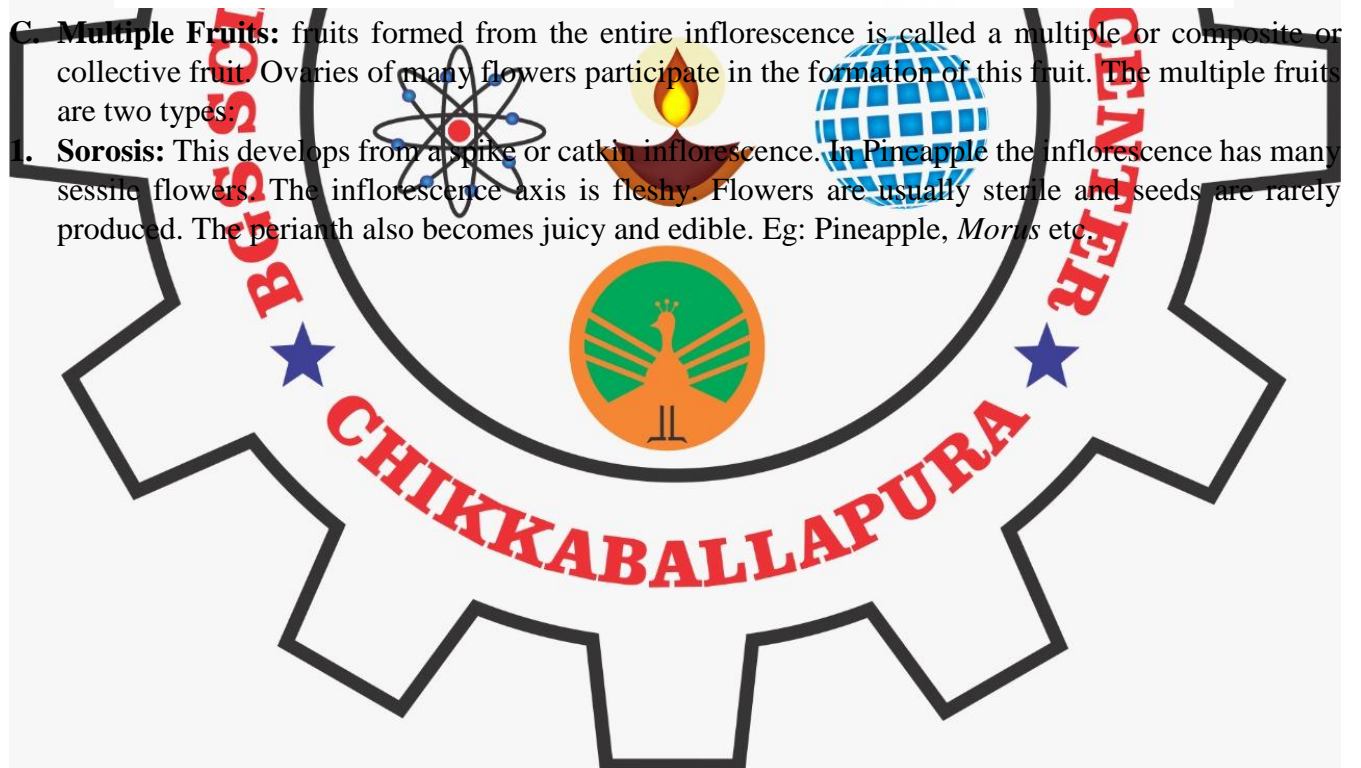
AGGREGATE OF DRUPES
Eg: *Rubus*



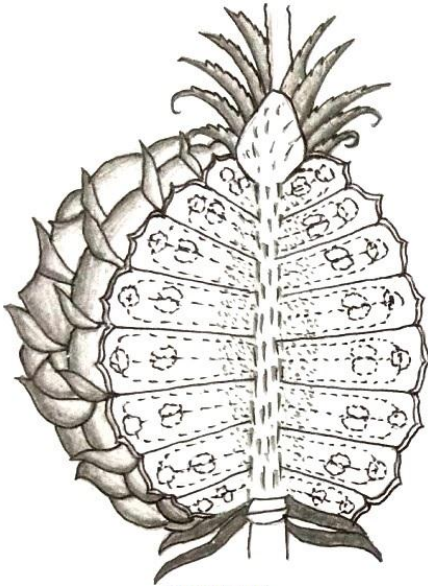
AGGREGATE OF BERRIES
Eg: *Annona*

C. Multiple Fruits: fruits formed from the entire inflorescence is called a multiple or composite or collective fruit. Ovaries of many flowers participate in the formation of this fruit. The multiple fruits are two types.

- 1. Sorosis:** This develops from a spike or catkin inflorescence. In Pineapple the inflorescence has many sessile flowers. The inflorescence axis is fleshy. Flowers are usually sterile and seeds are rarely produced. The perianth also becomes juicy and edible. Eg: Pineapple, *Morus* etc.



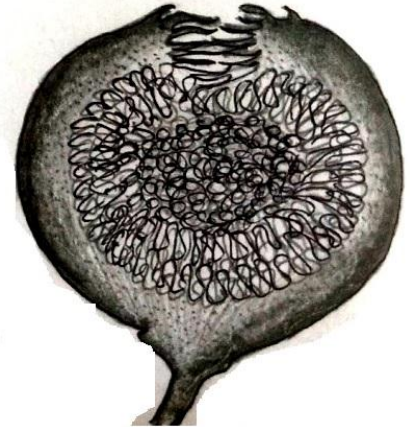
2. **Syconus:** this develops from a hypanthodium inflorescence. Here the inflorescence axis is a fleshy, hollow ball like structure. Each female flower produces a small achene. Thus large number of seed like achenes are enclosed inside the fleshy edible receptacle. Eg: *Ficus* sps.



SOROSIS
Eg: Pineapple



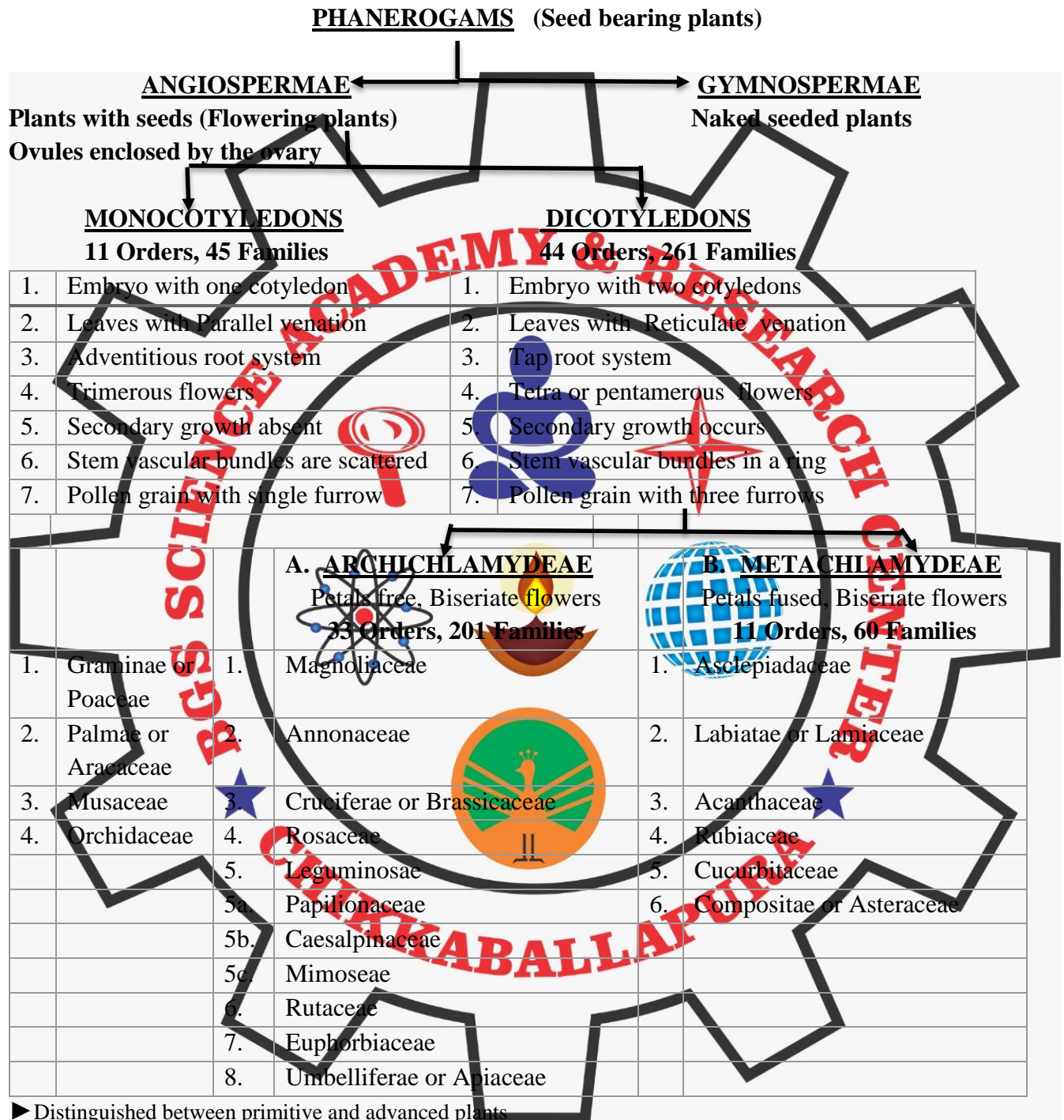
MULBERRY (*Morus*)



SYCONUS
Eg: *Ficus* sp.



OUTLINE CLASSIFICATION BY ADOLF ENGLER (1884-1930) AND KARL PRANTL (1849-1893) Published monographs in several volumes i.e., “Dienaturalichen Pflanzenfamilein” - Phylogenetic system.



▶ Distinguished between primitive and advanced plants

▶ This is the Phylogenetic system

▶ This system is widely accepted and adopted by the entire world.

▶ Phylogenetic arrangement of plant groups help us to understand the origin and diversification of plants during the course of its evolution

KEY CHARACTERS OF FAMILY: GRAMINAE OR POACEAE: Grass family- Herbs with round stem (culm) having hollow internodes. Leaves mostly flat, two ranked and usually with open leaf sheath. Inflorescence spikelet. Flowers bisexual, perianth lobes are indistinct. Bracts of glumes, lemma and palea. Ovary superior, single carpel with one ovule on basal placentation. Fruit a dry indehiscent caryopsis.

Systematic Position:

Class : Monocotyledonae
 Order : Glumiflorae
 Family : Poaceae
 Genus : *Oryza*
 Species : *sativa*

Technical description of *Oryza sativa*

Habit: Annual herb, cultivated as annual cereal in both tropical and temperate regions.

Root: The adventitious roots arise from the lower nodes of the plant and its tillers.

Stem: Erect, cylindrical, branched, hollow except at nodes, thick, nodes and internodes conspicuous, the internodes are covered by sheathing leaf bases.

Leaf: Simple with sheathing leaf base, alternate, sheath always encircled at the internode, ligulate, lamina long, linear, with rough surface, entire, acute with parallel venation.

Inflorescence: A terminal panicle. Panicle has a main axis called Rachis. It is divided into many lateral branches called rachilla on which flowers or spikelets are borne. Each spikelet has 2 alternately arranged small sterile glumes and 2 fertile glumes are arranged alternatively above. Fertile glume of outer one is called lemma. It is considered as bract. The inner one is called palea and it is considered as bracteole. The lemma is boat shaped, 5-nerved and hairy on the nerves. The apex is pointed and usually prolonged into an awn.

Flower: Bracteate, bracteolate, zygomorphic, hypogynous, irregular, complete, bisexual and sessile.

Perianth: The perianth is highly reduced and represented by two broad, thick and membranous structures called lodicules.

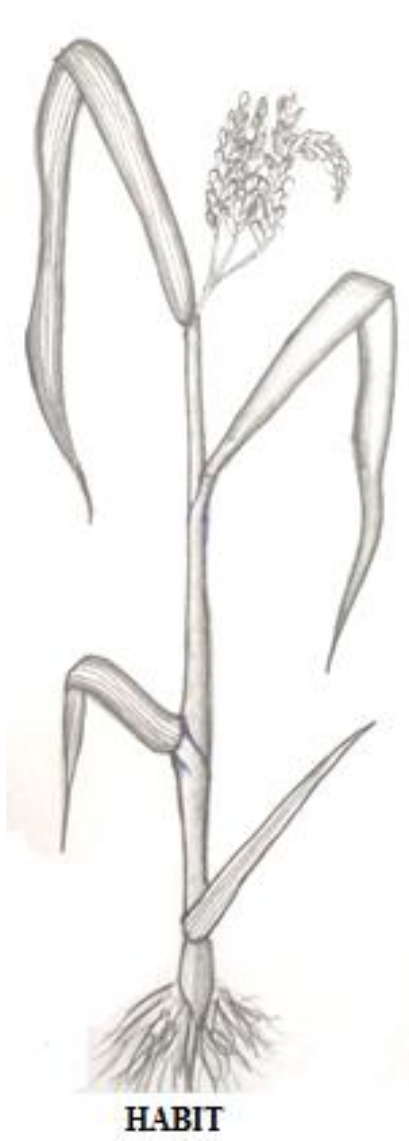
Androecium: Six stamens, arranged in two regular whorls. The filaments are long, slender and free; anthers bi-celled, versatile, introrse.

Gynoecium: monocarpellary, ovary superior, unilocular, longer than broad, single ovuled, anatropous ovule on basal placentation; the ovary is surrounded by two long styles with feathery stigmas.

Fruit: A caryopsis.

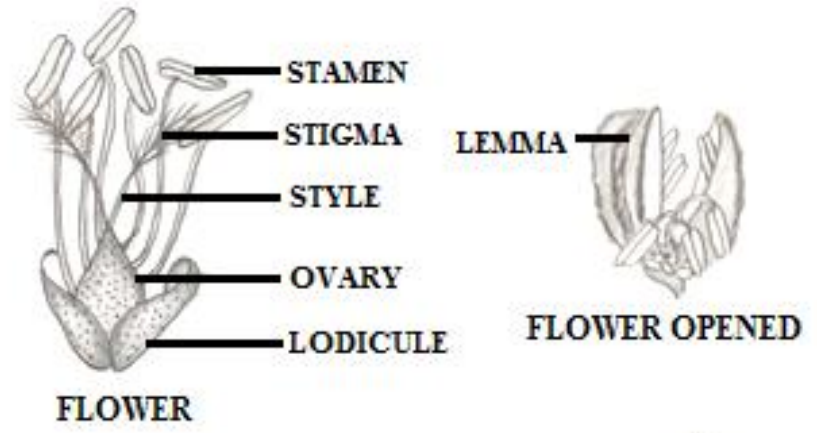
Seed: Albuminous.

Floral Formula:



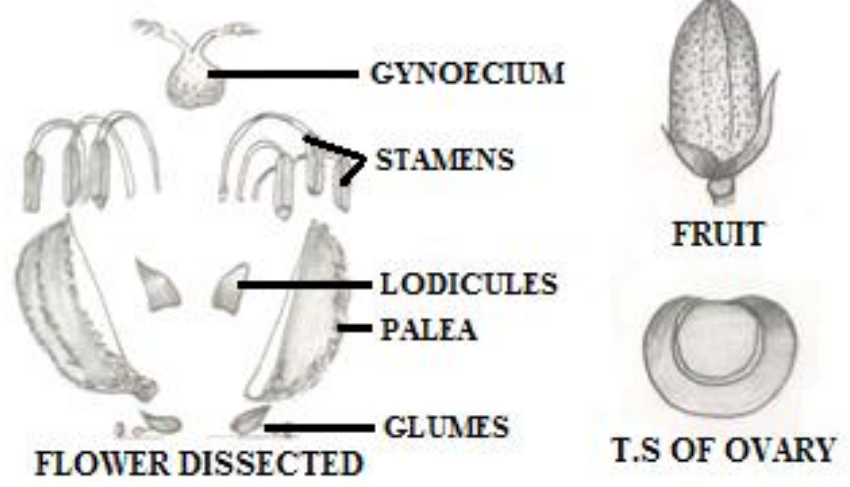
HABIT

Oryza Sativa



FLOWER

FLOWER OPENED



FLOWER DISSECTED

FRUIT

T.S OF OVARY



FLORAL DIAGRAM

Apluda mutica

Habit: Annual or perennial wild herb.

Roots: Fibrous or adventitious root system.

Stem: Erect, cylindrical, branched, hollow except at nodes, thick, nodes and internodes conspicuous, the internodes are covered by sheathing leaf bases.

Leaf: Simple with sheathing leaf base, alternate, sheath always encircled at the internode, ligulate, lamina long, linear, with rough surface, entire, acute with parallel venation.

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Perianth: The perianth is highly reduced and represented by two broad, thick and membranous structures called lodicules.

Androecium: 3 stamens, arranged in one whorl. The filaments are long, slender and free; anthers bicelled, versatile, introrse.

Gynoecium: Single carpel (monocarpellary); ovary superior, unilocular, longer than broad, single ovuled, anatropous ovule on basal placentation; the ovary is surmounted by two long styles with feathery stigmas.

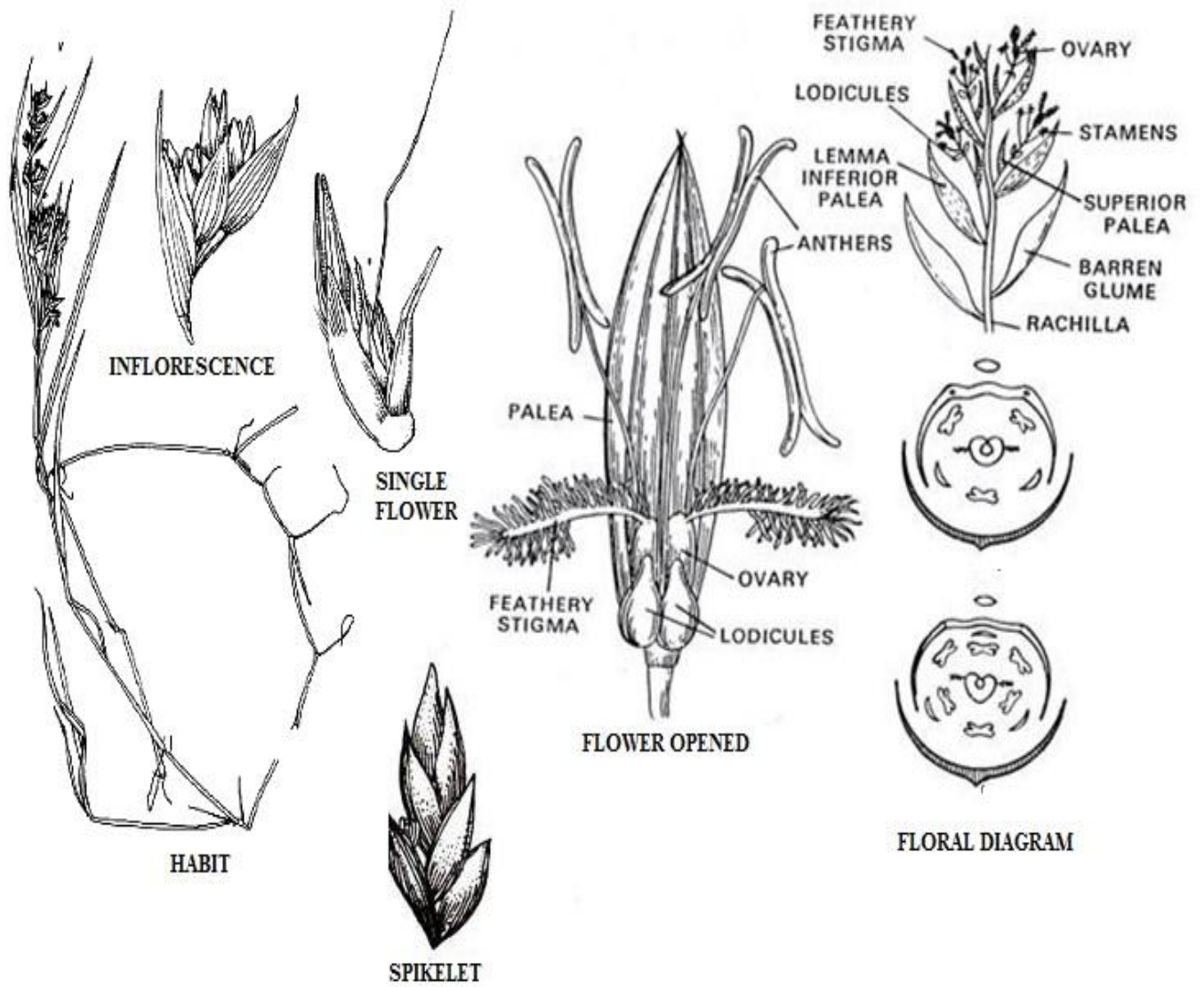
Fruit: A caryopsis.

Seed: Albuminous.

Floral Formula:



Apluda mutica



KEY CHARACTERS OF ARECACEAE:

Mainly trees with stout unbranched stem ending in crown of leaves, leaves large, compound, alternate, young leaves are plicate, exstipulate with long petioles, inflorescence enclosed in a persistent spathe, flowers unisexual, perianth 6 in two whorls of 3 each, in male flower 6 stamens in two whorls, anthers versatile, in female flowers- carpels three, apocarpous or syncarpous, superior, trilocular or rarely unilocular, fruit berry or drupe, seed endospermic.

Systematic Position:

Class : Monocotyledonae
 Order : Principes
 Family : Arecaceae
 Genus : *Cocos*
 Species : *nucifera*

Habit: It is a cultivated, large, unbranched, perennial tree.

Root: Adventitious roots arising from the base of bulbous stem.

Stem: Aerial, woody, erect, cylindrical, unbranched, old stem protected by woody leaf bases.

Leaves: Pinnately compound, alternate, crowded at the apex of stem, petiolate, leaf-base sheathing, broad and persistent, exstipulate, leaflets are 3-4 feet in length, linear, acute, thick, leathery, parallel venation

Inflorescence: It is branched panicle, usually a spadix with a woody spathe. Male flowers are of small size and produced in large numbers. The male flowers at the apex and the female flowers at the base.

Male Flower: Bracteate, Sessile or shortly pedicellate, bracteate, unisexual, actinomorphic, incomplete, trimerous, staminate

Perianth: Tepals 6, free, arranged in two whorls of 3 each, polyphyllous or slightly connate at the base, perianth lobes tough, persistent, coriaceous, leathery or fleshy, valvate or imbricate aestivation.

Androecium: stamens are 6 in number, two whorls of 3 each, polyandrous, anthers versatile, ditheous, basifixed or dorsifixed, introrse, filament short and distinct.

Gynoecium: Absent

Female Flower: Bracteate, Sessile or shortly pedicellate, bracteate, unisexual, actinomorphic, incomplete, trimerous, Pistillate, hypogynous

Perianth: As found in male flower.

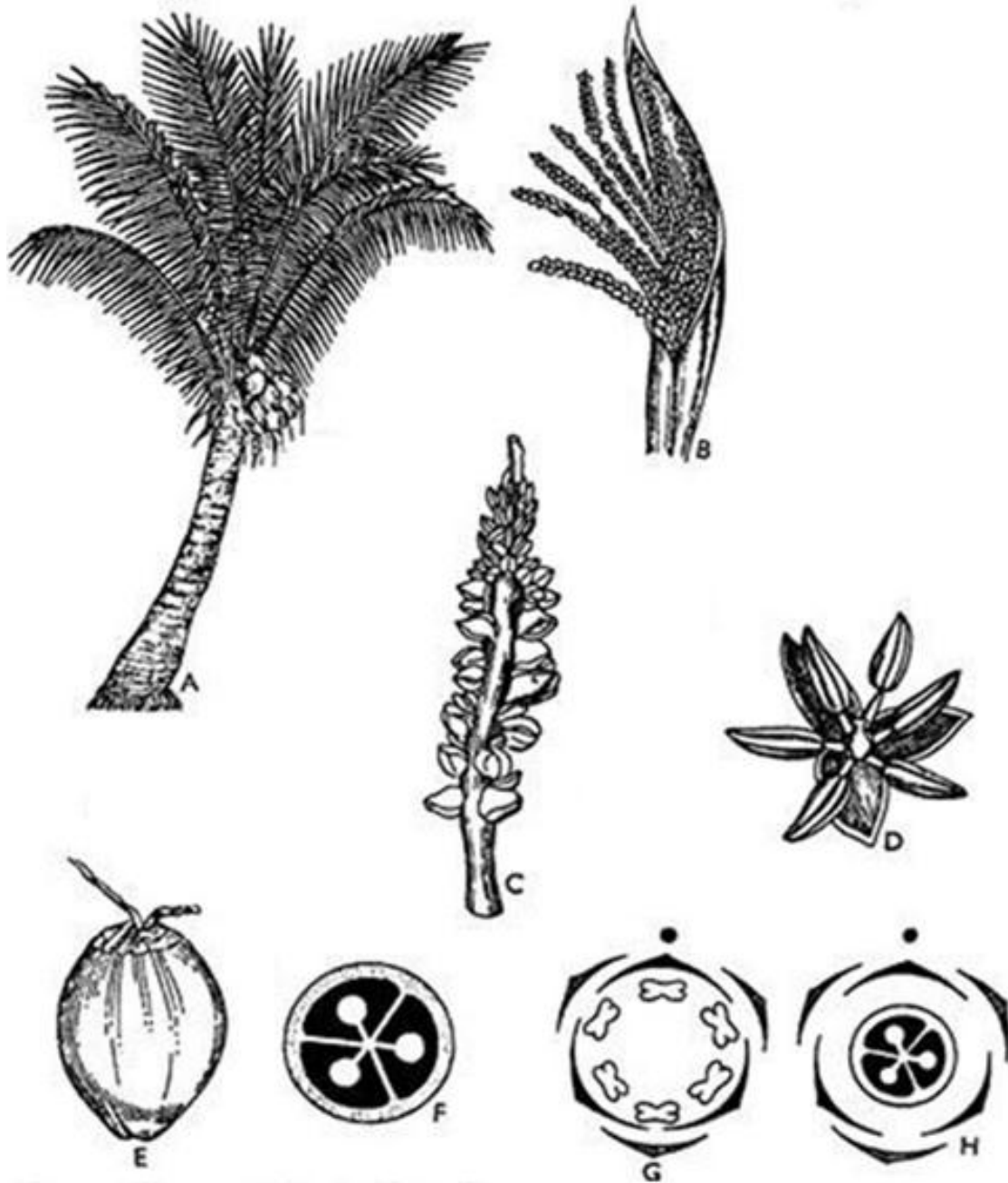
Androecium: Absent

Gynoecium: carpels 3 in number, syncarpous, ovary superior, trilocular, axile placentation, single ovule in each locule, style short, stigma small or broad or 3 lobed.

Fruit: Fibrous drupe.

Seed: Endospermic.

Floral formulae – Male flower : $\oplus \sigma P_{3+3} A_{3+3} G_0$
Female flower : $\oplus \rho P_{3+3} A_0 G_{(3) \text{ or } 3}$
Hermaphrodite flower : $\oplus \rho P_{3+3} A_{3+3} G_{(3) \text{ or } 3}$



Palmae (*Cocos nucifera*) : A. Plant with hanging fruits; B. Inflorescence; C. Single rachilla; D. Single staminate flower; E. Fruit with persistent calyx; F. T.S. of ovary; G. Floral diagram of staminate flower, and H. Floral diagram of pistillate flower

KEY CHARACTERS OF FAMILY: MUSACEAE: Banana family- Perennial herbs appear like trees, leaves are large forming crown at the apex of stout unbranched stem, pseudo stem present. Flowers unisexual or bisexual, stamens (5+1), 5 fertile, 1 staminode. Ovary inferior, tricarpeal, syncarpous. Fruit berry.

Systematic Position:

Class : Monocotyledonae
 Order : Scitaminae
 Family : Musaceae
 Genus : *Musa*
 Species : *paradisiaca*

Habitat: Mesophyte, cultivated as agricultural plant.

Habit: A perennial herb, appears like tree due to the development of false stem.

Root: Adventitious.

Stem: Actual stem is underground branched rhizome, the aerial erect columnar structure is pseudo stem, formed by the fusion of sheathing leaf bases rolled upon one another to form a pseudo aerial stem.

Leaf: Cauline, simple, alternate, exstipulate, large, broadly elliptical or oblong, entire, obtuse, petiolate (leaf base sheathing may be upto 6 feet in length, breaking transversely at maturity), furrowed midrib, unicostate with pinnately parallel venation.

Inflorescence: A spadix covered by thick violet pink spathe.

Flower: Ebracteate, ebracteolate, sessile, zygomorphic, complete, bisexual, trimerous, epigynous.

Perianth: Tepals 6, arranged in two whorls of 3 each, gamophyllous, superior; only one posterior tepal of inner whorl is free, innermost and boat-shaped, prolonged into an apical appendage, the outer whorl of 3 and inner whorl of 2 tepals united to form a tubular structure, imbricate or valvate aestivation.

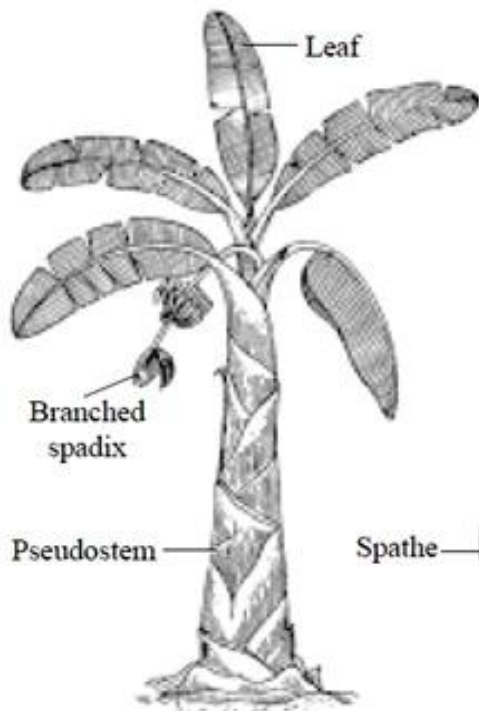
Androecium: Stamens 5, in two whorls, outer whorl of 3 and inner whorl of 2 stamens, posterior stamen of inner whorl is a staminode, filament long flattened, anther dithecous, linear, adnate and introrse.

Gynoecium: tricarpeal, syncarpous trilocular, inferior ovary, ovules many on axile placentation, abortive, ovary triangular, style long, simple, stigma capitate.

Fruit: Berry

Floral formula: $\text{Ebr } o|o \quad \text{♀ } P_{(3+2)+1} \quad A_{3+2+1} \text{ staminode } \overline{G_{(3)}}$

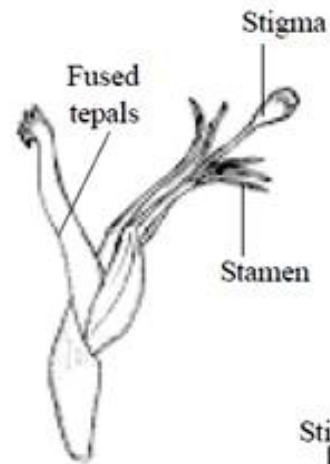




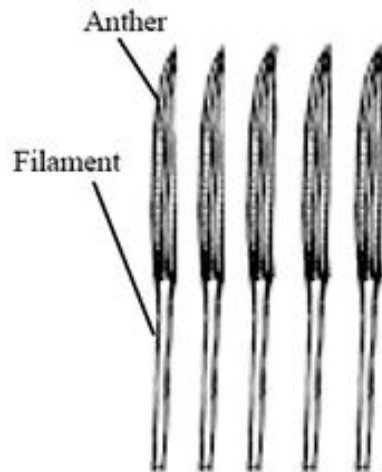
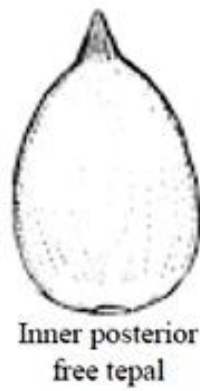
Musa paradisiaca



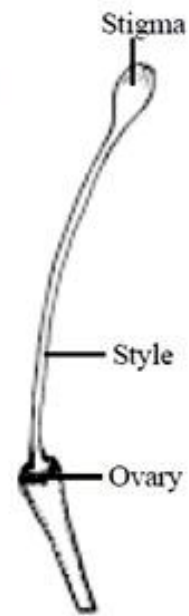
Spathe with flowers



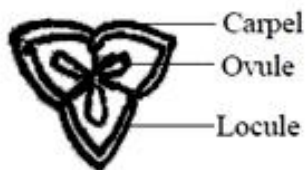
Bisexual flower



Stamens



⊗ Gynoecium



T.S. of ovary

Floral formula : Bisexual flower

Br., Ebrl., ⊗, ♀, P₍₃₊₂₎₊₁, A₃₊₃, G₍₃₎.

Musa paradisiaca



Floral diagram

KEY CHARACTERS OF FAMILY: ORCHIDACEAE: Orchid family- Perennial herbs, leaves two ranked, perianth inconspicuous. Flowers bisexual, zygomorphic, perianth (3+3), median lobe of inner whorl is modified into labellum. Stamens and stigma fused to form gynostegium or column or gynandrium. Rostellum and pollinia present. Ovary inferior, twisted, tricarpeal, unilocular, ovules many, minute in size on parietal placentation. Fruit Capsule.

Systematic Position:

Class : Monocotyledonae
 Order : Microspermae
 Family : Orchidaceae
 Genus : *Vanda*
 Species : *roxburghii*

Habitat: Epiphytic plant growing on tree trunks.

Habit: Perennial Herb.

Root: Fibrous with 3 types namely, clinging root for fixation, absorptive roots for absorption of minerals and hanging or Aerial roots for absorption of moisture from atmosphere.

Stem: Erect, cylindrical, branched, partially covered with sheathing leaf base. Sometimes modified into pseudo bulbs.

Leaf: Simple with sheathing base, lanceolate, exstipulate, thickly coriaceous, fleshy, entire with parallel venation.

Inflorescence: Terminal racemes.

Flower: Pedicellate, bracteate, Bisexual, complete, zygomorphic, homochlamydeous, trimerous, epigynous, very showy, sweet scented.

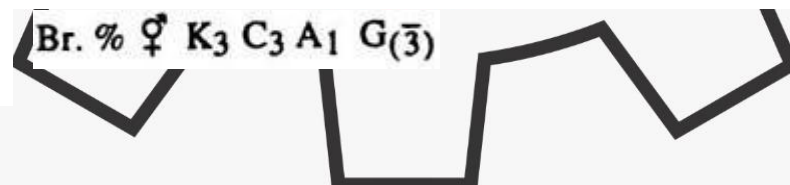
Perianth: Tepals 6, arranged in two whorls of three each, petaloid, tepals of outer whorl are equal. The lateral tepals of inner whorl are equal and the remaining posterior one is larger and brightly coloured called labellum, Free.

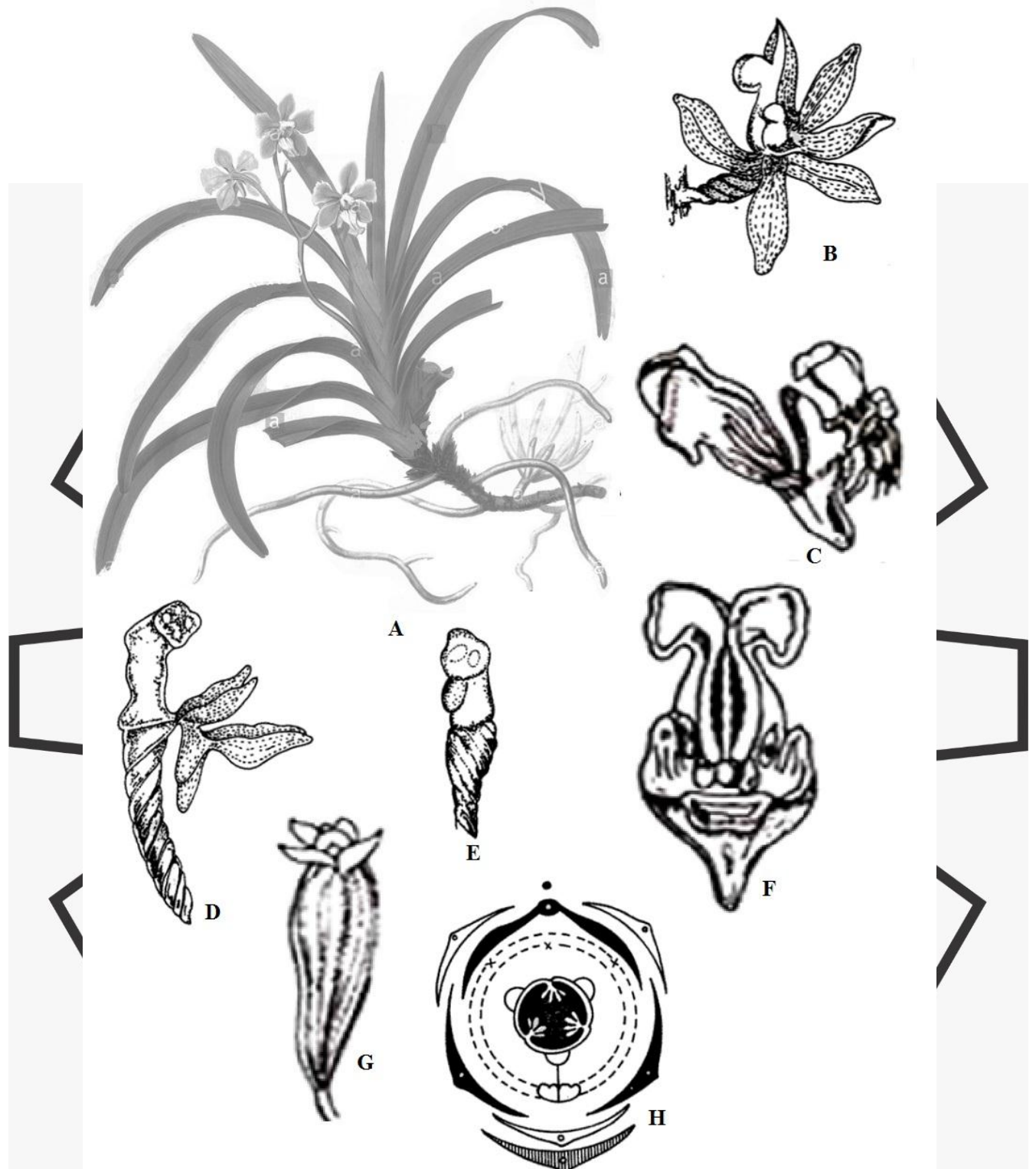
Androecium: Stamens -6, but under considerable modification into staminodes. Only one is fertile, filament and style united (Gynandrous) to form a structure called Gynostegium (Column). Anther lies on the top of rostellum. And it is attached to the column at its back by a short filament, anther 2-celled, pollinia -2.

Gynoecium: Carpel -3, syncarpous, stigma 3, the lateral 2 are fertile, and the third one is sterile, ovary inferior, many ovules on parietal placentation.

Fruit: Capsule

Floral Formula:





**A. FLOWERING TWIG B. FLOWER C. BACK VIEW OF THE FLOWER
 D. DISSECTED FLOWER SHOWING RESUPINATE OVARY, COLUMN, STIGMA,
 ANTHAR AND LABELLUM E. OVARY WITH COLUMN AND STIGMAS AND
 ANTHAR F. COLUMN G. FRUIT H. FLORAL DIAGRAM**

Vanda roxburghii

KEY CHARACTERS OF MAGNOLIACEAE: Magnolia family-Trees or shrubs, leaves simple, alternate. Leaves stipulate (Bud scales) a circular stipular scar. Flowers are large, showy, fragrant, perianth parts 6-18, tepals free, stamens indefinite (numerous) spirally arranged on the extended thalamus called torus below the carpels. Ovary polycarpellary, apocarpous, superior. Sepals similar to petals. Fruit eteario of follicles or berries.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Ranales
 Family : Magnoliaceae
 Genus : *Michelia*
 Species : *champaca*

Habitat: Mesophytic widely growing graceful, ever-green tree with dark-grey bark and also cultivated for the fragrance of flowers.

Habit: Medium sized perennial tree.

Root: Tap root, branched.

Stem: Aerial, erect, hard, woody, branched, cylindrical, differentiated into nodes and internodes, aromatic oil glands present.

Leaf: Ramal, alternate, stipulate, stipules convolute, petiolate, slightly pulvinate, simple, ovate or oblong-lanceolate, entire with acute apex, coriaceous, glabrous, dark green, unicostate with reticulate venation.

Inflorescence: Solitary or axillary cymose clusters.

Flower: Bracteate, bracteolate (Cyclic) pedicellate, pedicel short, complete, regular, actinomorphic; bisexual, homochlamydeous, hypogynous, spirocyclic, pale-yellow, very fragrant and large.

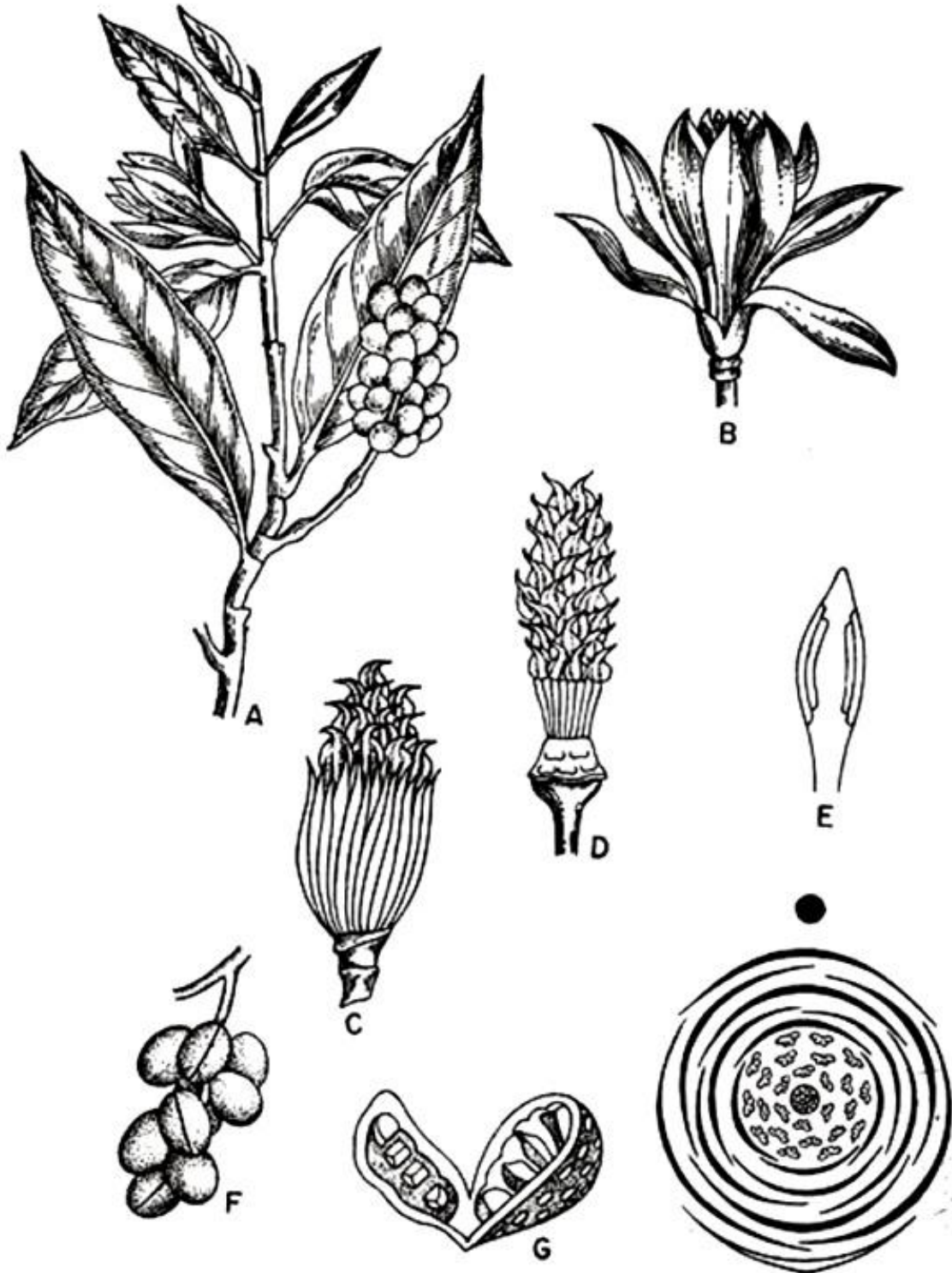
Perianth: Usually 9 -15 tepals, polytepalous, arranged in 3-5 whorls. pale yellow in colour, fragment with imbricate aestivation.

Androecium: Indefinite or many, polyandrous, spirally arranged on the extended thalamus called torus, below the carpels , distinguished into filament, connective and anther lobes, ditheous, basifixed, dehiscence longitudinal, introrse.

Gynoecium: Polycarpellary, apocarpous; superior ovary, spirally arranged on a cone like and elongated thalamus above the stamens; each carpel with a swollen ovary, unilocular, one to many ovules in each locule on marginal placentaion. Curved style and beaked with simple stigma,

Fruit: An etaerio's or aggregate of follicles, dark coloured with white specks.

Seed: Large, endospermic, endosperm copious, embryo small.



Michelia champaca Linn. A—Branch with leaves and fruits ($\times \frac{1}{2}$); B—Flower ($\times \frac{1}{2}$); C—Flower with perianth segments removed ($\times 1$); D—Carpels ($\times 1$); E—Stamen showing broad filament, long anther lobes and protruded connective; F—Aggregate fruit ($\times \frac{1}{4}$); G—Split follicle.

KEY CHARACTERS OF ANNONACEAE: Custard apple family- Woody shrubs, trees or climbers. Leaves exstipulate, aromatic with gland dotted, sepals distinct, trimerous, stamens indefinite (numerous), polycarpellary, apocarpous, superior ovary. Perianth lobes 3+3 or 3+3+3. Fruit is Aggregate or etaerios.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Ranales
 Family : Annonaceae
 Genus : *Annona*
 Species : *squamosa*

Habitat: Mesophyte, widely growing in waste lands, some are cultivated for its fruit in horticultural fields.

Habit: Medium sized tree usually aromatic and perennial.

Root: Tap root system.

Stem: Erect, Woody, cylindrical, branched, with distinct nodes & internodes, aromatic oil glands present.

Leaf: Cauline, ramal, simple, alternate, exstipulate, petiolate, lanceolate, entire, acute, lqmina glabrous with gland dotted, unicostate with reticulate venation.

Inflorescence: Extra axillary cymose.

Flower: Pedicellate, Bracteate, ebracteolate, actinomorphic, Bisexual, complete, regular, trimerous, aromatic, homochlamydeous and hypogynous.

Perianth: Tepals 6, free, arranged in two whorls of three each. Tepals of outer whorl are small, inner whorl of the tepals are thick, large, basally saccate on inner side attached to convex receptacle with valvate aestivation.

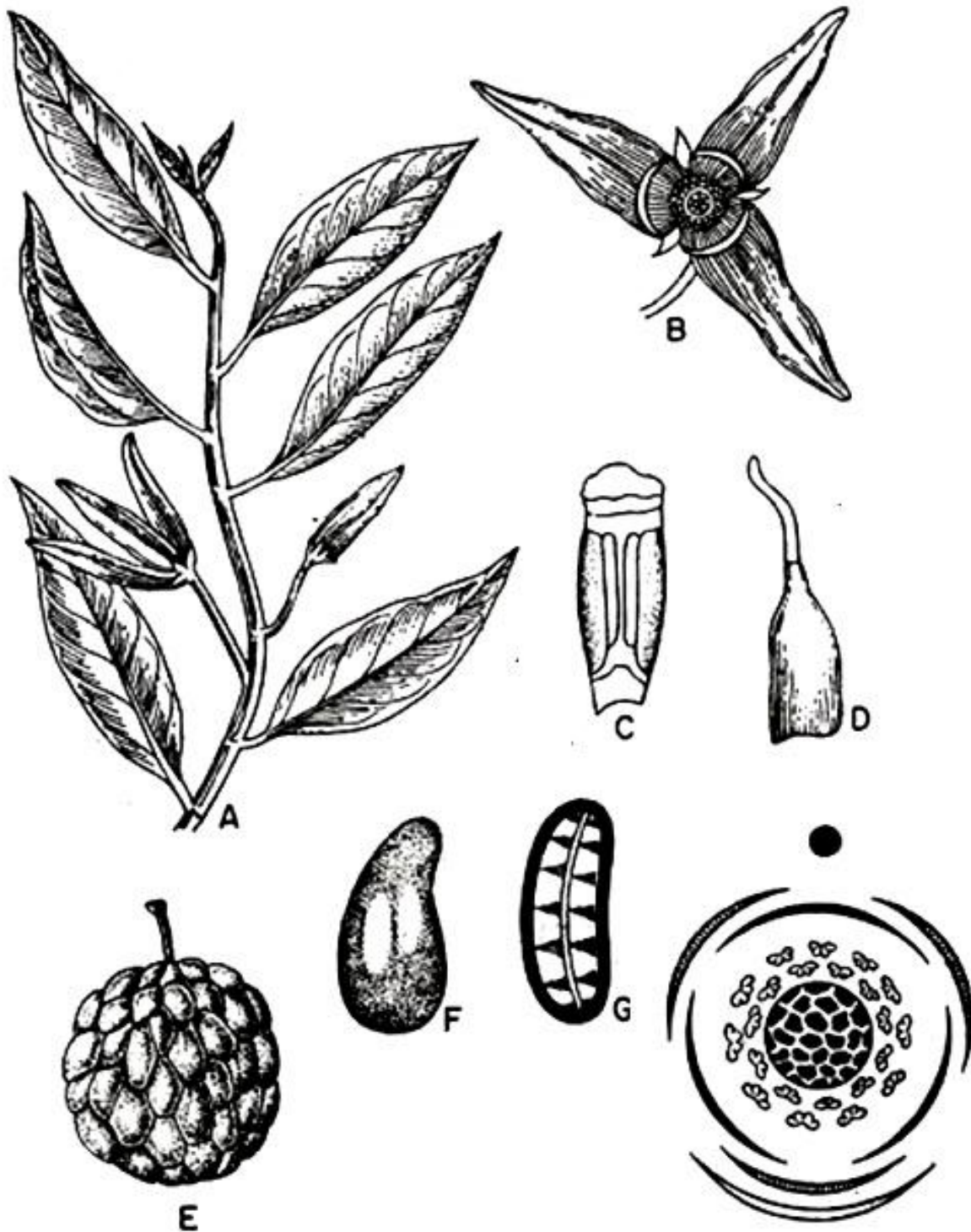
Androecium: Stamens many, free, filament short, spirally arranged on the conical receptacle at the base. The anthers lobes are thick, adnate and filament extend over the anther lobes, dithecous, extrorse.

Gynoecium: Carpels many, free, spirally arranged on axis, above the stamens, ovary superior, each carpel with single ovule on marginal placentation, style flat & short, stigma simple.

Fruit: Aggregate (etaerio of berries).

Seed: Ruminant endospermic dark coloured with a hard and shiny seed coat.

Floral Formula: $\oplus \varnothing K_3 C_{3+3} A_\alpha G_\alpha$ or (α)



Annona squamosa Linn. A—Branch with leaves and flowers ($\times \frac{1}{2}$); B—A flower ($\times 1$); C—Stamens; D—one carpel; E—Fruit ($\times \frac{1}{2}$); F—Seed; G—Same in l.s. (C & D much enlarged, F & G—slightly enlarged).

Systematic Position:

Class	: Dicotyledonae
Subclass	: Archichlamydeae
Order	: Ranales
Family	: Annonaceae
Genus	: <i>Artabotrys</i>
Species	: <i>odoratissimus</i>

Habitat: Mesophyte, widely growing and some are cultivated in gardens.

Habit: It is an ornamental, evergreen, aromatic, perennial, prickly shrub, climbs with the help of hooks.

Root: Tap root system.

Stem: Erect, woody, cylindrical, branched, with distinct nodes & internodes, climbing with the help of hooks, bark contain oil glands.

Leaf: Cauline, ramal, simple, alternate, exstipulate, petiolate, lanceolate, entire/wavy, acute, glossy, unicostate with reticulate venation.

Inflorescence: Extra axillary or solitary cyme, (arising on the peduncle with curves into hook for climbing).

Flower: Pedicellate, Bracteate, ebracteolate, actinomorphic, Bisexual, complete, regular, trimerous, aromatic, homochlamydeous and hypogynous.

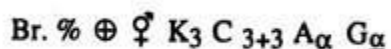
Perianth: Tepals 9, free, arranged in three whorls of three each. Tepals of outer whorl are free, small, the tepals of the middle whorl are large, thick broadly saccate and tepals of the inner whorl are small with valvate aestivation.

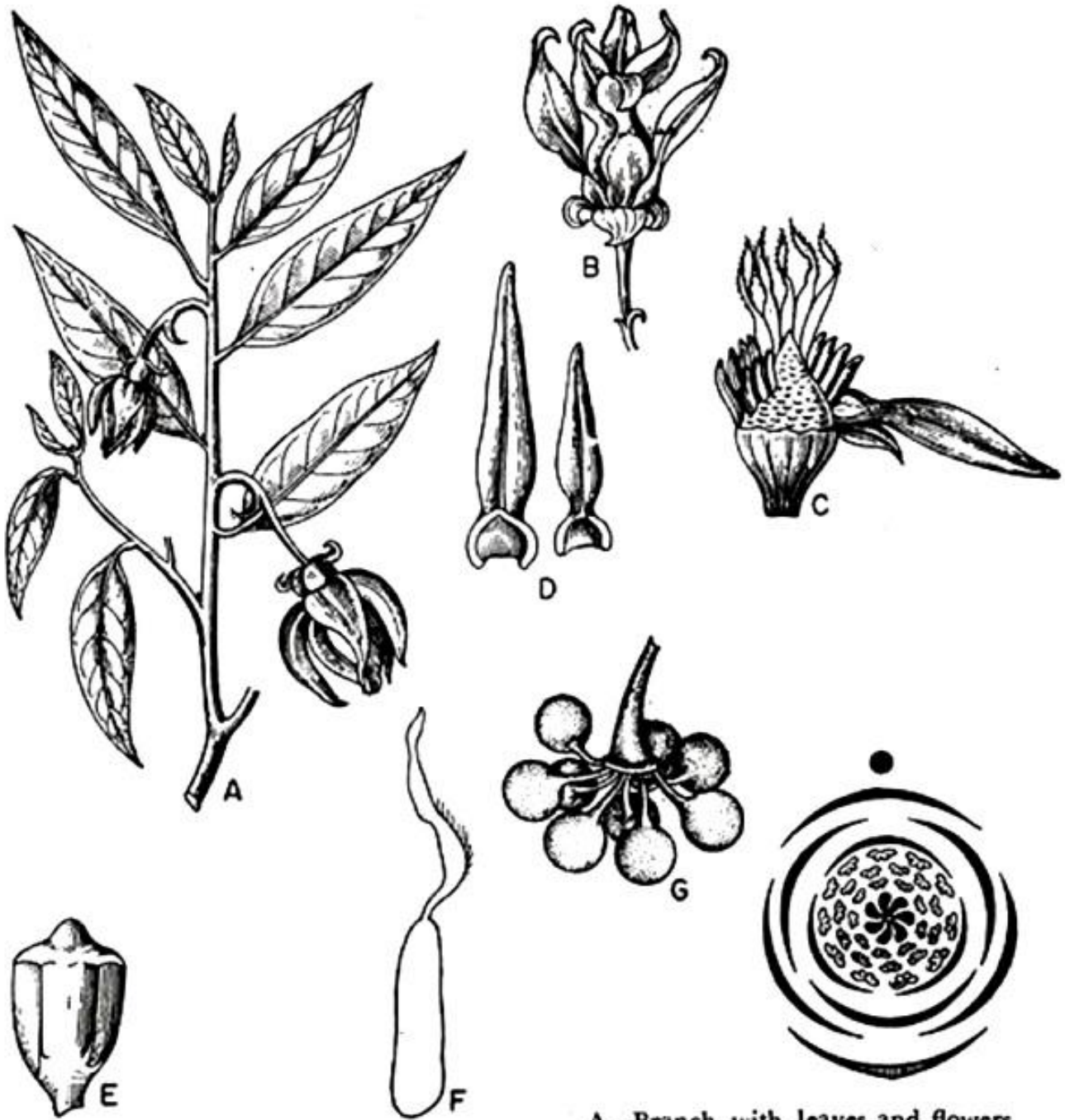
Androecium: Stamens many, free, filament short, spirally arranged on the convex receptacle at the base. The anthers lobes are thick, adnate and filament extend over the anther lobes, dithecous, introrse and inserted.

Gynoecium: Carpels many, free, spirally arranged on the conical receptacle, above the stamens, ovary superior, each carpel with single ovule on marginal placentaion, style short, single, stigma simple.

Fruit:

Aggregate (etaerio of berries).

Floral Formula:



A—Branch with leaves and flowers ($\times \frac{1}{3}$); B—One flower ($\times \frac{1}{2}$); C—Stamens and carpels spirally arranged on a conical receptacle; D—Petals, outer longer, inner shorter; E—subsessile stamens; F—Carpel with flat style; G—Cluster of berries ($\times \frac{1}{3}$).

Artabotrys odoratissimus

KEY CHARACTERS OF CRUCIFERAE OR BRASSICACEAE: Mustard family- herbs with smelling watery juice. Flowers tetramerous, sepals four, petals four. Cruciform corolla; each petal is having narrow claw and expanded limb. Tetradynamous stamens (2+4), ovary superior with a false septum, carpels two. Fruit siliqua or silicula.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Rhodales
 Family : Brassicaceae
 Genus : *Brassica*
 Species : *campestris*

Habitat: Mesophyte, cultivated for seeds.

Habit: Ephemeral, pungent sulphurous odour herb.

Root: Tap root system and branched.

Stem: Aerial, erect, branched, Herbaceous, cylindrical, differentiated into nodes and internodes, glabrous, hollow contain yellowish latex with sulphurous odour.

Leaf: Cauline, ramal, simple, alternate, exstipulate, petiolate, lower leaves are lyrate and upper leaves are lanceolate with unicostate reticulate venation.

Inflorescence: Terminal simple raceme.

Flower: Ebracteate, ebracteolate, pedicellate, actinomorphic, complete, bisexual, tetramerous, cruciform and hypogynous.

Calyx: 4 sepals, polysepalous, arranged in two whorls of two each. The inner lateral sepals are sometimes pouched at the base and serve as nectar containers. Aestivation is imbricate aestivation.

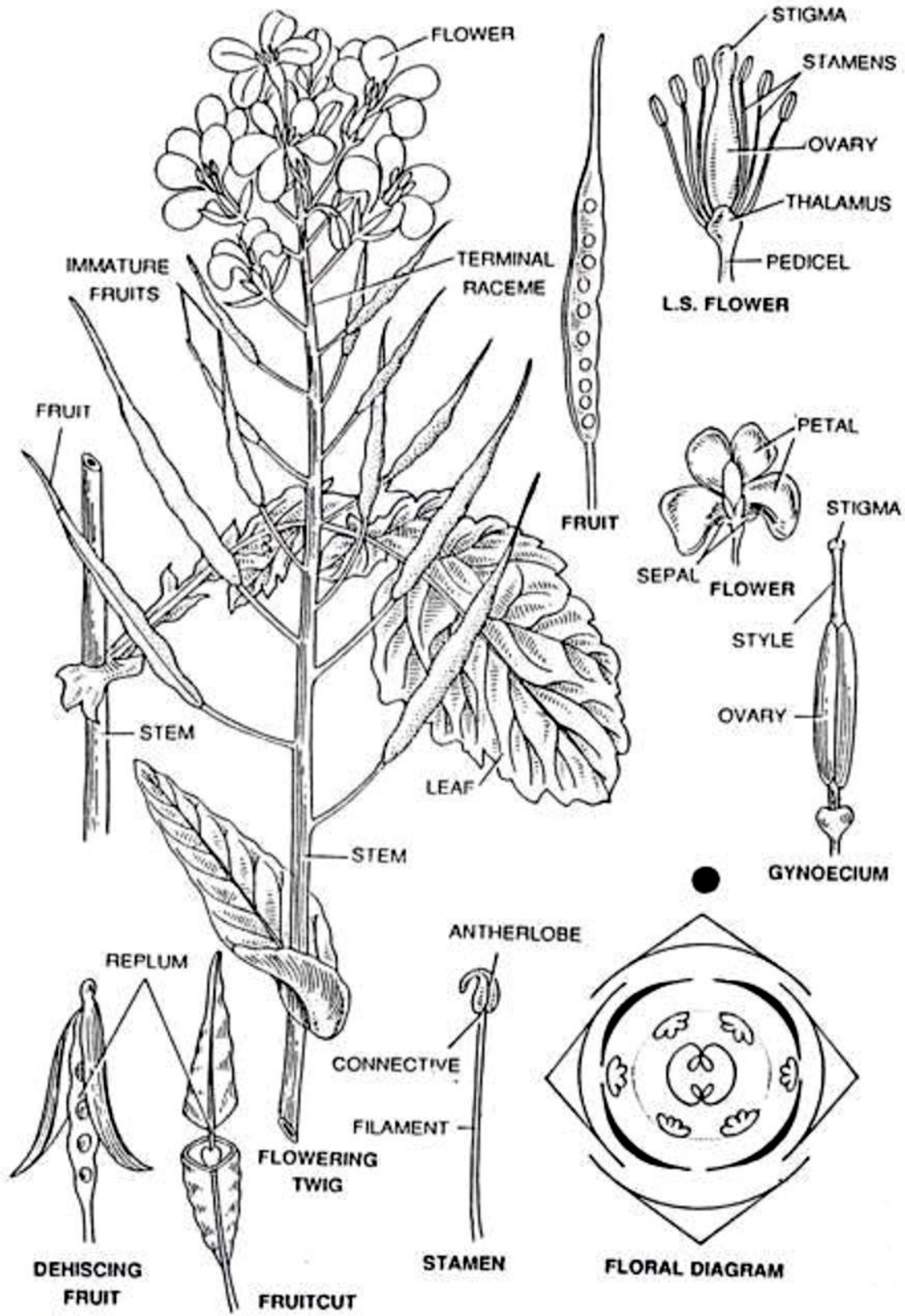
Corolla: Petals 4, polypetalous, cruciform arranged in a single whorl. These are alternate to the sepals. Each petal is differentiated into a narrow claw and a broad expanded limb, valvate aestivation.

Androecium: 6 stamens, arranged in two whorls of 2 and 4. Outer two stamens are short and inner 4 stamens are long (tetradynamous). At the base of the outer two short stamens are present green glands or nectaries. Anthers are bilobed, basifixed and introse.

Gynoecium: Bicarpellary, syncarpous, superior ovary, unilocular, but becomes bilocular (due to the development of false septum or replum from the ingrowths of the parietal placentae). Placentation is parietal. Ovules are anatropous or campylotropous. Style is short with bilobed stigma.

Fruit: Siliqua.

Seed: Small, nonendospermic with 2 cotyledons.



Cruciferae (Brassicaceae). *Brassica campestris* Linn.

KEY CHARACTERS OF ROSACEAE: Rose family- Perennial shrubs or trees, Leaves stipulate (Adnate stipules), sepals synsepalous, flowers pentamerous, actinomorphic, stamens numerous and usually in multiples of 5, ovary superior or inferior or perigynous. Fruit is a collection of achenes, drupe or pome.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Rosales
 Family : Annonaceae
 Genus : *Rosa*
 Species : *indica*

Habitat: Mesophyte, cultivated in gardens for the fragrance of flowers.

Habit: It is an ornamental, perennial prickly shrub.

Root: Tap root system.

Stem: Aerial, erect, branched, prickly, solid, woody, cylindrical and differentiated into nodes and internodes.

Leaf: Cauline, ramal, Compound, bipinnately imparipinnate, petiolate, stipulate (stipules adnate to the petiole), leaflets serrate, ovate, acute, uncostate, reticulate venation.

Inflorescence: Flowers terminal or axillary solitary cymose.

Flower: Pedicellate, bracteate (bracts rarely persistent), rosaceous, heterochlamydeous, actinomorphic, complete, bisexual, perigynous, flowers are white, yellow, red or pink coloured with scented.

Calyx: Five sepals, gamosepalous, narrowly lanceolate, inferior, calyx-tube persistent, adnate to the gynoecium with imbricate or quincuncial aestivation.

Corolla: Five to indefinite petals, inserted on the rim of the cup polypetalous large, brightly coloured, showy, scented, imbricate aestivation in bud, inner whorl of the petals are modified into stamens.

Androecium:

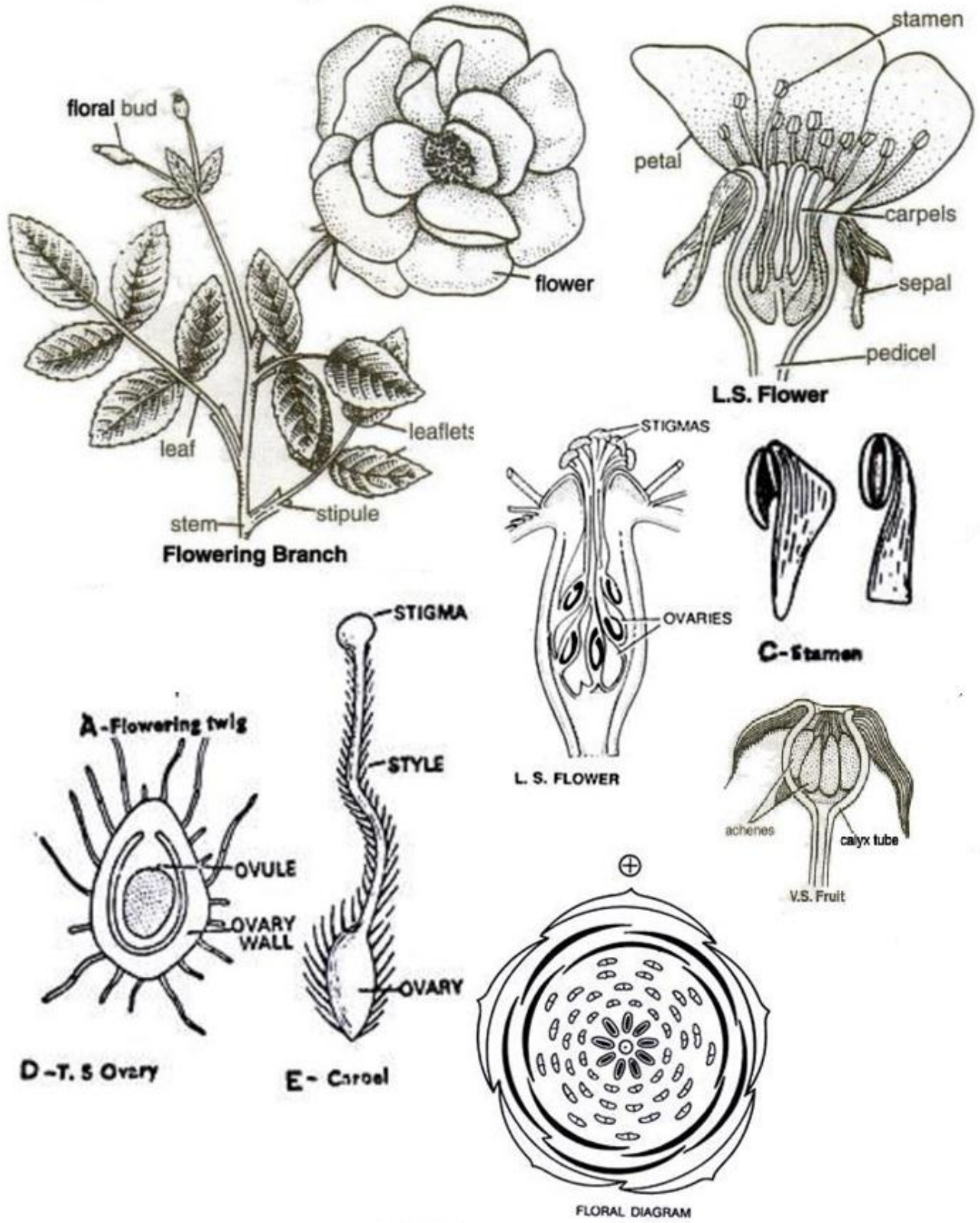
Stamens many, inserted on the rim of the cup or disc, polyandrous, inferior, anthers bicelled, dorsifixed, introrse. Outer whorl of the stamens are modified into petals.

Gynoecium: Many carpels, apocarpous, found in the bottom of calyx cup, each carpel has a single ovary, half superior, unilocular with single ovule on basal placentation. Style is subterminal, single, stigma thickened, single.

Fruit: An etaerio of achenes.

Seeds: Exalbuminous.

Floral formula:



Rosaceae—*Rosa indica*, Eng., rose; Verna. Gulab, Jangligulab.

KEY CHARACTERS OF FAMILY LEGUMINOSAE: legume family- plants are herbs, shrubs, trees or vines. Leaves simple or pinnately compound, rarely palmately compound, alternate or opposite, usually stipulate, petiole base pulvinus, calyx with odd sepal anterior, fruit is pod or legume.

KEY CHARACTERS OF SUBFAMILY: PAPILIONACEAE: Flowers zygomorphic, papilionaceous corolla, i.e., consisting of standard 1, 2 wings and 2 keel, corolla aestivation descendingly-imbricate, posterior petal is outermost, petals 5 but anterior petals basally fused. Stamens monadelphous or diadelphous.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Rosales
 Family : Leguminosae
 Subfamily : Papilionaceae
 Genus : *Crotalaria*
 Species : *juncea*

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Habit: The plants are either herbs or shrubs; cultivated for fibre (*Crotalaria juncea*-Indian sunn hemp-Verna-San) and seeds, some are ornamentals.

Root: Taproot and branched, nodulated, nodules contain nitrogen fixing bacteria.

Stem: Erect, branched, cylindrical, pubescent, green, sometimes grooved.

Leaves: Alternate, petiolate, simple or compound, if compound it is trifoliate rarely 5 to 7 foliate, digitate (usually all leaflets born at the apex of the petiole), stipulate (minute stipules), leaflets are linear or oblong, entire, shining silky hairs on both the sides, net veined.

Inflorescence: Flowers arranged in solitary or racemose inflorescences, the flowers are being arranged in either terminal, lateral or leaf opposed racemes.

Flower: Pedicellate (short peduncle), zygomorphic, irregular, hermaphrodite, complete, hypogynous, bracteate, usually large and showy.

Calyx: 5 sepals, gamosepalous, sub-bilabiate, the upper lip bifid, the lower cordate trifid, the teeth being linear or lanceolate.

Corolla: 5 petals, polypetalous, papilionaceous; standard usually broad and shortly clawed; the wings obovate oblong, the keel is broad and nearly equal to wing in size, petals of keel are united, incurved and beaked; descending imbricate aestivation; usually yellow coloured, sometimes pink and purplish, big and showy.

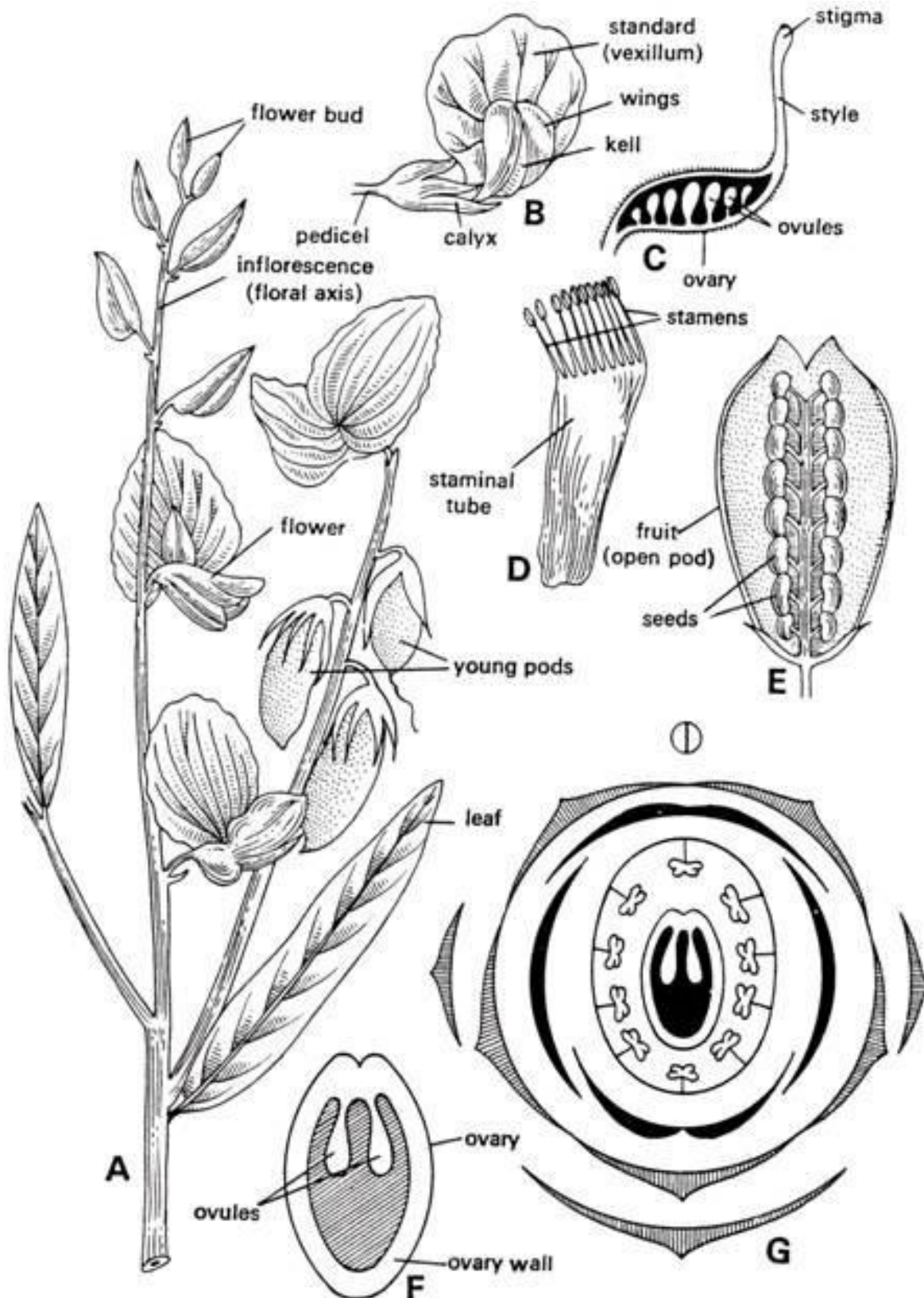
Androecium: 10 stamens, monadelphous, connate, the anthers are 2-celled, dimorphous, dehiscence by longitudinal slits.

Gynoecium: One carpel (monocarpellary), ovary superior, unilocular, many ovuled sessile, style long, strongly incurved or reflexed, somewhat bearded (hairy), the stigma is small and oblique, placentation marginal.

Fruit: Legume or pod, globose or oblong sessile, turgid or inflated, with many loose seeds.

Seeds: Exalbuminous, small, usually flat, different coloured.

Floral Formula: $\text{♂ } K(2) + (3), C1 + 2 + (2), A 10, \underline{G1}$



Papilionaceae—*Crotalaria juncea*, A, flowering twig with young pods; B, flower; C, L.S. gynoecium; D, androecium; E, dehiscent fruit; F, T.S. of ovary; G, floral diagram.

KEY CHARACTERS OF SUBFAMILY: CAESALPINACEAE: Flowers zygomorphic, perianth aestivation usually imbricate, stamens 5-10, corolla aestivation ascendingly-imbricate, posterior petal is innermost, petals 5, polypetalous. Stamens usually 10, rarely numerous, polyandrous or monadelphous.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Rosales
 Family : Leguminosae
 Subfamily : Papilionaceae
 Genus : *Cassia*
 Species : *tora*

Verna. Pamaar, Chakunda; Eng. Sickle senna.

Habit: A medium sized tree or shrub.

Root: Taproot and branched.

Stem: Erect, aerial, woody, branched, cylindrical, glabrous and solid.

Leaves: Cauline and ramal, compound, alternate, paripinnate, pulvinus at the base, petiolate, stipulate (stipules caducous), leaflets 4-8 pairs, ovate, entire, acute, glabrous, venation unicostate reticulate.

Inflorescence: Racemose, typical raceme.

Flower: Pedicellate (long pedicels), bracteate (bracts minute and caducous) or ebracteate, hermaphrodite, actinomorphic, complete, hypogynous, yellow, pentamerous, cyclic.

Calyx: Five sepals, polysepalous, more or less petaloid (yellowish green), inferior, quincuncial aestivation, odd sepals anterior.

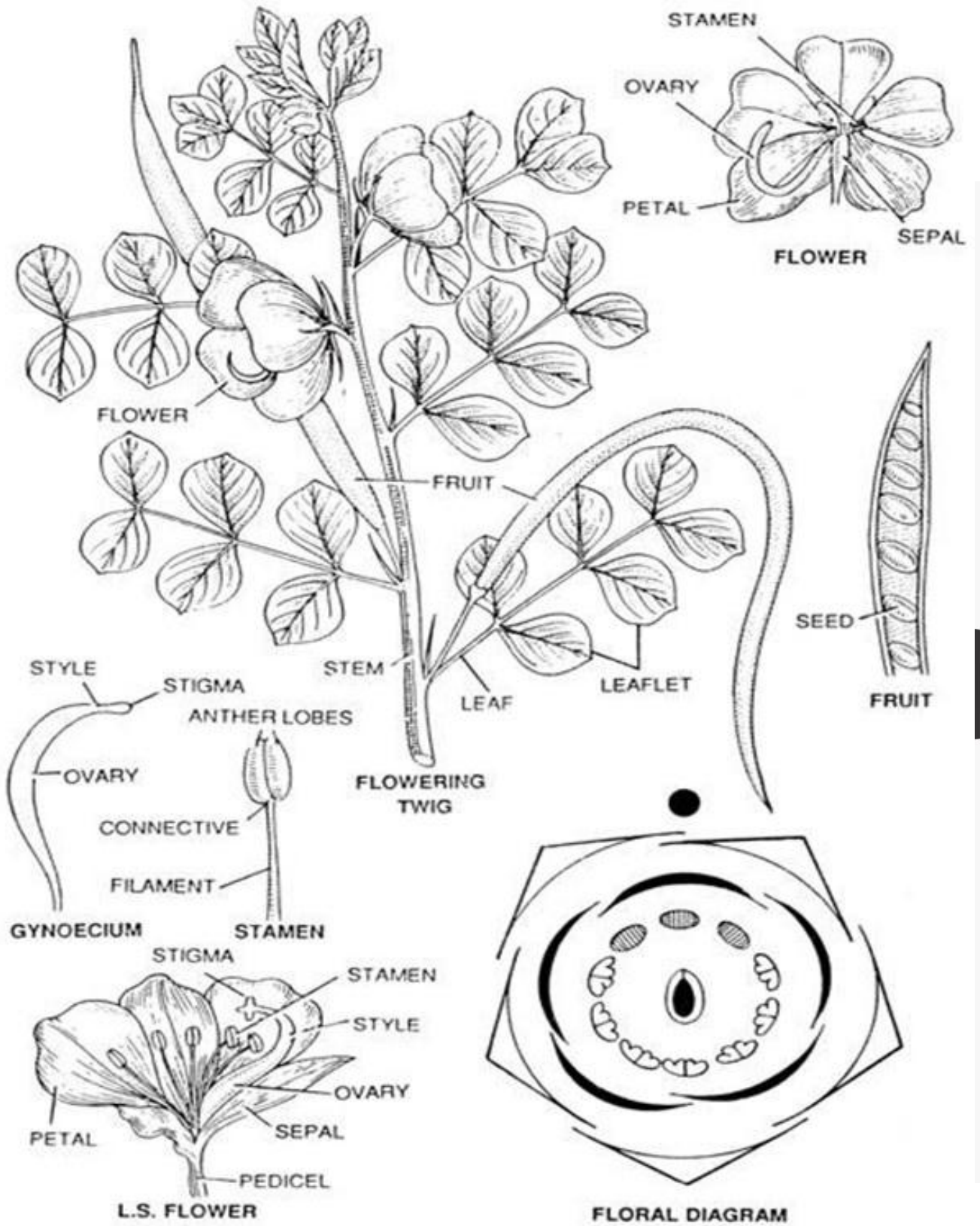
Corolla: Five petals, polypetalous, yellow, clawed, ascending imbricate aestivation, inferior.

Androecium: Ten stamens, polyandrous, unequal in length, three posterior stamens reduced to staminodes, basifixed anthers with abortive and indehiscent lobes, ditheous, introrse.

Gynoecium: One carpel (monocarpellary), ovary superior, unilocular, marginal placentation, style short, stigma terminal, hairy.

Fruit: A legume, black when ripe.

Floral formula: $\text{Br } \cdot \cdot \cdot \text{ } \overset{\circ}{\text{K}}5, \text{C}5, \text{A}7 + 3, \text{G } \underline{\text{L}}$



Caesalpinaceae (Leguminosae). *Cassia tora* Linn.; Eng. Sickle senna; Verna. Pamaar, chakunda.

***Tamarindus Indica* L., Eng. Tamarind:** Verna. Imli.

Stem: woody, aerial, erect, cylindrical, branched, solid.

Leaf: cauline and ramal, exstipulate, alternate, compound, uni-and paripinnate, petiolate, leaf base pulvinus, leaflet elliptical, entire, obtuse, unicostate reticulate, glabrous.

Inflorescence: Racemose, axillary raceme.

Flower: bracteate, bracteolate, pedicellate, complete, zygomorphic, hermaphrodite, perigynous, cyclic.

Calyx: 5, polysepalous, posterior sepal large, imbricate.

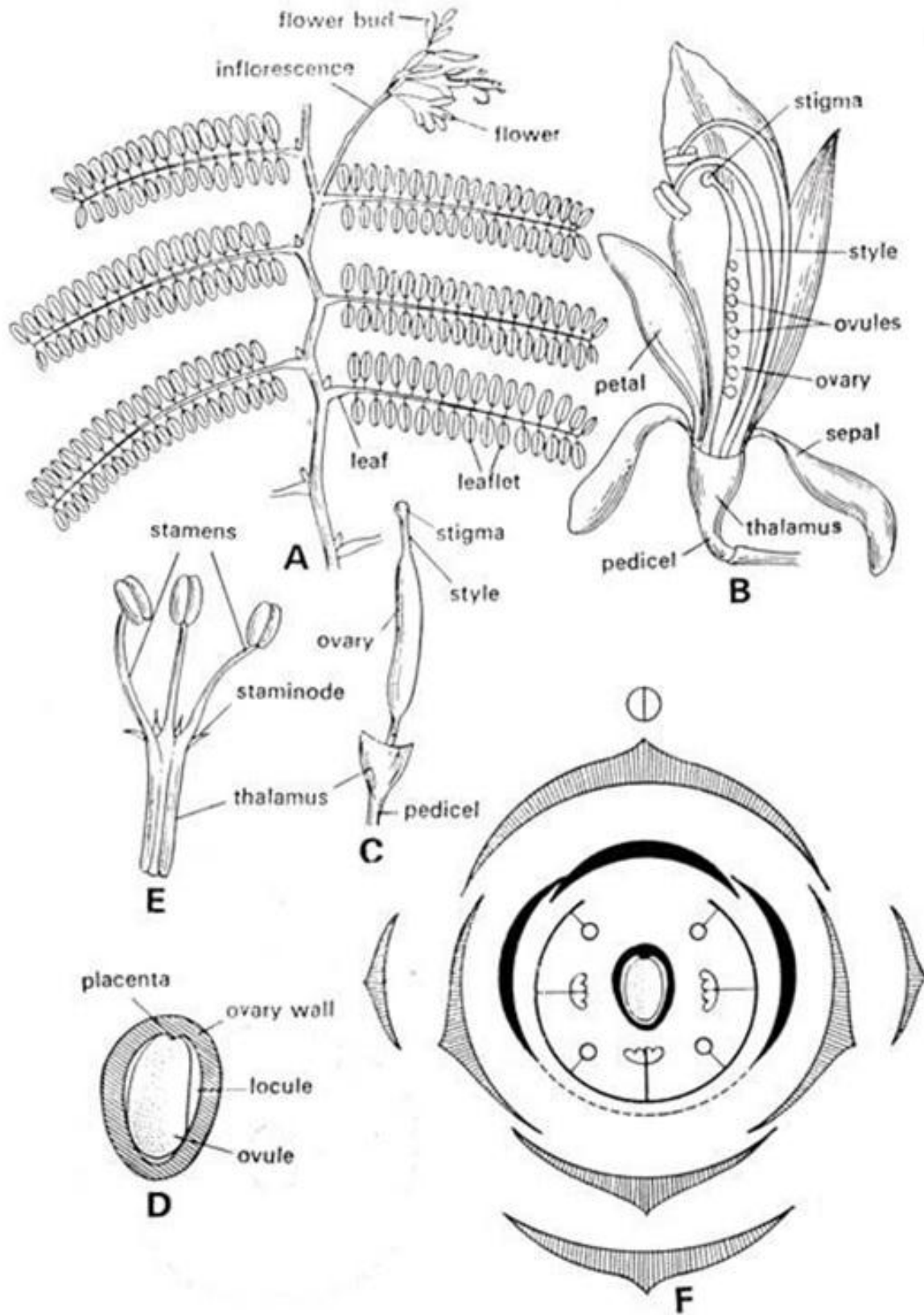
Corolla: 5, polypetalous anterior two petals reduced, imbricate.

Androecium: 3 stamens, 4 staminodes, all 7 form a staminal column, monadelphous, ditheous, versatile, introrse.

Gynoecium: 1, monocarpellary, half-inferior, marginal, ovules many, style long, stigma globular.

Fruit: legume, pod.





Caesalpinaceae—*Tamarindus indica* L. (Mim). A, flowering twig; B, L.S. of flower; C, gynoecium; D, T.S. of ovary; E, stamens; F, floral diagram.

KEY CHARACTERS OF SUBFAMILY: MIMOSEAE: Leaves are bipinnately compound, stipules are represented by a pair of thorns. Flowers are pentamerous and actinomorphic, perianth aestivation valvate or rarely imbricate, stamens 10 or usually more, filaments coloured and often much longer than corolla.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Rosales
 Family : Leguminosae
 Subfamily : Papilionaceae
 Genus : *Mimosa*
 Species : *pudica*

Verna-Chhui-mui, Lajyanti:

Habit: Perennial herb or shrub.

Root: Taproot and branched.

Stem: Erect or prostrate, woody, solid, cylindrical, branched, prickly, densely clothed with deflexed bristles.

Leaf: Compound bipinnate, very sensitive, rachis beset with ascending bristles stipulate, stipules lanceolate, striate margins bristly, pinnae usually four, 2½ to 3½ inches long, leaflet, 12 to 20 pairs, ½” long, sessile, obliquely narrow-oblong, acute, subcoriaceous, glabrous above, appressed-bristly beneath.

Inflorescence: Heads usually in pairs.

Flower: Small, hermaphrodite, actinomorphic, complete, tetramerous, hypogynous.

Calyx: 4 sepals, minute, gamosepalous, campanulate, shortly toothed.

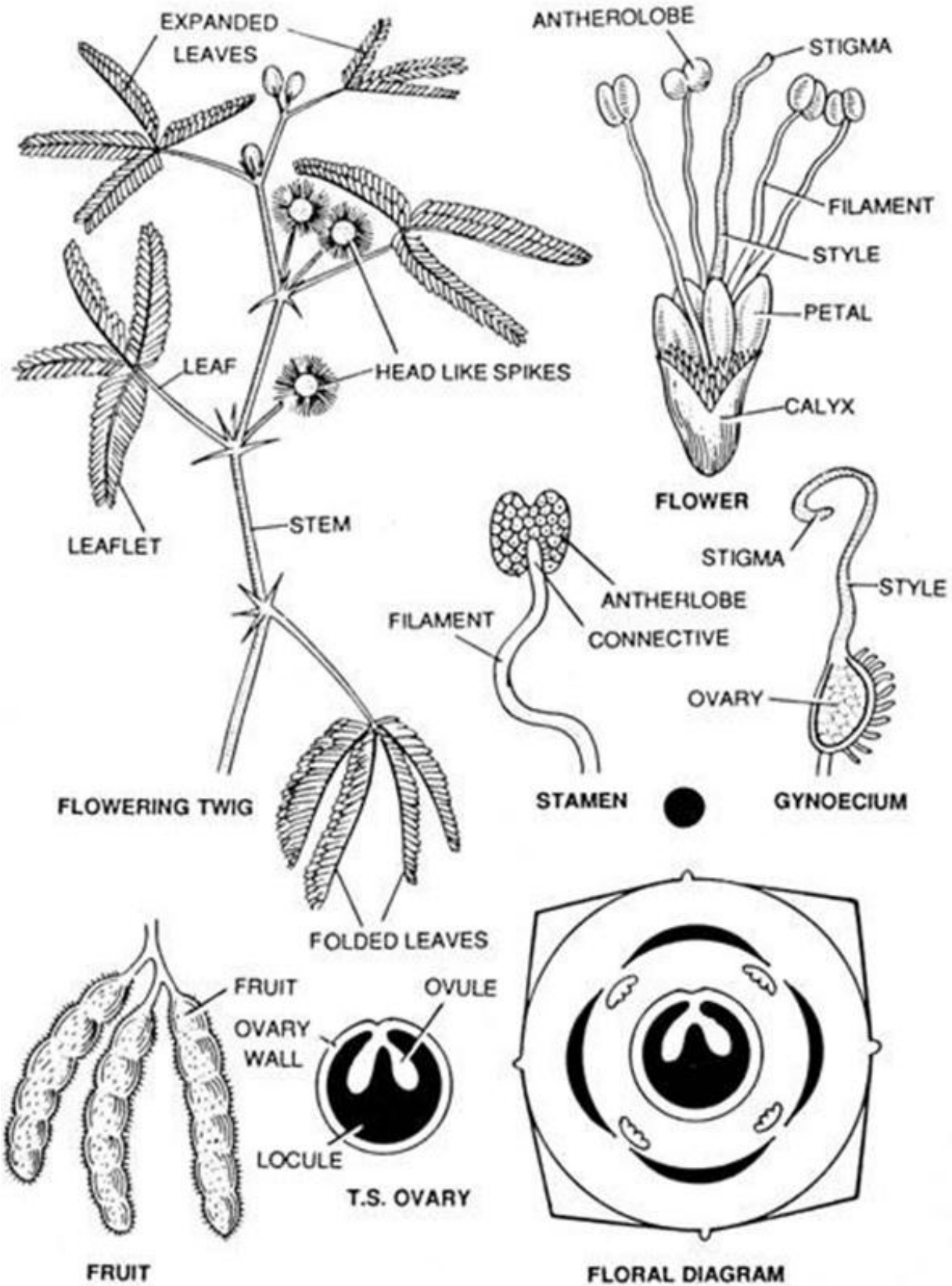
Corolla: 4 petals, gamopetalous, connate towards the base, small, inconspicuous, valvate aestivation, inferior.

Androecium: 4 stamens, conspicuous, brightly coloured, free, filaments filiform, anthers small, bicelled, not gland crested.

Gynoecium: 1, monocarpellary, ovary superior, unilocular, marginal placentation, style filiform, stigma minute, terminal.

Fruit: Pod flat, membranous, joints 3-5 falling away when ripe from the sutures which are armed with weak spreading yellowish bristles.

Floral Formula: $\oplus \ominus K(4), C(4), A4, G\bar{1}$.



Mimosaceae (Leguminosae), *Mimosa pudica* Linn.

***Acacia Nilotica*; Verna-Babul, Kikar:**

Habit: A medium sized spiny tree.

Root: Taproot and branched.

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

Leaf: Compound, bipinnate, stipulate, stipules modified into spines, petiolate, rachis possesses glands, leaflet oval, entire, obtuse, uncostate reticulate venation.

Inflorescence: The flowers are arranged in compound cymose heads.

Flower: Sessile, bracteate, actinomorphic, hermaphrodite, hypogynous, complete, fragrant, small yellow.

Calyx: Sepals 4 or 5, minute, gamosepalous, campanulate, valvate aestivation, inferior.

Corolla: Petals 4 or 5, gamopetalous, valvate aestivation, inferior.

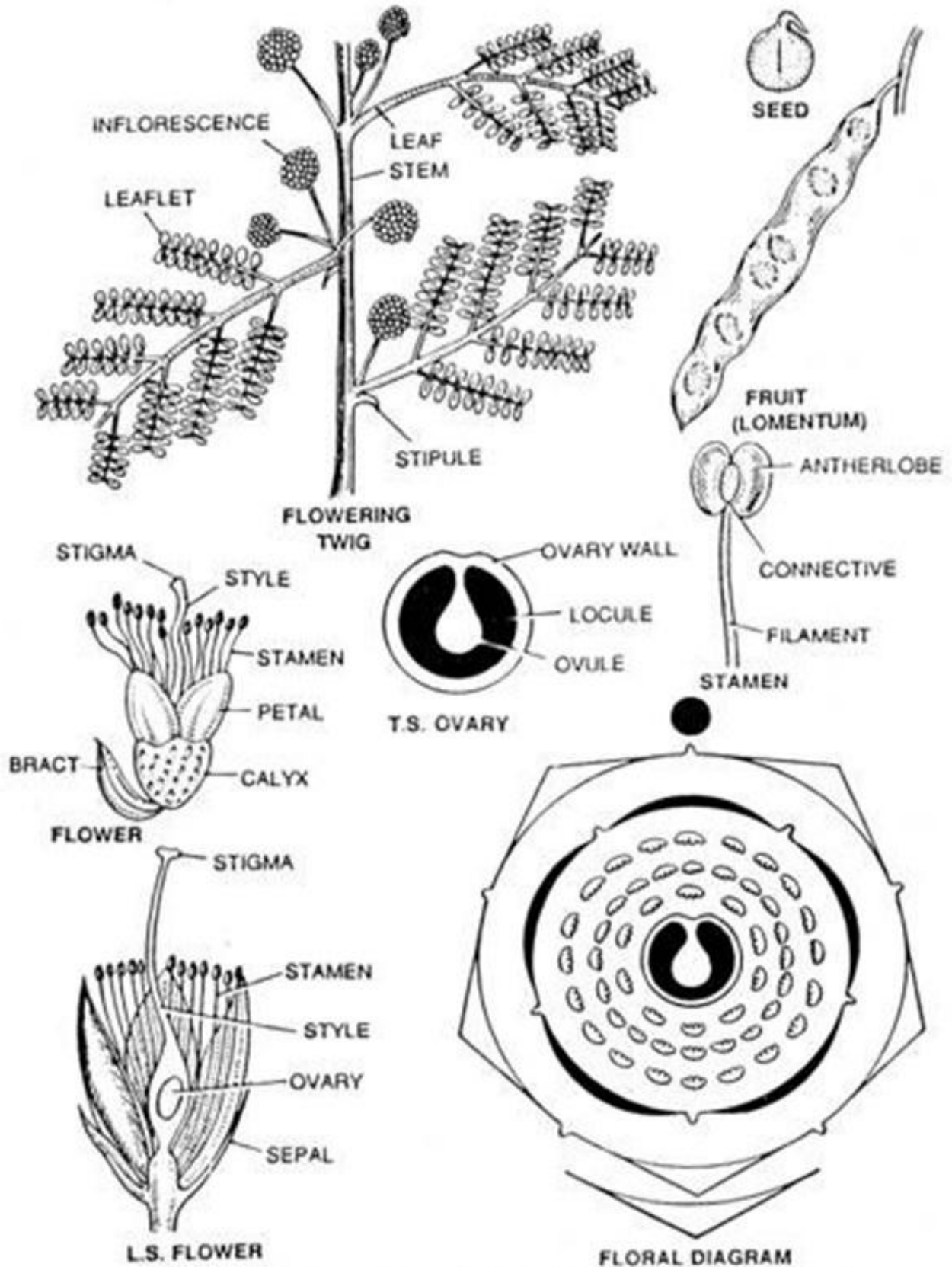
Androecium: Stamens indefinite, polyandrous, long filaments, minute anthers, introrse, yellow.

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

Fruit: A lomentaceous pod.

Floral Formula: $\oplus \ominus K(4 - 5), C(4 - 5), A\infty G\perp$.





Mimosaceae (Leguminosae), *Acacia nilotica* (Linn) Del.

KEY CHARACTERS OF RUTACEAE: Citrus family- Shrubs or trees with aromatic oil glands, very clear dots in leaves, leaves alternate, pinnately compound or palmately compound. Inflorescence Cymose. Stamens polyadelphous or diplostemonous or obdiplostemonous. Prominent disc present below the ovary. Flowers bisexual and hypogynous, fruit berry.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Geraniales
 Family : Rutaceae
 Genus : *Murraya*
 Species : *exotica*

Habit: Evergreen large shrub.

Root: Taproot and branched.

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

Leaf: Compound, pinnate, exstipulate, alternate, leaflets 3 – 7, oval, entire, smooth, coriaceous, alternate, petioled, unicostate reticulate venation, notched at the tip, dark green, shining above and oblique at the base.

Inflorescence: Cymose, short terminal and axillary corymb cymes.

Flower: Pedicellate, ebracteate, pentamerous, hermaphrodite, complete, hypogynous, white, very fragrant, 1/2" diameter.

Calyx: Five sepals, five-lobed or five partite, gamosepalous, minute, acute, inferior, quincuncial aestivation.

Corolla: Five petals, polypetalous, white, fragrant, oblong lanceolate, spreading above, inferior, imbricate aestivation.

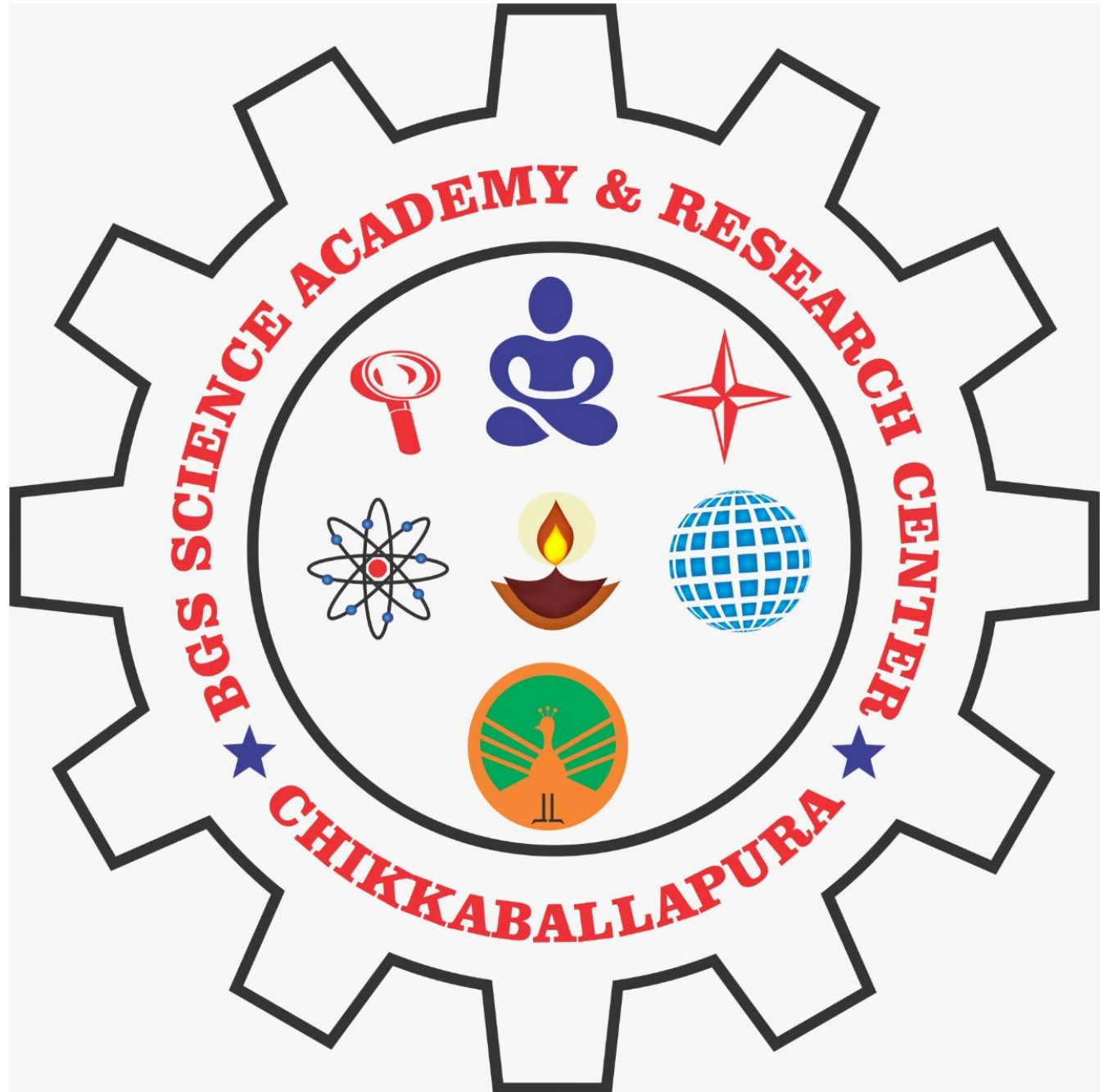
Androecium: Ten stamens, inserted round an elongated disc, alternate filaments shorter, obdiplostemonous, anthers bi-celled, introrse, polyandrous.

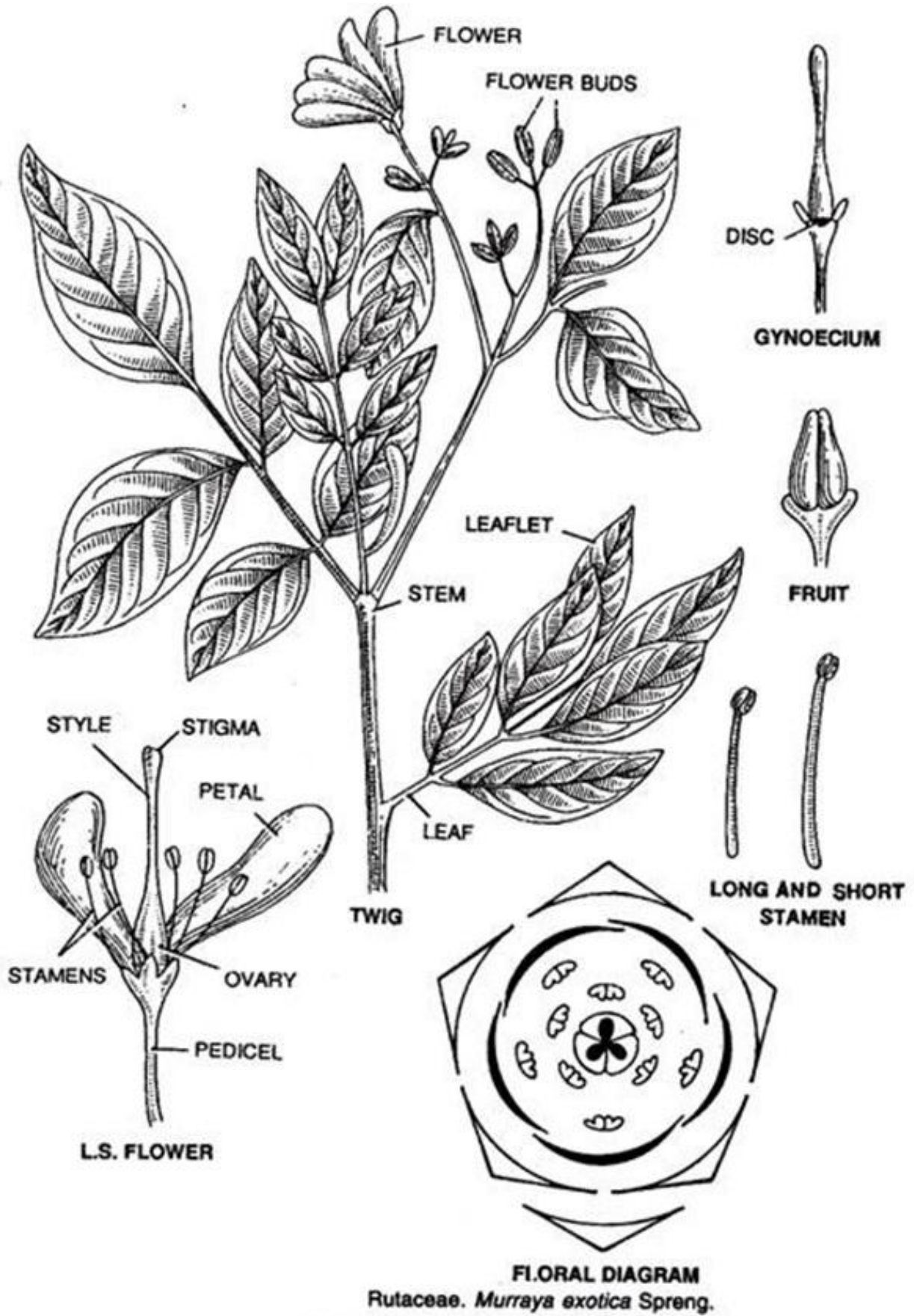
Gynoecium: Two or three carpels, syncarpous, ovary superior, two or three locular, axile placentation, two ovules in each chamber, style filiform, disk present below ovary.

Fruit:

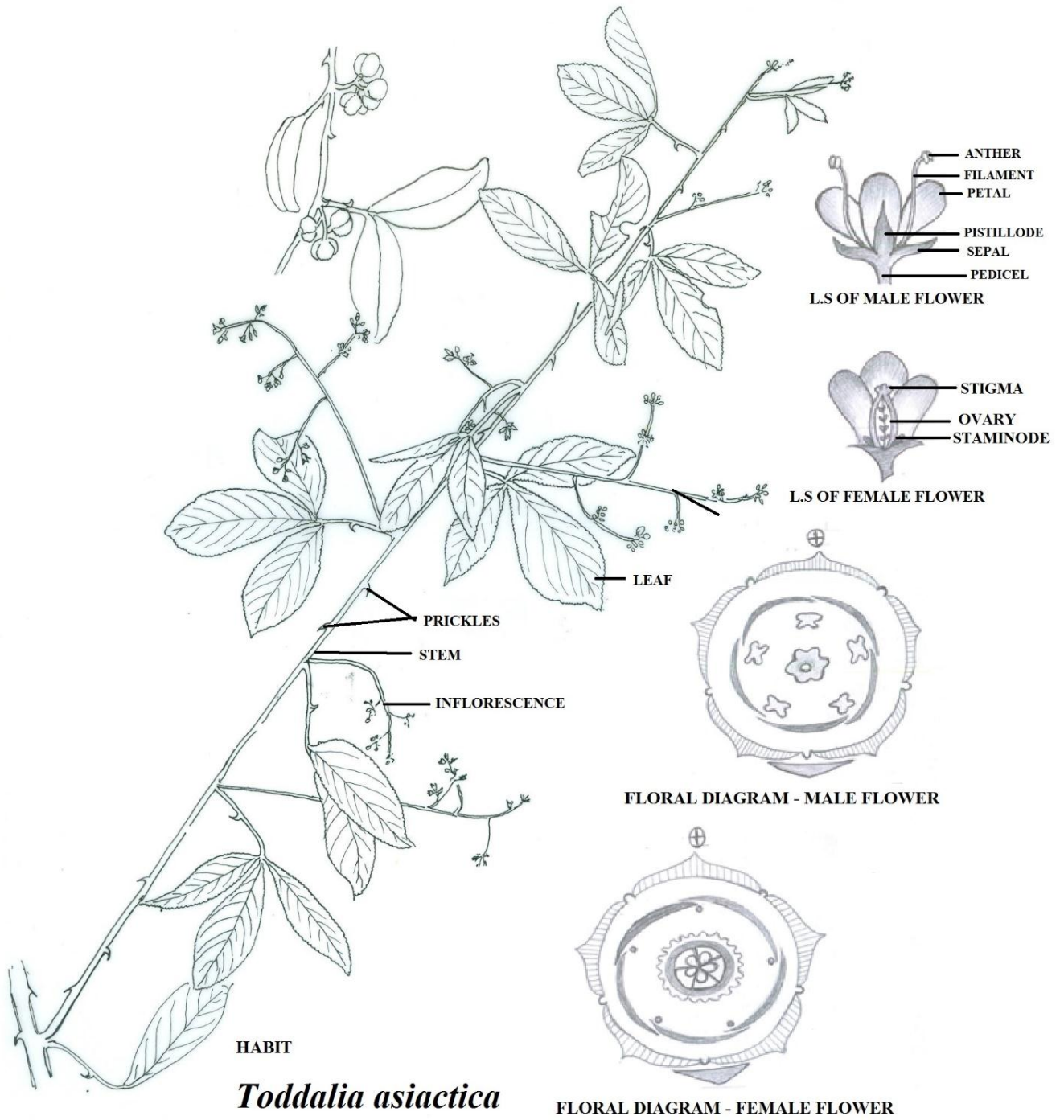
Ovoid berry, orange red when ripe.

Floral Formula: $\oplus \overset{\circ}{\sigma} K (5), C 5, A 5 + 5, G (2-3).$





Toddalia asiatica**Habitat:** Mesophyte**Habit:** Erect, Evergreen, Perennial, bushy shrub, climbing with the help of prickles.**Root:** Taproot and branched.**Stem:** Erect or woody, cylindrical, branched with nodes and internodes, cylindrical, green, epidermal prickles are present on it.**Leaf:** Cauline, ramal, exstipulate, alternate, trifoliately palmately compound, oval, entire, glabrous, alternate, petioled, aromatic, gland dotted leaves, tip acute unicastate reticulate venation,**Inflorescence:** Cymose paniculate (flowers are polygamous, male, female, bisexual flowers present).**Male Flower:** Bracteate, ebracteate, pedicellate, actinomorphic, heterochlamydeous, incomplete, unisexual, pentamerous, gynoecium reduced.**Calyx:** Five sepals, gamosepalous, with valvate aestivation.**Corolla:** Five petals, polypetalous, white, shorter than stamens with imbricate aestivation.**Androecium:** Five stamens, polyandrous, alternate to petals, opposite to the sepals, exerted, anthers are ditheous, dorsifixed and extrose.**Gynoecium:** absent (reduced into pistillode).**Female Flower:** Pedicellate, bracteates, ebracteolate, actinomorphic, heterochlamydeous, incomplete unisexual, pentamerous, androecium reduced.**Calyx:** Five sepals, gamosepalous, with valvate aestivation.**Corolla:** Five petals, polypetalous, white, shorter than stamens with imbricate aestivation.**Androecium:** stamens are reduced into staminodes.**Gynoecium:** five carpels, syncarpous, ovary superior, single ovule on a prominent disc in each carpel on axile placentation, style simple, stigma capitate.**Fruit:** A sub globose berry; orange when ripe; seeds 3 or 4, sub reniform.



KEY CHARACTERS OF EUPHORBIACEAE: Rubber family- Herbs, shrubs or small trees, milky latex present. Flowers monochlamydeous. Inflorescence Cyathium in Euphorbia species, racemose or cymose. Flowers unisexual, perianth absent in Euphorbia species. Ovary tricarpeal, syncarpous, superior ovary, ovules on axile placentation. Stigma trifid, fruit capsule or regma.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Geraniales
 Family : Euphorbiaceae
 Genus : *Croton*
 Species : *sparganium or bonplandianus*

Habit: Annual wild herb.

Stem: Erect, herbaceous, branched, rough, latex present, solid, cylindrical.

Leaf: Alternate, simple, petiolate, exstipulate, serrate margin, acute, rough, uncostate and reticulate venation.

Inflorescence: Racemose, raceme, male flowers on the upper portion, female flowers on the lower portion of inflorescence.

Flower: Pedicellate, bracteate, unisexual, monoecious plant, actinomorphic, incomplete, hypogynous, glands present.

Male Flower:

Calyx: 5 sepals, polysepalous, persistent, imbricate.

Corolla: 5 petals, polypetalous, 5 glands opposite sepals, valvate aestivation.

Androecium: Stamens many, inserted on receptacle, filaments free, incurved in bud, anthers adnate, dithecal, exerted.

Female Flower:

Calyx: As in male flowers.

Corolla: Absent.

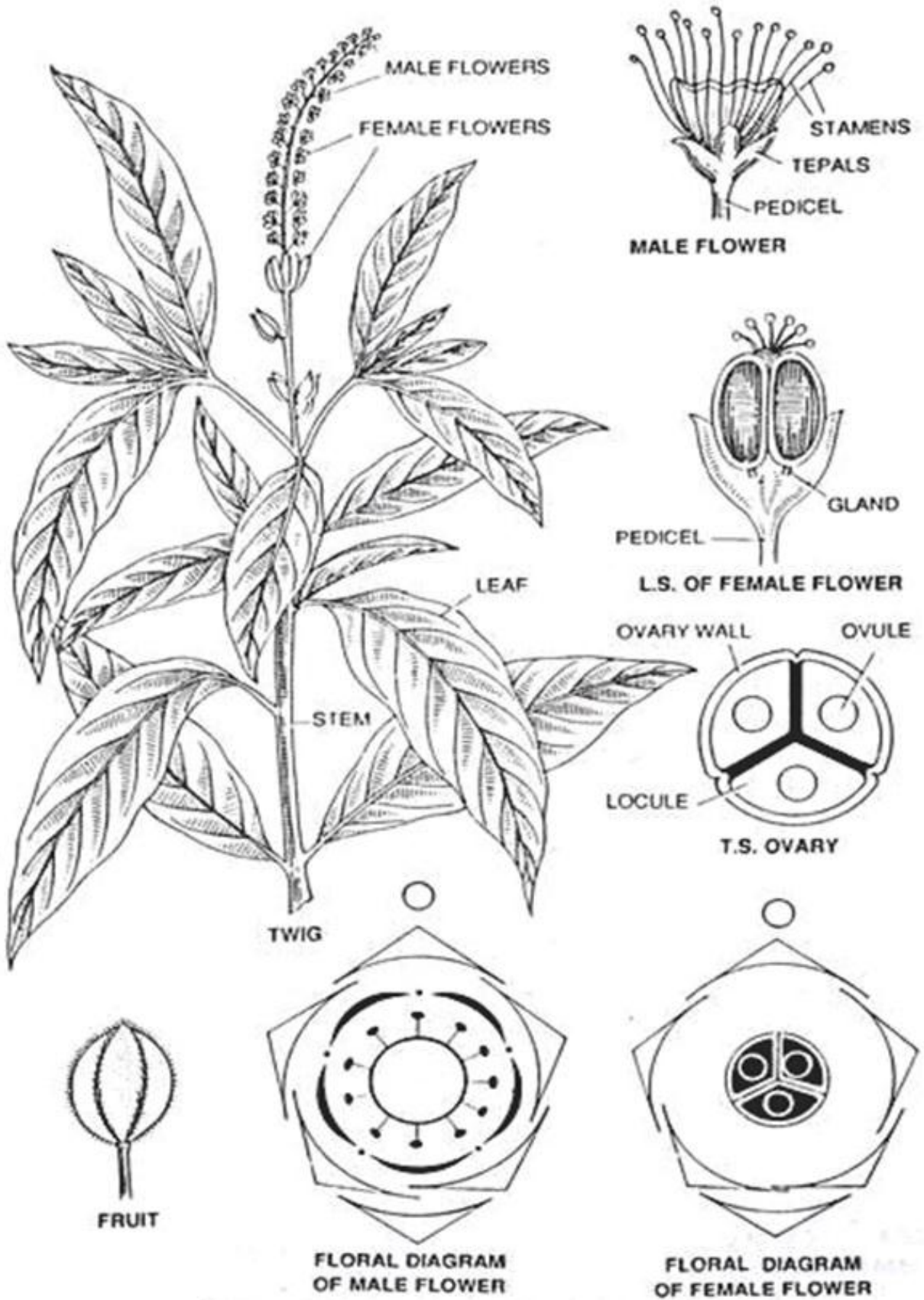
Gynoecium: 3 carpels (tricarpeal), syncarpous, 3 styles ending in 3 bifid stigmas, ovary superior, three chambered, single ovule in each locule, axile placentation.

Fruit: Indehiscent capsule.

Floral Formulae:

Male flower— $\oplus \sigma K 5, C 5, A \infty$

Female flower— $\oplus \varphi K 5, C 0, G (3)$.



Euphorbiaceae. Croton sparciflorus.

Euphorbia hirta:

Habit: Annual wild herb.

Stem: Erect, usually un-branched (sometimes branched), herbaceous, cylindrical, solid, covered with yellow crisped hairs.

Leaf: Simple, opposite, superposed, sub-sessile (short petiole), acute, oblong, lanceolate, serrulate, stipulate, stipules caducous, unicostate with reticulate venation.

Inflorescence: Large number of cyathia densely crowded and arranged in peduncled axillary cymes.

Flowers: Pedicellate, unisexual, monoecious, enclosed within minute involucre of bracts forming cupular structure.

Male Flower:

Perianth: Absent, naked flower.

Androecium: Single stalked stamen representing male flower, bracteate, anthers 2-celled dehiscing longitudinally.

Female Flower:

Perianth: Absent, naked flower.

Gynoecium: A single stalked, bracteate, tricarpeillary pistil represents female flower, it remains surrounded by male flowers (stalked stamens), ovary superior, three-chambered, single ovule in each locule, axile placentation, three styles, three bifid stigmas.

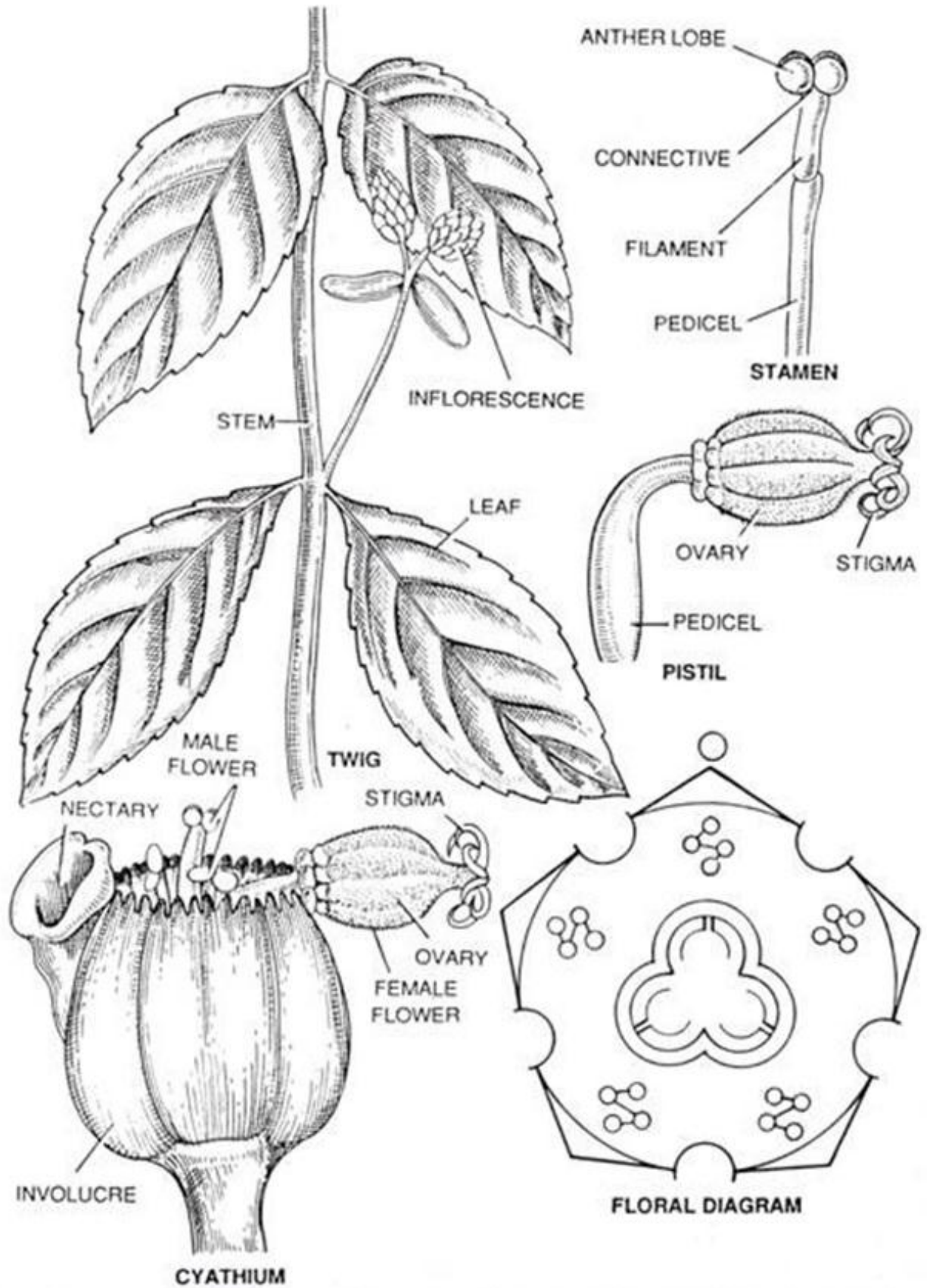
Fruit: A capsule.

Floral Formulae:

Male flower— $\oplus \sigma K 0, C 0, A 1$

Female flower— $\oplus \varphi K 0, C 0, G (3)$.





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

KEY CHARACTERS OF FAMILY: UMBELLIFERAE OR APIACEAE: Coriander family or carrot family- Aromatic herbs, leaves compound with sheathing leaf base. Inflorescence umbel or compound umbel. Ovary inferior, stamens 5, stylopodium present, fruit schizocarpic cremocarp.

Systematic Position:

Class : Dicotyledonae
 Subclass : Archichlamydeae
 Order : Geraniales
 Family : Apiaceae
 Genus : *Coriandrum*
 Species : *sativum*

Technical description of Coriandrum sativum, Verna. – Dhaniya.

Habit: An annual cultivated, aromatic, ephemeral herb.

Root: Taproot and branched.

Stem: aerial, erect, herbaceous, green, fistular (solid nodes and hollow internodes), branched, cylindrical, aromatic, ribbed, glabrous, nodes, slightly swollen.

Leaf: cauline, ramal, exstipulate, petiolate, decomposed, much branched when old, base slightly sheathing, uncostate reticulate venation.

Inflorescence: Compound umbel with involucre of bracts.

Flower: Pedicellate, bracteate, ebracteolate, bisexual, complete, epigynous, the outer flowers of the inflorescence are zygomorphic, i.e., with large and unequal petals, whereas the central flowers are actinomorphic with equal and small petals.

Calyx: 5 sepals, gamosepalous, green, acute, valvate aestivation, superior, calyx tube adnate to the ovary wall.

Corolla: 5 petals, polypetalous, in peripheral flowers two posterior petals bilobed and smallest, one anterior deeply bilobed (keeled) and largest two lateral large, bilobed, one lobe very small and the other large, zygomorphic, imbricate aestivation, purplish white, the petals of central flowers are small and equal in size, each petal consists of two equal lobes.

Androecium: 5 stamens polyandrous, alternating with petals, filaments long, anthers dorsifixed, introrse and inserted.

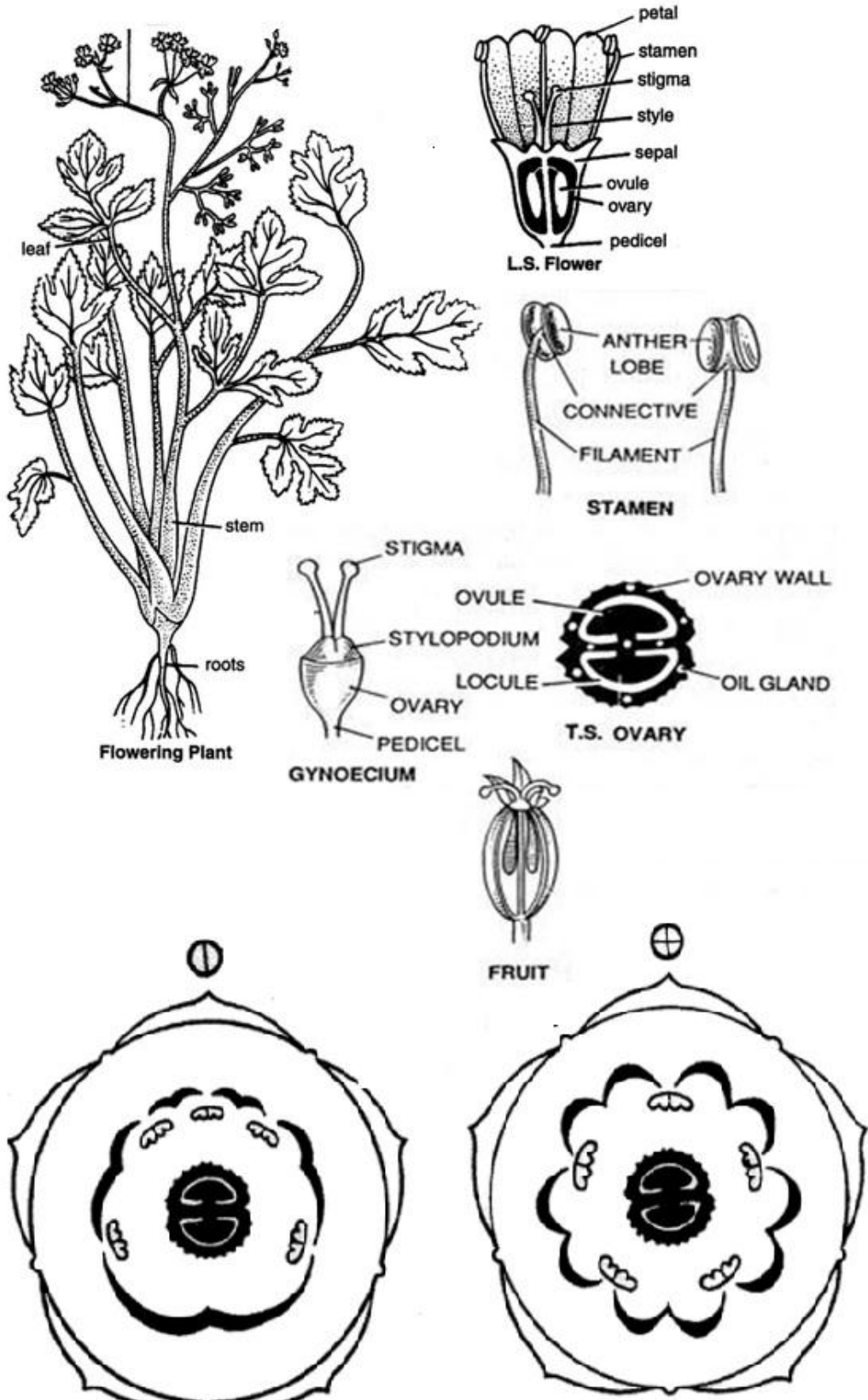
Gynoecium: bicarpellary, syncarpous, ovary inferior, bilocular, one ovule in each locule, axile placentation, epigynous disc present at the top of ovary is called stylopodium, prolonged in two short styles, vittae present in ovary wall.

Fruit: Cremocarp.

Floral Formula:

$\cdot \text{ } \overline{\text{K}} (5), \text{C } 5, \text{A } 5, \text{G}_{(2)} \quad (\text{zygomorphic flowers})$

$\oplus \text{ } \overline{\text{K}} (5), \text{C}5, \text{A } 5, \text{G}_{(2)} \quad (\text{actinomorphic flowers})$



Floral Diagram (zygomorphic flower)

Floral Diagram (actinomorphic flower)

Umbelliferae. Coriandrum sativum Linn., Eng. Coriander; Verna. Dhaniya.

Centella asiatica (Linn.) Urb. (Syn. *Hydrocotyle asiatica* Linn.) Verna. Brahmi; Eng. Asiatic pennywort:

Habit: Prostrate herbs, rooting at nodes.

Root: Adventitious roots.

Stem: Prostrate, herbaceous, weak, cylindrical, stolon, leaves and roots at nodes.

Leaves: Simple, arising in groups from nodes, orbicular or reniform, crenate and often lobed, glabrous, shining, petiolate, long petioled, stipulate, stipule, adnate to petioles.

Inflorescence: Racemose, simple umbels, 3-6 flowers in each group.

Flower: Pedicellate, small pedicels, bracteate, bracts small, ovate, embracing the flowers, hermaphrodite, actinomorphic, regular, complete, epigynous.

Calyx: 5 sepals, minute, connate, valvate aestivation.

Corolla: 5 petals, polypetalous, valvate aestivation.

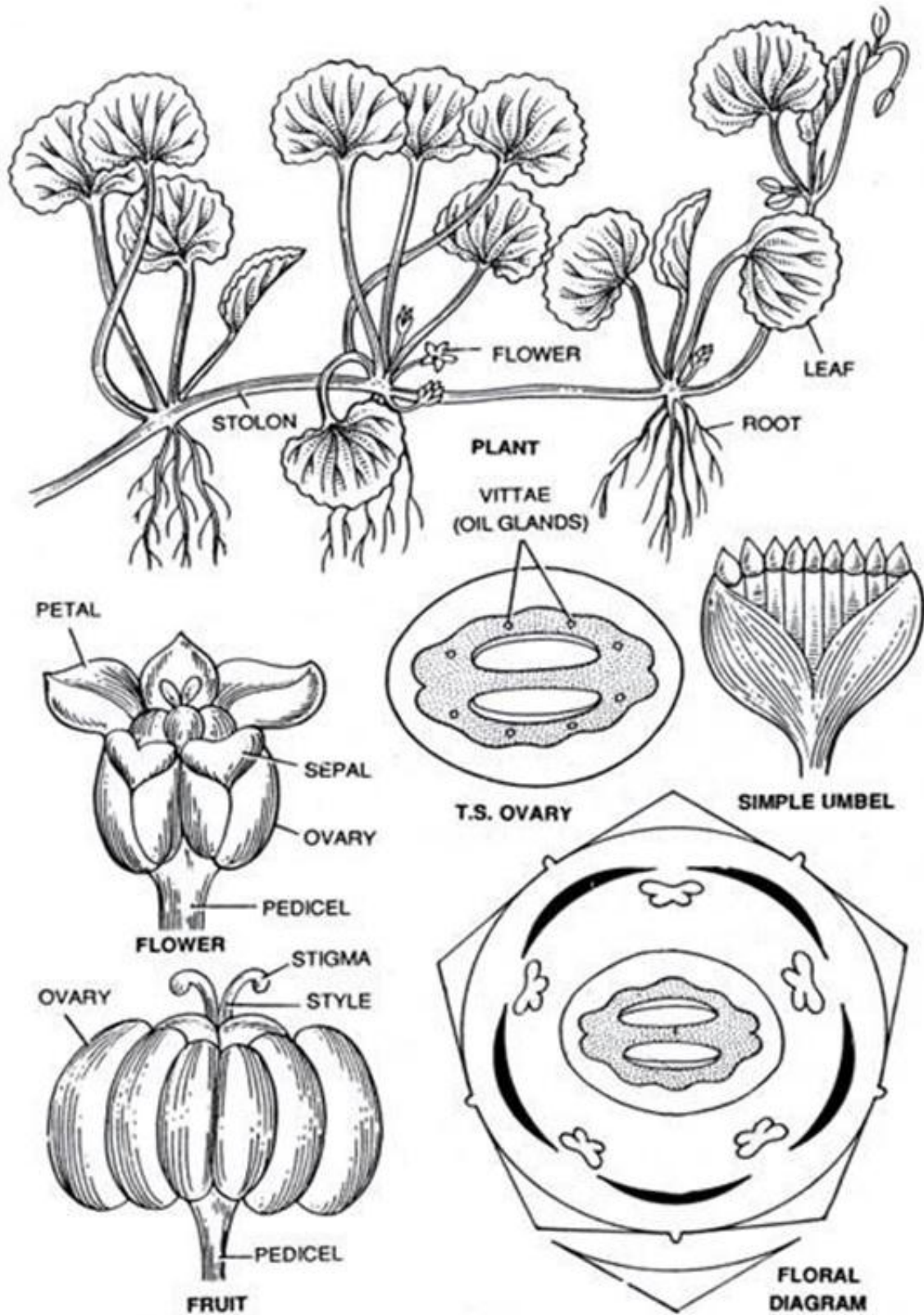
Androecium: 5 stamens, polyandrous, alternate to petals, filament short, anther ditheous, introrse.

Gynoecium: 2 carpels, syncarpous, ovary inferior, 2-celled, disk 2-lobed, vittae present in ovary wall, axile placentation and one ovule in each locule.

Fruit: Cremocarp, laterally compressed.

Floral Formula:





Umbelliferae (Apiaceae). *Centella asiatica* (Linn). Urb. (Syn. *Hydrocotyle asiatica* L);
Eng. Asiatic pennywort; Verna. **Brahmi**.

KEY CHARACTERS OF FAMILY: ASCLEPIADACEAE: Milk weed family, herbs or vines with milky latex, leaves exstipulate and opposite or whorled, flowers pentamerous, actinomorphic, staminal corona present, Ovary superior, bicarpellary, apocarpous, carpels two. Gynostegium and pollinia are present. Fruit is a pair of follicles.

Systematic Position:

Class : Dicotyledonae
 Subclass : Metachlamydeae
 Order : Contortae
 Family : Asclepiadaceae
 Genus : *Calotropis*
 Species : *procera*

Habit: A shrub, about 3 to 6 feet high, younger parts and the under surface of the leaves covered with white waxy secretion, all parts contain milky latex.

Stem: Erect, branched, glabrous, woody below and herbaceous above, tomentose, solid, cylindrical.

Leaf: cauline, ramal, simple, sub-sessile, opposite decussate, exstipulate, , thick, glaucous- green, elliptical or obovate oblong with cordate or often amplexicaul base, acute or shortly acuminate, unicostate reticulate venation.

Inflorescence: Polychasial cyme.

Flower: Pedicellate, bracteate, actinomorphic, complete, bisexual, regular, pentamerous except pistil, hypogynous.

Calyx: 5 sepals, polysepalous or connate at the base, greenish, lobes lanceolate, acute apex, interior quincuncial aestivation.

Corolla: Petals 5, gamopetalous, pink or whitish with purple spots, lobes spreading, inferior, twisted or contorted aestivation.

Androecium: Five stamens, filaments connate in a fleshy staminal tube around the ovary, the apex of the staminal tube united with the much-dilated stigmatic head to which the anthers are also coherent, forming the pentagonal gynostegium, anthers short, broad tipped with inflexed membranous flaps, bicelled, the pollen grains of each cell agglutinated into sac like pollinium, the pollinia of each anther are united together by means of short stalks or caudicles to a distinct dark coloured dot-like structure, the corpusculum, which lies at the angle of the gynostegium, thus forming a translator. A corona is present behind each stamen.

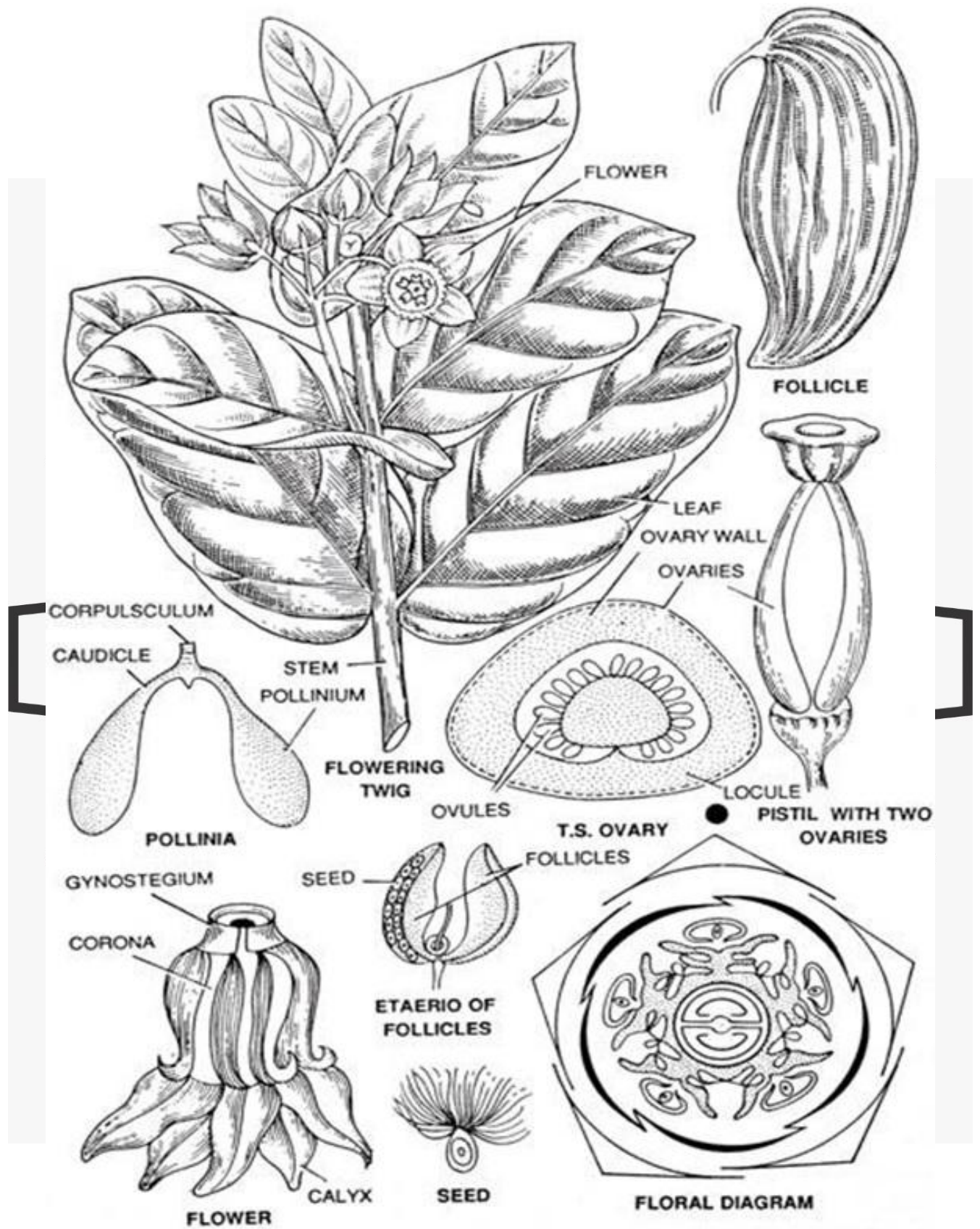
Gynoecium: 2 carpels (bicarpellary), apocarpous; the pistil free below and fused above, two distinct ovaries end in two styles forming a pentangular stigmatic head to the sides of which the anthers are coherent; ovary superior, unilocular, many ovules, marginal placentation.

Fruit: A pair of follicles.

Seeds: Mainly, broadly ovate, flat tomentose with tuft of silky hairs.

Floral Formula:

$\oplus \text{ } \overset{\text{♂}}{\text{K}} 5, \overline{\text{C}(5)}, \text{A}5, \text{G}(2).$



Asclepiadaceae. *Calotropis procera* (Ak.)

Asclepias curassavica:

Habit: An erect, perennial, ornamental herb.

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

Leaves: Simple, opposite, short petiolate, exstipulate, linear, lanceolate, entire, acute, unicostate reticulate venation.

Inflorescence: Cymose, umbellate cyme or Polychasial cyme.

Flowers: Pedicellate, purple-yellow, small bisexual, actinomorphic, hypogynous.

Calyx: 5 sepals, polysepalous, imbricate aestivation.

Corolla: 5 petals, gamopetalous, twisted aestivation,

Androecium: Five stamens, filaments connate in a fleshy staminal tube around the ovary, the apex of the staminal tube united with the much-dilated stigmatic head to which the anthers are also coherent, forming the pentagonal gynostegium; anthers short, broad tipped with inflexed membranous flaps, bi-celled, the pollen grains of each cell agglutinated into sac like pollinium; the pollinia of each anther are united together by means of short stalks or caudicles to a distinct dark coloured dot-like structure, the corpusculum, which lies at the angle of the gynostegium, thus forming a translator. A corona is present behind each stamen.

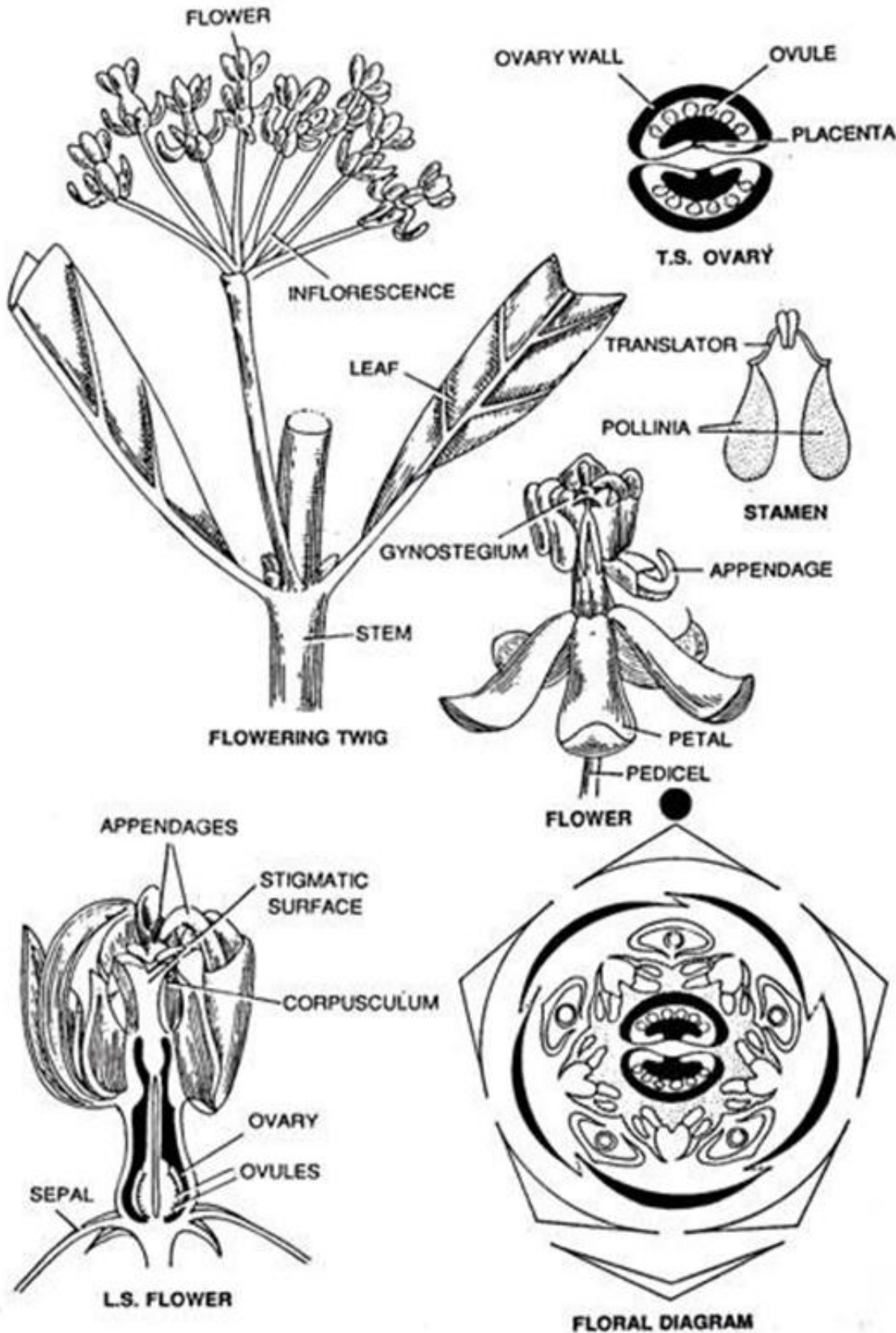
Gynoecium: 2 carpels (bicarpellary), apocarpous; the pistil free below and fused above; two distinct ovaries end in two styles forming a pentangular stigmatic head to the sides of which the anthers are coherent; ovary superior, unilocular, many ovules, marginal placentation.

Fruit: A pair of follicles.

Floral Formula:

$\oplus \overset{\circlearrowleft}{\text{K}} 5, \overline{\text{C}(5)}, \text{A}_5, \text{G}(2)$





Asclepiadaceae. *Asclepias curassavica* Linn. Eng. Blood flower; Verna. Kukatundi.

KEY CHARACTERS OF FAMILY LABIATAE OR LAMIACEAE: Mint family, aromatic herbs with square stems, leaves opposite decussate. Inflorescence verticillaster or Thyrsus. Flowers zygomorphic, stamens 2-4, didynamous, calyx and corolla bilabiate (2/3). Ovary deeply 4 lobed, gynobasic style, Fruit carcerulus.

Systematic Position:

Class : Dicotyledonae
 Subclass : Metachlamydeae
 Order : Tubiflorae
 Family : Labiatae or lamiaceae
 Genus : *Ocimum*
 Species : *sanctum*

Technical description of *Ocimum sanctum*, (Verna. Tulsi)

Habit: A perennial herb with typical aromatic smell.

Stem: Erect, branched, quadrangular, somewhat woody, solid, branches covered with soft hairs.

Leaf: Simple, opposite, short petioled, exstipulate, ovate, serrate, acute, gland dotted, unicostate reticulate venation.

Inflorescence: Thyrsus

Flower: Pedicellate, bracteate, bracts small and caducous, bisexual, complete, zygomorphic, complete, purple, hypogynous.

Calyx: 5 sepals, gamosepalous, bilabiate, petaloid (purple coloured), posterior lip broad and boat shaped, anterior lip with 4 small lobes possessing mucronate teeth, gland dotted, imbricate aestivation, inferior.

Corolla: 5 petals, gamopetalous, bilabiate, corolla tube short, upper lip four lobed, lower lip large, imbricate aestivation, inferior.

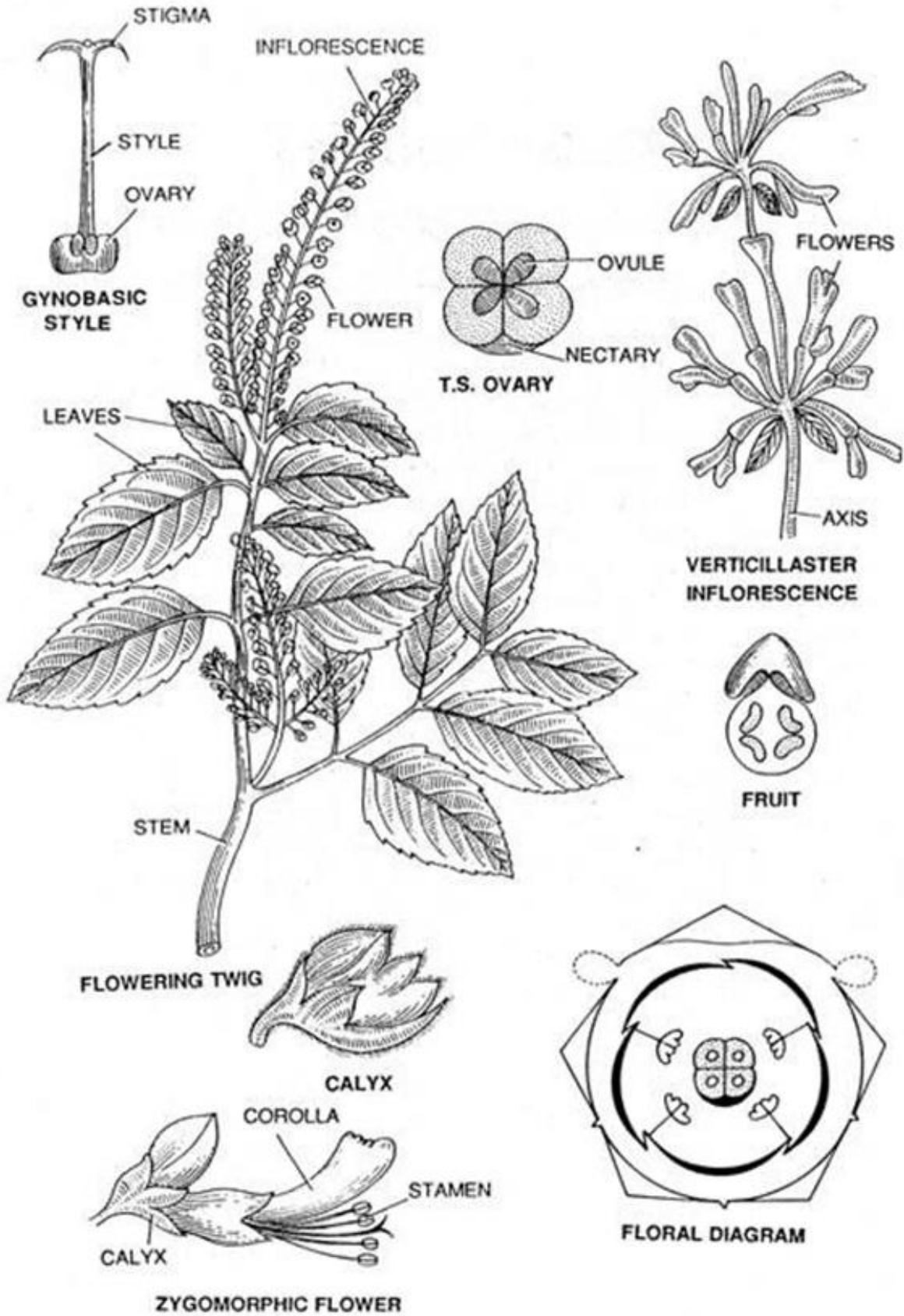
Androecium: 4 stamens, polyandrous, didynamous, epipetalous, fifth posterior stamen completely suppressed, anthers bicelled, introrse, dorsifixed.

Gynoecium: 2 carpels (bicarpellary), syncarpous, ovary bilocular in early stage but becomes tetralocular in later stage, ovary superior, four chambered, axile placentation, single ovule in each locule, gynobasic style (i.e., it arises from the base of the ovary), stigma bifid.

Fruit: Schizocarpic, carcerulus, 4 nutlets developed.

Floral Formula:

$\frac{\text{♂}}{\text{♀}} K (1 + 4), \overline{C(4+1)}, A 2 + 2, G(2).$



Labiatae–*Ocimum sanctum* Linn. (Verna. tulsi).

Leucas aspera

Habit: It is wild aromatic annual herb.

Roots: Tap root

Stem: Aerial, erect, branched, herbaceous, quadrangular, glandular hairs are present, aromatic.

Leaves: Cauline, ramal, simple, opposite decussate, petiolate, exstipulate, lanceolate, serrate, acute, unicostate reticulate venation.

Inflorescence: Verticillaster (A false whorl of arrangement of flowers around the nodal region of the stem) with usually six-flowered whorls.

Flower: Pedicellate, bracteate, ebracteolate, zygomorphic, complete, bisexual, heterochlamydeous and hypogynous.

Calyx: 10 sepals, fused, tubular of funnel shaped, toothed, pubescent, valvate aestivation.

Corolla: 5 petals, gamopetalous, forms two lips (bilabiate or bilipped corolla), upper lip has two notches and lower lips has three notches, white in colour, with imbricate aestivation.

Stamens: 4 stamens, didynamous, epipetalous, dorsifixed, ditheous, brown in color, introrse and inserted.

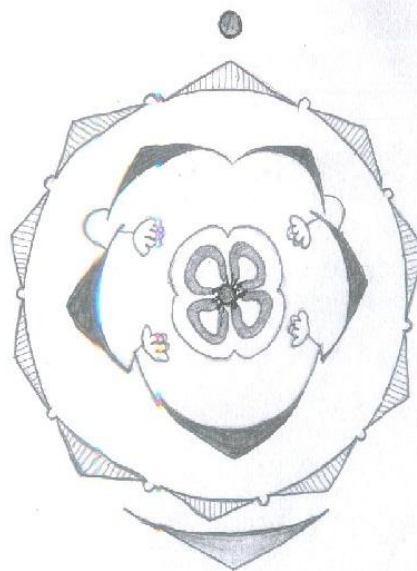
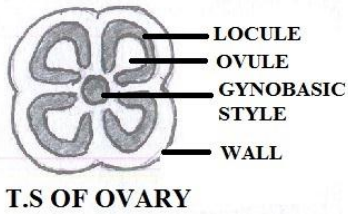
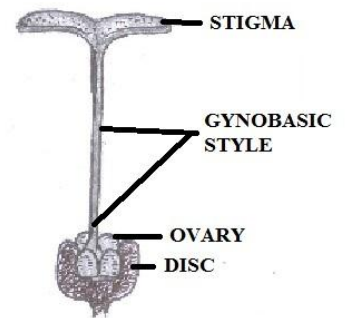
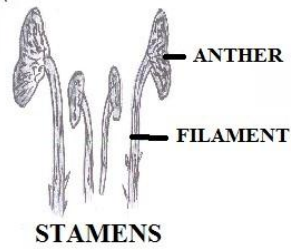
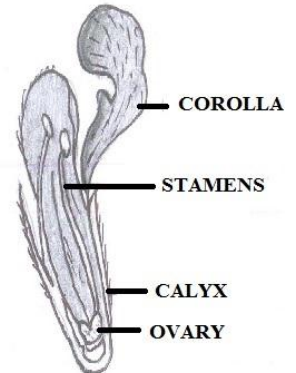
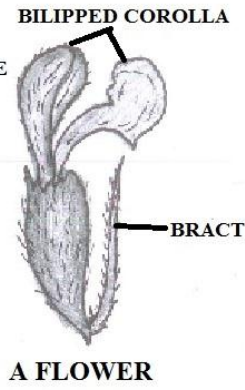
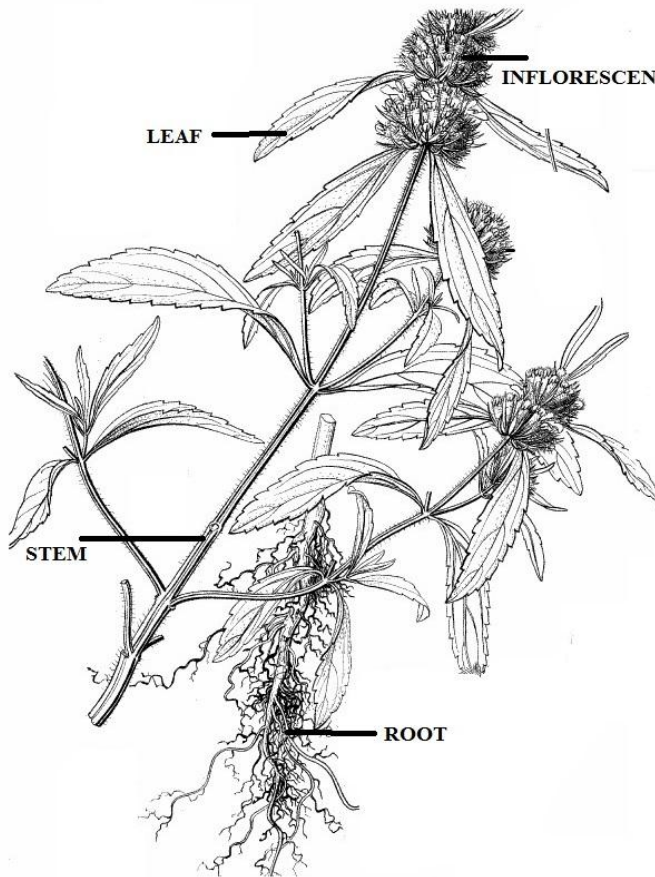
Carpel: Bicarpellary, syncarpous, ovary superior, tetralocular due to formation of false septum, each locule contain single ovule on axile placentation. A circular cup shaped nectar disc present around the base of the ovary. Style Gynobasic i.e., arised from the base of the ovary, stigma bifid.

Fruits: Carcerulus with persistent calyx.

Seed: Non-endospermic.

Floral Formula: $Br\ o\ p\ \bar{\sigma}\ K_{(3/2)\ or\ 5}\ C_{(2/3)\ or\ (4/1)\ or\ (0/5)}\ A_{2+2\ (std)}\ G_{(2)}$





LEUCAS ASPERA

KEY CHARACTERS OF FAMILY: ACANTHACEAE: Acanthus family, herbs, shrubs or trees; leaves opposite decussate, Flowers zygomorphic, corolla bilipped or bilabiate (2/3). Tubular, stamens 4, didynamous, epipetalous, bicarpellary syncarpous superior ovary.

Systematic Position:

Class : Dicotyledonae
 Subclass : Metachlamydeae
 Order : Tubiflorae
 Family : Acanthaceae
 Genus : *Justicia*
 Species : *simplex*

Habit: An undershrub, commonly grown as hedge plant.

Root: Tap root system, adventitious roots are developed from the nodal region of the prostrate stem.

Stem: Semi erect or prostrate, branched, cylindrical, solid, herbaceous, ribbed, glabrous/ pubescent.

Leaf: Simple, opposite decussate, cauline, petiolate, lanceolate, entire, acute, glabrous, unicostate reticulate venation.

Inflorescence: Racemose

Flower: Sessile, bracteate (bracts lanceolate), bracteolate, hermaphrodite, zygomorphic, complete, bisexual, hypogynous.

Calyx: 5 sepals, gamosepalous, connate at the base and free above, green, inferior.

Corolla: 5 petals, gamopetalous, bilabiate, upper lip consists of two lobes, lower of three lobes, yellowish white with pink or violet dots, imbricate aestivation, and inferior.

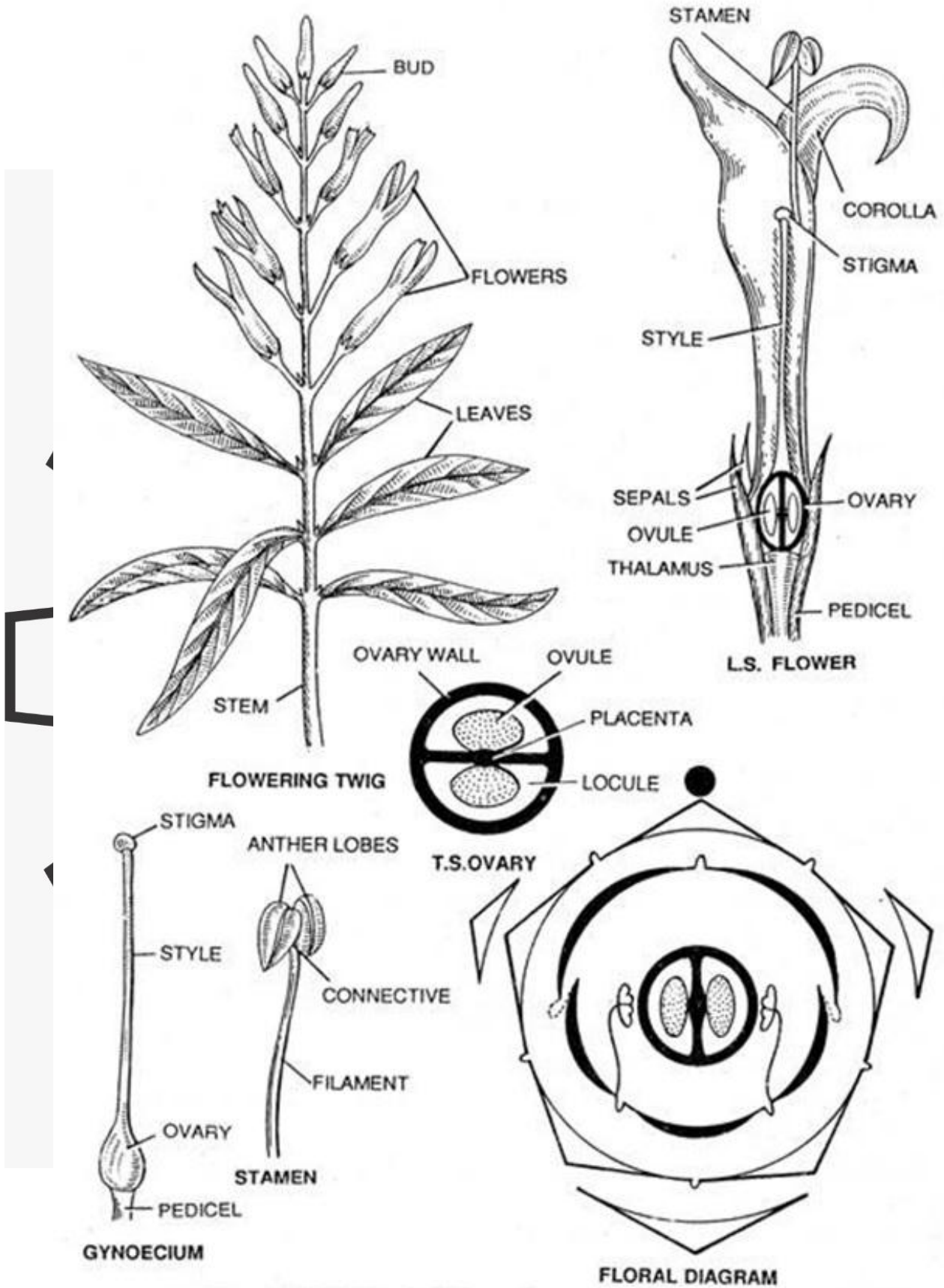
Androecium: 2 stamens, free, epipetalous, inserted on the upper part of the corolla, filaments long, anthers bicelled, basifixed.

Gynoecium: 2 carpels (bicarpellary), syncarpous, ovary superior, bilocular, axile placentation, two ovules in each locule, style filiform, stigma bifid.

Fruit: A capsule.

Floral Formula:

$\text{+} \frac{\text{♂}}{\text{♀}} \text{K} (5), \overline{\text{C}}(2+3) \text{A} 2 \underline{\text{G}}(2)$



Acanthaceae. *Justicia gendarussa* Brum; Verna.Nilli-Margandi.

***Ruellia* sp:**

Habit: An erect wild annual herb, common in the gardens near moist places.

Stem: Erect, branched, herbaceous, cylindrical, solid green.

Leaf: Simple, opposite decussate, sub-sessile, ovate, entire, acute, glabrous, unicostate reticulate venation.

Inflorescence: Cymose, dichasial cyme.

Flower: Pedicellate, bracteate, bracteolate, hermaphrodite, zygomorphic, funnel shaped, bluish pink, complete, hypogynous.

Calyx: 5 sepals, gamosepalous (connate at the base), acute, sepaloid, valvate aestivation, inferior.

Corolla: 5 lobes, funnel shaped, gamopetalous, bluish-pink, twisted aestivation, inferior.

Androecium: 4 stamens, polyandrous, epipetalous, anthers bicelled, basifixed, introrse.

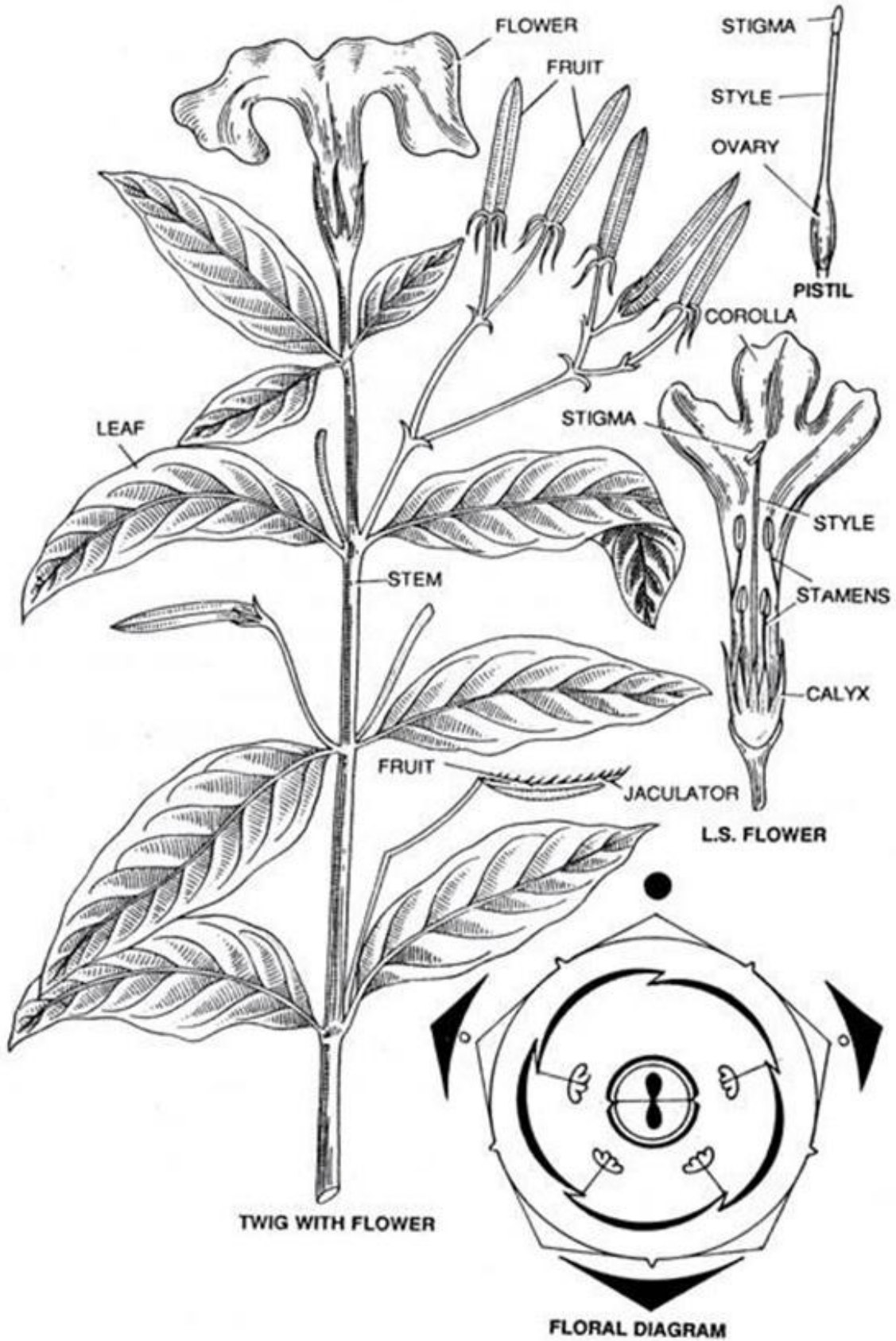
Gynoecium: bicarpellary, syncarpous, ovary superior, bilocular, axile placentation, one ovule in each locule, style slender, stigma single.

Fruit: An elongated capsule with tapering end, ejaculators present.

Floral Formula:



KEY



Acanthaceae. *Ruellia prostrata* Lamk.; Verna. Kalighawani.

CHARACTERS OF FAMILY: RUBIACEAE: Coffee family- Herbs, shrubs or trees, leaves stipulate interpetiolar or intrapetiolar, opposite or whorled. Flowers tetra or pentamerous, stamens alternate to the petals. Ovary inferior, carpels two or more, ovules on axile placentation. Fruit capsule or berry.

Systematic Position:

Class : Dicotyledonae
 Subclass : Metachlamydeae
 Order : Rubiales
 Family : Rubiaceae
 Genus : *Hamelia*
 Species : *patens*

Habit: A large, cultivated, ornamental, evergreen perennial shrub.

Root: Tap root system.

Stem: Aerial, Erect, branched, cylindrical, hairy, differentiated into nodes and internodes, solid, woody.

Leaves: Cauline, ramal, simple, whorled (three or more leaves at each node), cauline, petiolate, stipulate, stipules interpetiolar, ovate, entire, acute, unicostate reticulate venation.

Inflorescence: Cymose, polychasial cyme, each branch is monochasial helicoid cyme.

Flowers: Subsessile, bracteate, ebracteolate, bisexual, actinomorphic, complete, orange coloured, pentamerous and epigynous.

Calyx: 5 sepals, gamosepalous, petaloid, reddish, adnate to the ovary wall, superior valvate aestivation.

Corolla: 5 petals, gamopetalous, tubular, orange coloured, superior, twisted or valvate aestivation.

Androecium: 5 stamens, polyandrous, alternate to the petals, filaments short, epipetalous anthers basifixed, long, bicelled, introrse.

Gynoecium: pentacarpellary, syncarpous, ovary inferior, pentalocular, several ovules in each locule, axile placentation. Style single, terminal and bifid or capitate stigma

Fruit: Berry.

Floral Formula:

$\oplus \overset{\circ}{\underset{\circ}{K}}(5), \overline{C}(5), A(5), \overline{G}(5)$

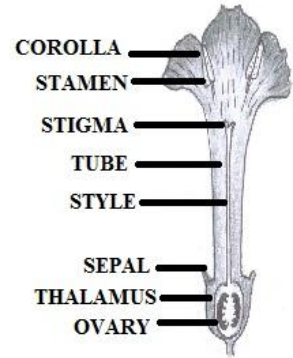




HABIT

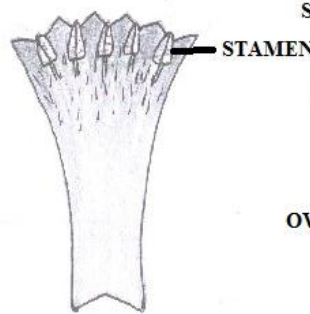


FLOWER



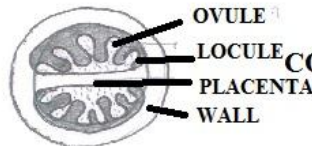
- COROLLA
- STAMEN
- STIGMA
- TUBE
- STYLE
- SEPAL
- THALAMUS
- OVARY

L.S OF FLOWER



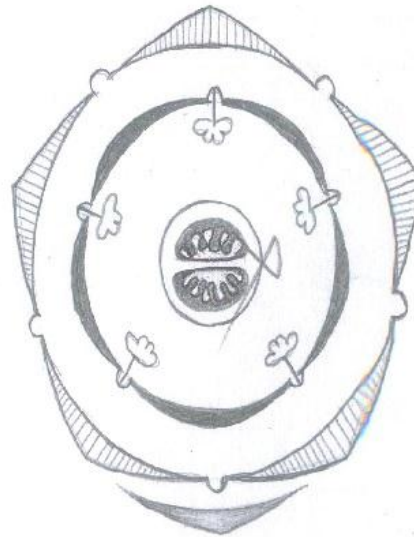
- STIGMA
- STYLE
- OVARY

GYNOECIUM



T.S OF OVARY

COROLLA OPENED



FLORAL DIAGRAM

HAMELIA PATENS

***Ixora coccinea* Linn; Verna. Rangan, Rookmini; Eng. Jungle flame Ixora:**

Habit: A large cultivated ornamental shrub.

Stem: Erect, branched, solid, cylindrical, green, herbaceous or somewhat woody.

Leaves: Cauline and ramal, simple, opposite, sessile, stipulate, ovate, smooth entire, acute, unicostate reticulate venation.

Inflorescence: Cymose, corymbose cyme.

Flower: Bisexual, actinomorphic, pedicellate, bracteate, bracteolate, complete, epigynous, tetramerous.

Calyx: 4 sepals, gamosepalous, superior, valvate aestivation.

Corolla: 4 petals, gamopetalous, corolla tubular, twisted aestivation.

Androecium: 4 stamens, epipetalous, inserted at the mouth of corolla, polyandrous, sessile, anthers bicelled, introrse, dorsifixed.

Gynoecium:

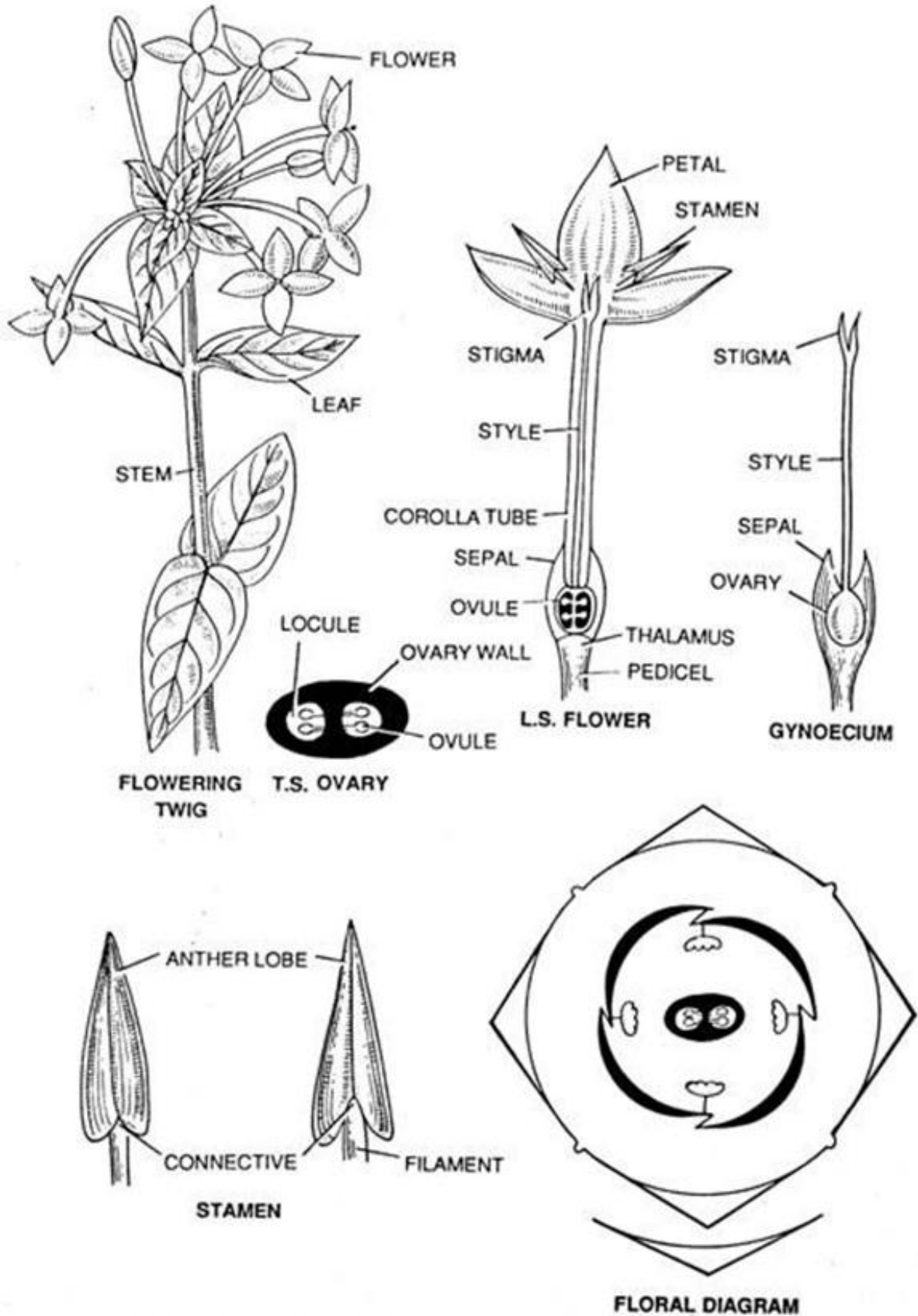
2 carpels (bicarpellary), syncarpous, ovary inferior, bilocular, single ovule in each locule, axile placentation, style very long, stigma single, bifid.

Fruit: Berry.

Floral Formula:

$Br \oplus \overset{\circ}{\underset{\circ}{Q}} K (4), \overline{C} (4), A_4, G (\overline{2})$.





Rubiaceae. *Ixora coccinea* Linn.: Eng. Jungle flame ixora; Verna. Rangan, rookmini.

KEY CHARACTERS OF FAMILY: CUCURBITACEAE: Pumpkin family, climbing or prostrate tendril bearing herbs. Leaves exstipulate, weak stemmed plants with extra-axillary or leaf opposite tendrils. Flowers unisexual, ovary tricarpeal, syncarpous, many ovules on parietal placentation. Stigma trifold, Fruit pepo or berry.

Systematic Position:

Class : Dicotyledonae
 Subclass : Metachlamydeae
 Order : Cucurbitales
 Family : Cucurbitaceae
 Genus : *Coccinea*
 Species : *indica*

Technical description of *Coccinea grandis* (syn. *Coccinea indica*)

Habit: An annual climbing herb, climbs with the help of tendrils.

Root: Taproot, branched and annual.

Stem: aerial, prostrate, herbaceous, weak, green, cylindrical, solid, branched, hairy, tendril-climber.

Leaf: Alternate, exstipulate, simple, petiolate, palmate, dentate margin, mucronate apex, multicostate reticulate venation. Leaf opposite tendrils present.

Inflorescence: Solitary axillary cyme.

Male flower:

Bracteate, ebracteolate, pedicellate, incomplete, staminate, actinomorphic, pentamerous.

Calyx: Sepals 5, gamosepalous, green, campanulate, hairy, valvate or imbricate aestivation.

Corolla: Petals 5, gamopetalous, campanulate, valvate or imbricate aestivation.

Androecium: Stamens 5, synandrous found in the form of (2+2+1), seemingly 3; 4 stamens fused in two groups of 2 each, one free; anthers are monothealous, basifixed, extrorse and coiled.

Gynoecium: Absent.

Female flower:

Bracteate, ebracteolate, pedicellate, incomplete, pistillate, actinomorphic, pentamerous, epigynous.

Calyx: Same as in the male flower.

Corolla: Same as in the male flower.

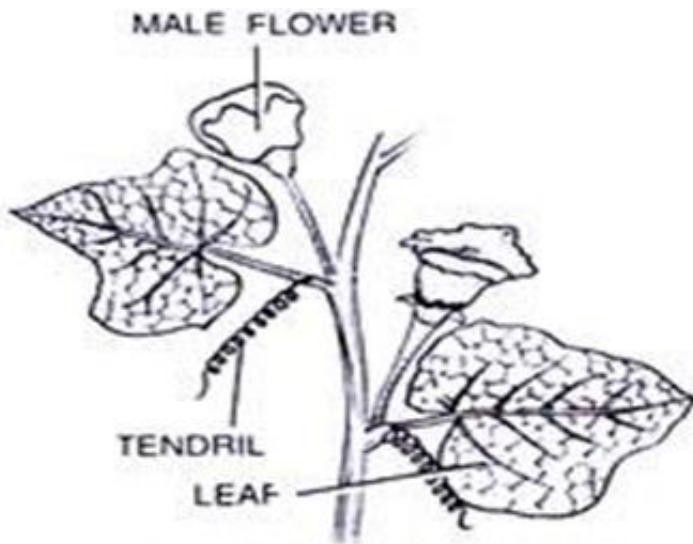
Androecium: Absent, staminodes are present.

Gynoecium: Tricarpeal, syncarpous, ovary inferior, trilocular, parietal placentation, style long and slender, stigma 3 and each is bilobed.

Fruit: Pepo

Floral formulae:

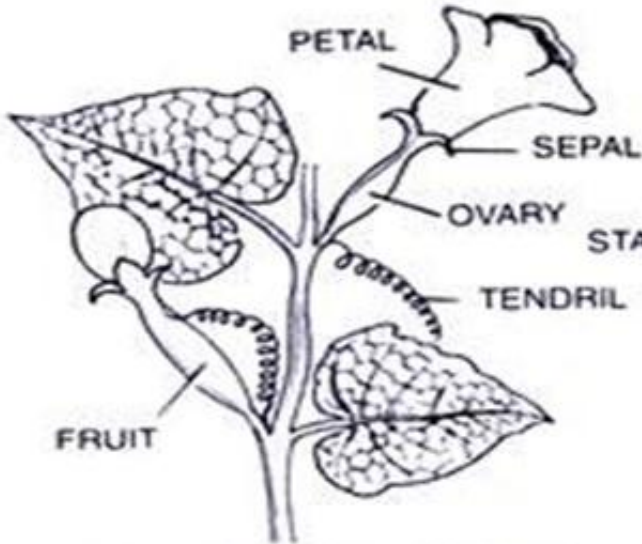
Male flower – $Br \oplus \sigma K (5) C (5) A (2) + (2) + 1 G_0$
Female flower – $Br \oplus \phi K (5) C (5) A 3std G (3)$.



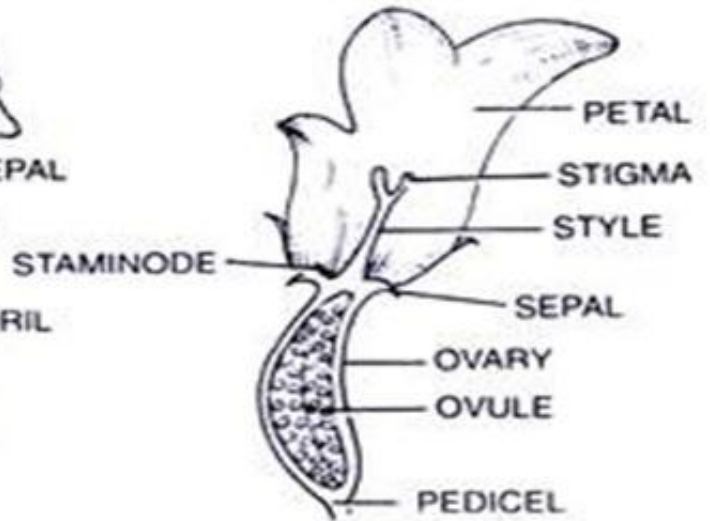
A MALE FLOWERING TWIG



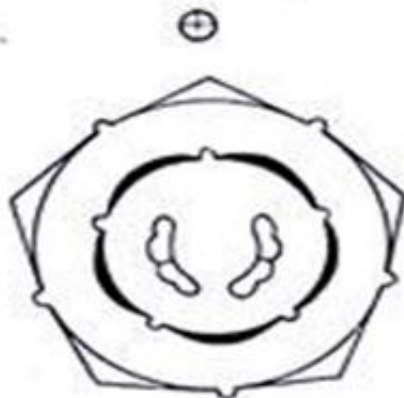
L.S. MALE FLOWER



A FEMALE FLOWERING TWIG



L.S. FEMALE FLOWER



FLORAL DIAGRAM (MALE)

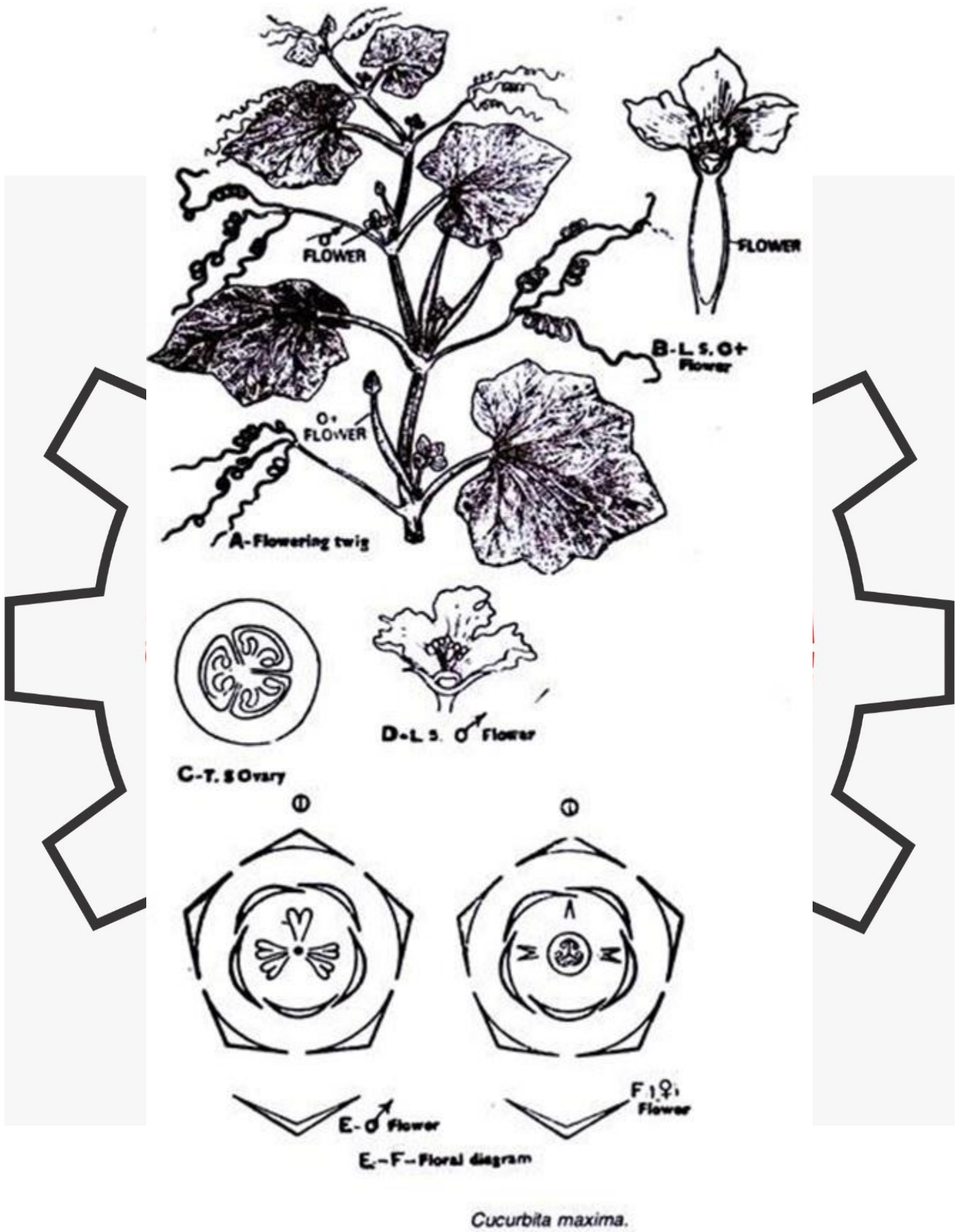


FLORAL DIAGRAM (FEMALE)
Coccinea grandis.

Cucurbita maxima**Habit:** A cultivated climber.**Root:** Taproot, branched.**Stem:** Herbaceous, prostrate, weak, hairy, angular, fistular, juicy, green.**Leaf:** Alternate, petiolate, exstipulate, simple, palmate, hairy, toothed margin, multicostate reticulate venation.**Inflorescence:** Female flowers solitary axillary but male flowers in cymose clusters.**Flower:** Unisexual.**Male flower:** Bracteate, pedicellate, actinomorphic, incomplete, staminate, yellow.**Calyx:** Sepals 5, gamosepalous, green, hairy, lobes linear or leafy, imbricate aestivation.**Corolla:** Petals 5, gamopetalous, campanulate, yellow, imbricate aestivation.**Androecium:** Stamens 5, Synandrous, two united in two pairs and one free, anthers twisted spirally mono and ditheous, extrorse.**Gynoecium:** Absent but pistillode present.**Floral formula:** $Br. \oplus \delta K (5) C (5) A (2) + (2) + 1 G_0$ **Female flower:**

Bracteate, pedicellate, pistillate, actinomorphic, incomplete, epigynous.

Calyx: Sepals 5, gamosepalous, green, hairy, lobes linear, imbricate aestivation, superior.**Corolla:** Petals 5, gamopetalous, campanulate, yellow, imbricate aestivation, superior.**Androecium:** Absent but staminodes present in three bundles 2 + 2 + 1.**Gynoecium:** Tricarpellary, syncarpous, ovary inferior, unilocular, parietal placentation. Ovules many on each placenta, style one stigma 3 forked.**Floral formula:** $Br \oplus \varphi K (5) C (5) A_{3std} G(3)$ 



Cucurbita maxima.

KEY CHARACTERS OF THE FAMILY: COMPOSITAE OR ASTERACEAE: Sunflower or aster family, Mostly herbs, vines or shrubs, rarely trees with involucre of head or capitulum inflorescence. Pappus often present. Stamens Syngenesious, ovary inferior, single celled, ovules on basal placentation. Fruit cypsela.

Systematic Position:

Class : Dicotyledonae
 Subclass : Metachlamydeae
 Order : Comanulales
 Family : Asteraceae or Compositae
 Genus : *Helianthus*
 Species : *annus*

Habit: It is an annual cultivated herb.

Root: tap root and branched.

Stem: aerial, erect, herbaceous, branched usually covered with hairs, conspicuous nodes and internodes present.

Leaf: aerial, simple, exstipulate, petiolate. Surface is hairy. Leaf margins are entire or serrate. Tip is acute, venation reticulate.

Inflorescence: Racemose, Head or Capitulum surrounded at the bases by a group of involucre. The receptacle is flat. The flowers in the receptacles are florets. There are two types of florets:

- **Homogamous:** In this case, all flowers are of same kind.
- **Heterogamous:** In this case, two types of flowers are present in the capitula. Example: Sunflower. Sunflower has two types of small flowers, disc florets and ray florets. The disc florets are present in the central region. They are tubular and bisexual. The ray florets are present towards the periphery. They are pistillate.

Ray florets: Sessile, unisexual, zygomorphic, irregular, ligulate or bracteate.

Calyx: Represented by pappus (small hairy structure) or may be absent.

Corolla: Petals 5, gamopetalous, may be bilabiate or ligulate.

Androecium: Absent

Gynoecium: bicarpellary, inferior ovary, unilocular, with single anatropous ovule, basal placentation.

Fruit : Cypsela (acheneal single seeded fruit).

Seed – Non-endospermic.

Floral formula:

Disc Florets: Sessile, bisexual, actinomorphic, regular, bracteate, complete and epigynous.

Calyx: Rudimentary, pappus.

Corolla: Petals 5, gamopetalous, tubular, 5 lobed, swollen near the base (where nectaries are present), valvate aestivation, variously coloured.

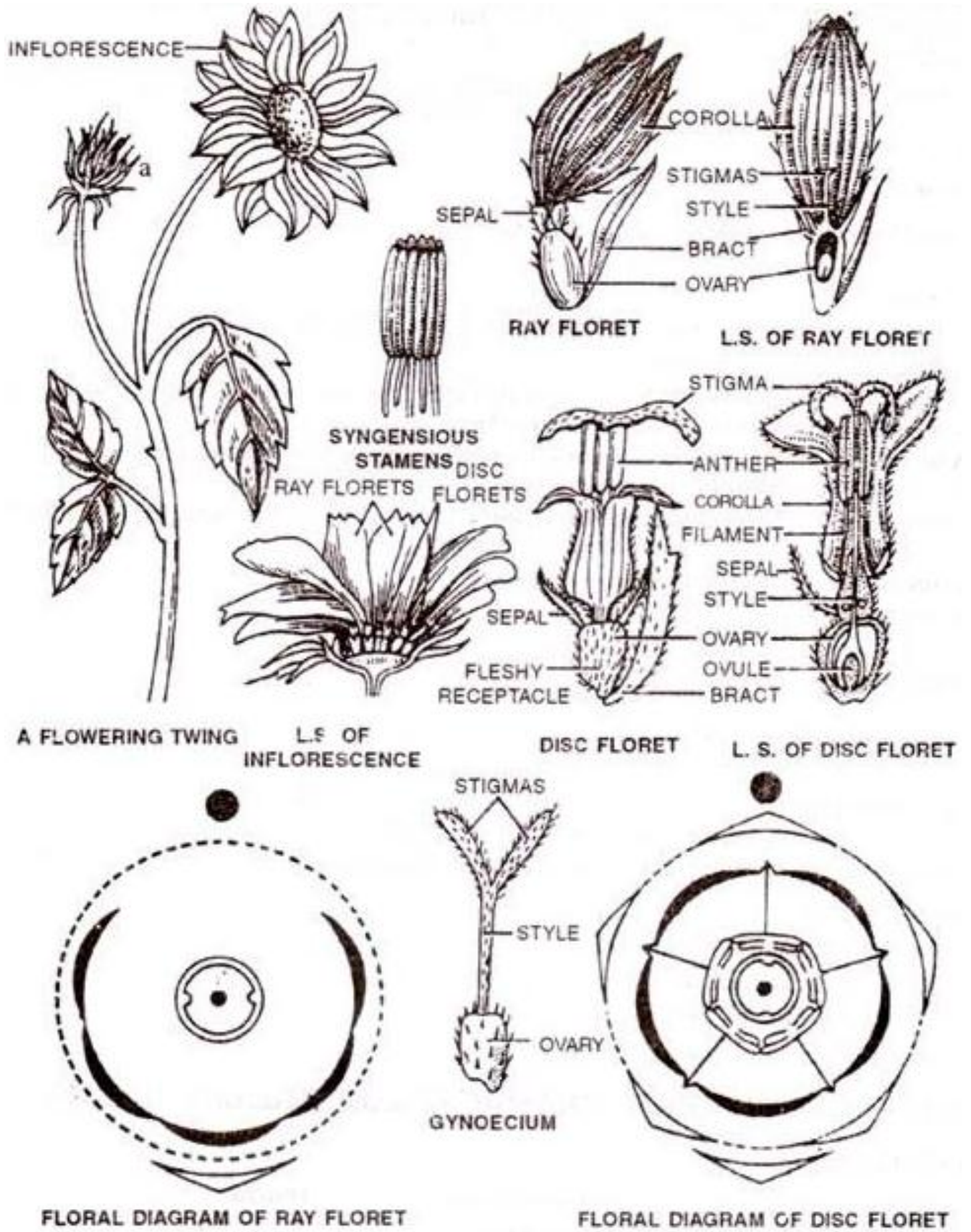
Androecium: 5 stamens, epipetalous, alternate with corolla lobes, anthers are introse, ditheous. United laterally in to a tube, filaments free, syngenesious.

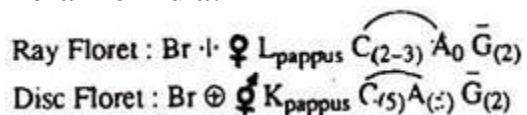
Gynoecium: Carpels 2, (bicarpellary), inferior ovary, unilocular, with single anatropous ovule, basal placentation.

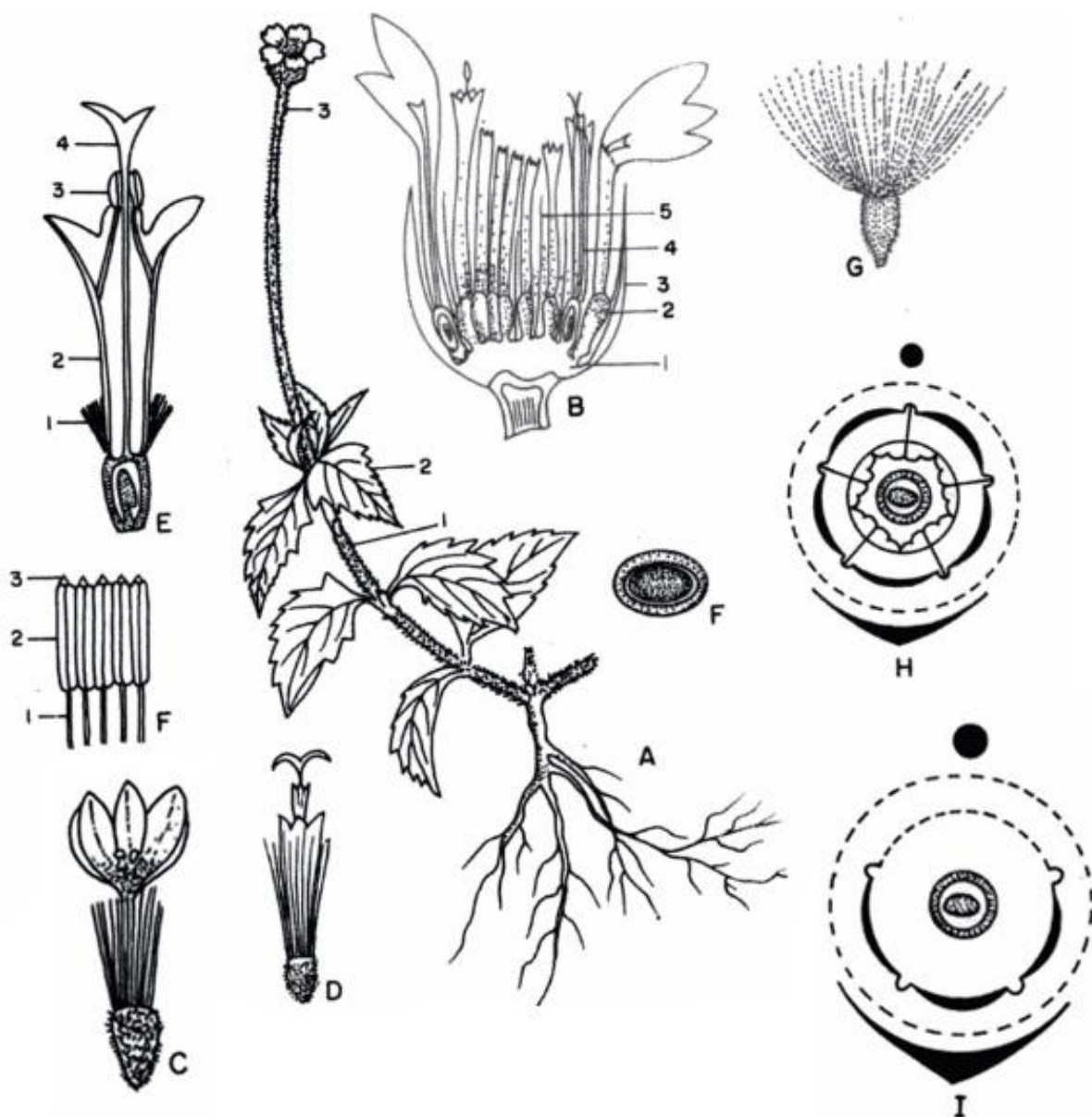
Fruit: Cypsela (acheneal single seeded fruit).

Seed: Non-endospermic.

Floral formula:



Tridax procumbens* L.*Habitat:** Mesophyte.**Habit:** It is a wild decumbent annual herb.**Root:** Tap-root adventitious roots from nodes and internodes touching the soil, narrow, much branched.**Stem:** Solid, terete, herbaceous, branched, watery sap present, green, upper side brownish, hispid, divided into nodes and internodes.**Leaf:** cauline, ramal, Simple, petiolate opposite-decussate, exstipulate; ovate-lanceolate, dentate, acute, pubescent with unicostate reticulate venation.**Inflorescence:** Head or Capitulum, terminal, heterogamous, the peduncle is highly reduced into flattened structure and the cup is formed by the fusion of involucre of bracts. Florets spirally arranged, much reduced, into two types: (i) Ray Florets & (ii) Disc Florets. Ray florets are found at the peripheral region and disc florets are found on the central region of the cup.**Ray Floret:** bracteate, ebracteolate, sessile, zygomorphic, incomplete, unisexual, pistillate and epigynous.**Calyx:** Sepals are highly reduced into hair like structures called pappus, white in colour, persistent with valvate aestivation.**Corolla:** Petals 5, gamopetalous, ligulate, tubular, unequal, campanulate, posterior two petals are highly reduced and inconspicuous, anterior three petals are yellow in colour with valvate aestivation.**Androecium:** Absent.**Gynoecium:** Carpels – 2, syncarpous; ovary inferior, monolocular, single ovule on basal placentation, style terminal, stigma bifid.**Disc Floret:** bracteate, ebracteolate, sessile, actinomorphic, complete, bisexual and epigynous.**Calyx:** As in ray florets.**Corolla:** Petals – 5, gamopetalous, tubular, campanulate, light yellow in colour with valvate aestivation.**Androecium:** Stamens – 5, epipetalous, filaments long, slender, attached to the corolla tube, anthers syngenesious, Anthers are fused to form a tube around the style, filaments free, ditheous, basifixed, introrse.**Gynoecium:** As in ray-florets.**Fruit:** Cypsella, slightly compressed black, silky, crowned with white bristly pappus, 1-seeded.**Floral Formula:**



Tridax procumbens

A: Flowering twig ; 1. Stem, 2. Leaf, 3. head inflorescence

B: L.S. Inflorescence 1. Receptacle, 2. Ray floret, 3. Bract, 4&5 Disc florets

C: Ray floret; D: Disc Floret; E: L.S. Ray floret 1. Pappus, 2. Corolla, 3. Anther, 4. Stigma

F: Androecium 1. Filament, 2. Anthers, 3. Hood G.T.S. Ovary G: Fruit H. Floral diagrams and I

ECONOMIC BOTANY
STUDY OF SOME ECONOMICALLY IMPORTANT PLANTS

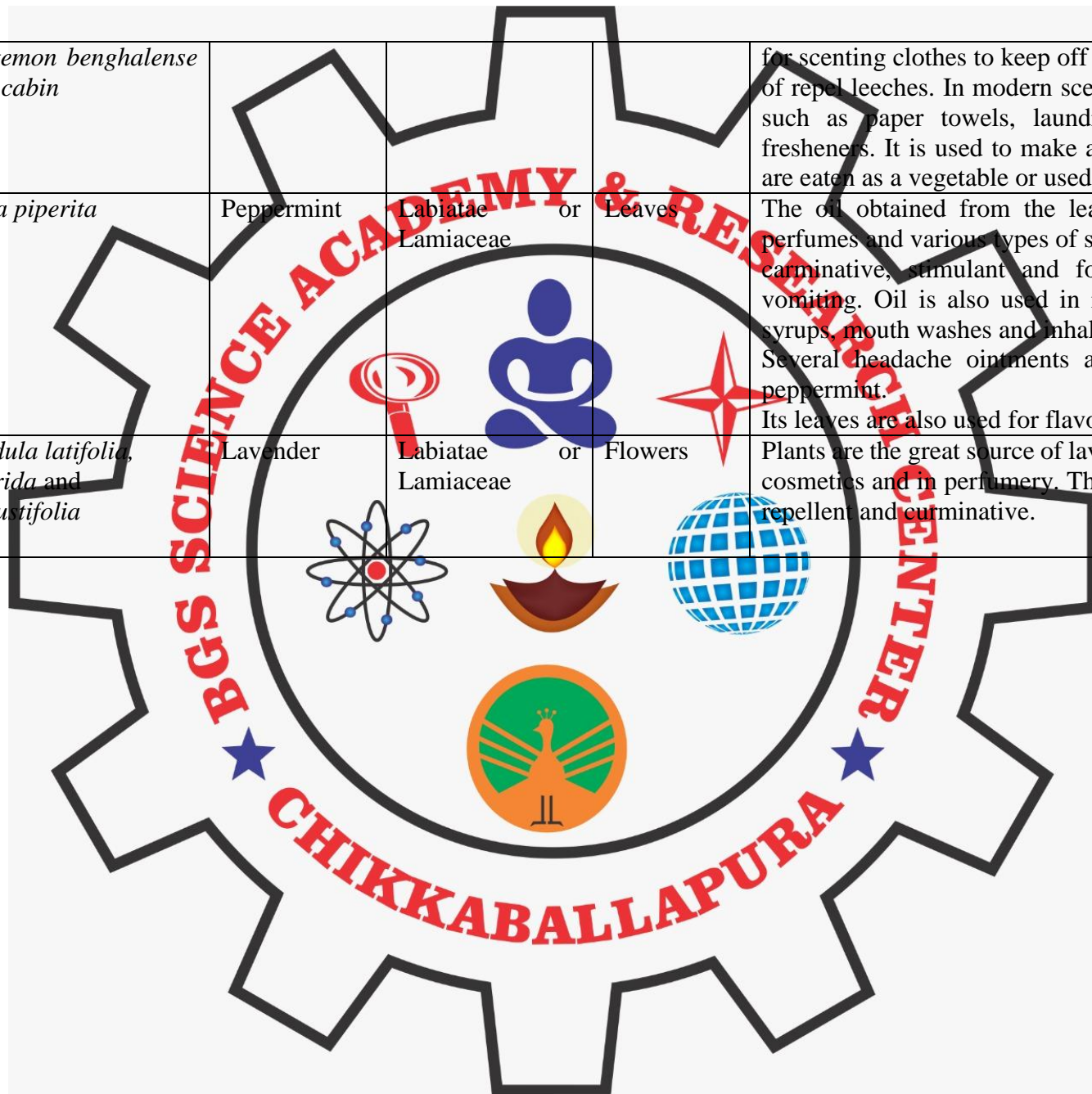
SL. NO	BOTANICAL NAME	COMMON NAME	FAMILY	PART USED	USES
I. EDIBLE OILS					
	<i>Arachis hypogea</i>	Ground nut	Fabaceae	Seed	Used to extract groundnut oil used in domestic food preparations, soap industries and cake used as cattle fodder.
	<i>Cocos nucifera</i>	Coconut	Aracaceae	Seed	Used to extract coconut oil, used as edible oil in food preparations, shampoo and soap industries.
	<i>Sesamum indicum</i>	Sesamum	Pedaliaceae	Seed	The seeds of this herb yield an edible oil used in confectionery and for making margarine, soaps, cosmetics, insecticides, perfumes and several medicines.
II. SUGAR AND STARCH					
	<i>Saccharum officinarum</i>	Sugarcane	Poaceae	Stem juice	Used in manufacture of sugar and also extract alcohol
	<i>Beta vulgaris</i>	Beet root	Chenopodiaceae	Tap root	Used as vegetables and also as a source of starch
	<i>Solanum tuberosum</i>	Potato	Solanaceae	Stem tuber	Used as vegetables and also as a source of starch
	<i>Manihot esculenta</i>	Tapioca	Euphorbiaceae	Tuberous roots	Used as vegetables and also as source of starch.
III. FIBERS					
	<i>Gossipium hirsutum</i>	Cotton	Malvaceae	Seed hairs	Used in textile industries to manufacture cloths, bandages and also used in bedding industries to prepare cushions, sofa etc.
	<i>Corchorus capsularis</i>	Jute	Tiliaceae	Phloem fibres	Used in manufacture of rough cloths, gunny bags, sacks, mats, ropes, threads etc
	<i>Cocos nucifers</i>	Coir	Aracaceae	Fruit wall fibres	Used to manufacture ropes, mats and also used in bedding industries.
IV. PAPER AND PULP					
	<i>Dendrocalamus sps</i> <i>Bambusa sps</i>	Bamboo	Poaceae	Stem	Stem pulp used in paper industries, paper used as stationary goods, tissue paper, napkins, newspapers, card boards etc.
	<i>Eucalyptus sps</i>	Eucalyptus	Myrtaceae	Stem	Stem pulp used in paper and textile

V. BEVERAGES					
<i>Coffea Arabica</i>	Coffee	Rubiaceae	Dried cotyledons	Used to prepare nonalcoholic beverage	
<i>Thea sinensis or Camellia sinensis</i>	Tea	Theaceae	Young dried leaves	Used to prepare nonalcoholic beverage	
<i>Theobroma cacao</i>	Cocoa	Sterculiaceae	seeds	The seeds on grinding yield cocoa and chocolate.	
VI. SPICES					
<i>Zingiber officinale</i>	Ginger	Zingiberaceae	Rhizome	Ginger is stimulant, carminative and diaphoretic. It is used in cold and cough and as a febrifuge. It is used to flavour food stuff, beer and other drinks. It is used as a condiment in curries.	
<i>Elettaria cordamomum</i>	Cardamom	Zingiberaceae	Seed	Used as spices in domestic food preparations and in condiments to increase the flavor.	
<i>Syzygium aromaticum</i>	Clove	Myrtaceae	Flower bud	Used to extract clove oil and is used as medicine to cure tooth ache, tooth paste and in preparation of condiments.	
<i>Cinnamomum zeylanicum</i>	Cinnamon	Lauraceae	Stem bark	Used as spices in domestic food preparations.	
<i>Ferula assafoetida</i> and <i>F. narthex</i>	Asafoetida	Umbelliferae or Apiaceae	Gum Resin	It is widely used in vegetable curries, sauces, and other foodstuffs. It is used in the treatment of cough, asthma, nervous affections, pneumonia, and bronchitis and whooping cough in children. It helps in digestion and metabolism of food.	
<i>Curcuma longa</i>	Turmeric	Zingiberaceae	Rhizome	Food, flavourant and adjunct. Also used as stimulant, Carminative, expectorant etc. Used as Cosmetic for beautifying skin problems	
<i>Crocus sativas</i>	Saffron	Iridaceae	Dried Stigma	Apart from flavouring and colouring properties it has extraordinary medicinal value also. Mostly used in exotic dishes like sweets, Biryani etc. It is effective medicine with ghee for diabetes.	
<i>Myristica fragrans</i>	Nutmeg	Myristicaceae	Dry seeds	Nutmeg are condiment. It has medicinal properties also. It cures dysentery, vomiting, Malaria, nausea etc. It has	

					carminative, aphrodisiac and astringent properties. It is also used in perfumery.
VII.	TIMBER				
	<i>Tectona grandis</i>	Teak	Verbenaceae	Stem heart wood	Used in cabinet works house building, furniture, ship and boat building etc.
	<i>Dalbergia latifolia</i>	Rosewood	Fabaceae	Stem wood	Used in manufacturing furniture, door, ship, boat and cabinet making etc
VIII.	MEDICINAL PLANTS				
	<i>Withania somnifera</i>	Ashwagandha	Solanaceae	Roots	Used as a tonic in geriatrics promote strength and vigour aphrodisiac and rejuvenator. It is used for the treatment of rheumatic pain, inflammation of joints and certain paralytic conditions. used for all types of nervous disorders and as sedatives in the treatment of insanity and in hypertension. Roots have long been in use for hiccup, cough, dropsy, rheumatism, and female disorders.
	<i>Aloe barbedensis</i>	Indian Aloe	Liliaceae	Leaves	After removing the skin of leaves they are given in fevers, enlargement of the liver, spleen and other glands, skin diseases, gonorrhoea, constipation, menstrual suppression, piles, jaundice and rheumatic affections. The juice of roasted leaf is being given with honey for cough and cold. The pulp of one leaf is being given daily in abdominal tumors, dropsy, carbuncles, piles, sciatica, rheumatism and retention of urine in fevers. A salad of leaves is eaten in indigestion, constipation and flatulence. The leaf juice is given as a remedy for intestinal worms in children. A poultice of the leaves is applied to tumours, cysts, inflamed parts and scalds.
	<i>Centella asiatica</i>	Indian Pennywort	Umbelliferae (Apiaceae)	Leaves	The weed is alterative, tonic, diuretic, antiphlogistic, blood purifier and local stimulant. It is a remedy for skin diseases, like chronic eczema, chronic ulcers etc., enlargement of glands, chronic rheumatism, chronic nervous diseases, madness, cholera, amenorrhoea and

					<p>piles. The leaves are a household remedy in early stages of dysentery of children.</p> <p>The powder of leaves is given with milk in small doses in mental weakness and to improve memory. The fresh juice of leaves mixed with milk is given as an alternative in gonorrhoea, jaundice and fevers; this is also useful for children in skin diseases and for improving the blood and nervous system. An ointment made of leaf juice and lanoline is of great value in elephantiasis.</p>
<i>Ocimum sanctum</i>	Holy Basil	Labiatae	Leaves	<p>The leaves are expectorant, stomachic, anticatarrhal, diaphoretic and aromatic; their decoction or infusion is given in malaria, gastric diseases of children and liver disorders; as a prophylactic against malaria fresh leaves are taken with black pepper in the morning. The leaf juice is given in chronic fever, haemorrhage dysentery and dyspepsia; it is also used to check vomiting and as an anthelmintic.</p>	
<i>Emblica officinalis</i>	Amala	Euphorbiaceae	Fruit	<p>The fruit is one of the richest sources of vitamin C. The fresh fruit is refrigerant, tonic, antiscorbutic, diuretic and laxative. It is used in fevers, vomiting, indigestion, habitual constipation and other digestion troubles. The dried fruit is a good astringent, refrigerant, stomachic, antiscorbutic and blood purifier. It is given in diarrhoea, dysentery and haemorrhage. The infusion of seeds is a useful eye-wash in ophthalmic diseases.</p>	
<i>Vinca rosea or Catharanthus rosea</i>	Catharanthus vinca	Apocyanaceae	Root bark	<p>Used in depressions of nervous systems against wasp stings. Relaxation of muscle pains, antibacterial agent.</p>	
<i>Azadirachta indica</i>	Neem (Margosa tree)	Meliaceae	All parts of plant body	<p>Used in tooth paste, soaps, shampoos, skin disorders. Seed cake used in fertilizer industries etc. seed oil is used in medicines.</p>	
<i>Pogostemon perilloides</i>	Patchouli	Labiatae or Lamiaceae	Leaves	<p>The leaves yield an essential oil, which is used for making soaps and perfumes. The dried leaves are used</p>	

	<i>Pogostemon benghalense</i> and <i>P. cabin</i>				for scenting clothes to keep off insects. The leaf extract of repel leeches. In modern scented industrial products such as paper towels, laundry detergents, and air fresheners. It is used to make an herbal tea and leaves are eaten as a vegetable or used as a seasoning.
	<i>Mentha piperita</i>	Peppermint	Labiatae Lamiaceae	or Leaves	The oil obtained from the leaves is widely used in perfumes and various types of soaps. The oil is used as carminative, stimulant and for treating nausea and vomiting. Oil is also used in rheumatic pains, cough syrups, mouth washes and inhalations. Several headache ointments are also prepared from peppermint. Its leaves are also used for flavouring purposes.
	<i>Lavendula latifolia</i> , <i>L. hybrida</i> and <i>L. angustifolia</i>	Lavender	Labiatae Lamiaceae	or Flowers	Plants are the great source of lavender oil used in soaps, cosmetics and in perfumery. The oil also used as insect repellent and curminative.



Plant Collection

Field work is one of the most essential part in the Botanical study. It permits to come across many types of plants, otherwise not seen and available in the laboratory. It is, therefore, advisable to go round many localities and explore their vegetation. Organised excursions or outings, led by experienced persons, add to the knowledge of common plants in nature. While on a collection trip, local or outstation, following things are to be carried along.

- (1) **Containers.** For packing the collected material, preferably carry plastic unbreakable containers or polythene bags.
- (2) **Preservatives.** Formalin-Acetic-Alcohol (FAA) or Alcohol 70% or Alcohol 90%, and/or Formalin 6%-10%.
- (3) **Other requirements.** Scalpel knife, blade, forceps, pencil, paper, a hand lens, a bag or vasculum for keeping plants or plant press with many newspapers or blotting papers. After collecting the plant, it should be immediately killed and preserved or pressed to avoid its rotting and dehydration. Plants -are either sprinkled or immersed with a little of the killing agent at the spot. On return to the laboratory collected material should be transferred to new and suitable containers with fresh preservative. The plants should be completely immersed in the preservative.

A few plants e.g. filamentous algae, fungi, reproductive parts of bryophytes, fertile parts of pteridophytes and different parts of gymnosperms and angiosperms if collected in large quantities, are preserved in containers. But if materials (except a few algae and fungi) are collected in lesser quantities a herbarium sheet is prepared. Even if large quantity of such plants is available, one plant with fertile parts be preserved in the form of a herbarium sheet, while others should be packed in CI container. Every tube should be labelled. It is desired to write the name of the specimen, place and date of collection. The place of collection and date should also be written on a small piece of white card with a pencil, on the spot and inserted in the container. On return to laboratory, material is identified with the help of standard books. A label bearing name of the division and class to which the material belongs, the name of the material, date and place of collection and also the name of student is pasted on the container. All the containers should be of uniform size as far as possible.

Herbarium techniques

A collection of dried plant specimen, mounted on sheets is known as herbarium. Freshly-picked specimen are dried and pasted on mounting paper of regulation-sized herbarium sheets. The purpose of such a collection is to study the vegetation of a locality and maintain its record.

[I] Preparation of herbarium sheets

1. **Equipment-** On excursion, for the collection of plants, several items required to be carried include-
 1. Trowel or pick,
 2. Collecting can (vasculum) or field plant press,
 3. Heavy laboratory plant press,

4. Blotting papers or newspapers,
5. Collecting sheets,
6. Mounting sheets,
7. Gum, gummed tape, labels, notebook, pen and pencil, etc.

Trowel or pick is used to dig out the plant as a whole wherever possible. A light-weight field press is most practical. It is made by taking two pieces of ply board or heavy binder's board of 12" X 17" size. These are held together by two pieces of heavy cord or ~trar~ tied or buckled together and press can be carried over the shoulders. A heavy plant press carries sheets of size at least 11.5 x 17 inches. It is made of iron and tied and tightened by iron chain and screws. This is used for pressing specimen after they are brought to the laboratory. Vasculum may be used in case only a small number of plants are to be brought back.

2. Collection- Collected plants are placed in the collecting sheets. The most practical size is 16.5 x 23 inches; when folded 16.5 x 11.5 inches. Old newspapers serve this purpose to an appreciable extent and a large supply should always be included in the kit. A specimen collected should represent root, stem, leaves' and flowers. The plants are placed between the sheets or newspapers in such a way that relation between different organs is maintained. Herbaceous plants, 2 feet or less higher, may be collected entire. These can be bent to V or N shape whenever necessary. The most desirable is to collect a branch, about one foot high, containing leaves and flowers. In cases, where entire plant or branch cannot be folded to the size of herbarium sheet, only reproductive and fruiting parts and a stem with a few leaves are collected. Delicate reproductive parts collapse even if pressed fresh. These can be pressed perfectly by applying bits of moist paper to the fresh reproductive structures and spreading them when plants are placed in the press. If parts of the herbaceous plant are thick and difficult to dry, split them before placing on the collecting sheet. Water plants collapse if dried by usual method. These should be rolled up in wet paper when in the field and brought to the laboratory. On return to the laboratory, these plants are placed in water and floated out on sheets of white paper. The sheets are taken out of water carefully, so that the various parts do not cohere. The white sheets are placed in the blotting paper and then dried as usual. After specimen has been collected and placed in collecting sheet, it is kept in plant press. This collecting sheet be placed in between blotting papers, one on either side. While on collection it is important to note date, locality, habitat, height, method of branching, colour of reproductive parts, common name, etc. This should be noted separately in a field-book.

3. Pressing- The collecting sheets should be transferred to a heavy laboratory press. It must be remembered that specimen would acquire the same shape, as on collecting sheet, after pressing. The press is securely tightened. It may also be equally useful if field press is kept under heavy weight. The press should be placed in a warm, well-aired place to dry. After 24 hours, press is taken out and opened. The old newspapers and blotting sheets are replaced by new unused ones. At least such 3-4 changes are given at an interval of 2-3 days. An average specimen takes about a week for complete drying. Sometimes to hasten the process of drying, plant press may be placed near the source of heat.

4. Mounting- The specimen are ready for mounting once they are completely dry. The standard size of the sheet is 16.5 x 11.5 inches. However, 16 x 10 inches size also has been used. The paper should be of

good weight and not thin and flexible. The quality should be so, that it does not turn yellow even with a considerable lapse of time.

To mount, one of the following methods would be found convenient –

1. The gum is spread on a glass plate and specimen is laid on it. As soon as all the parts come in contact with gum, it is lifted and then placed in a position on a mounting sheet.
2. The specimen is inverted and painted with gum by a brush and then transferred to a mounting sheet.
3. The specimen is placed on a herbarium sheet and small strips of gummed tape or cellulose tape are pasted at suitable places, so that most of the part remains loose. After mounting the specimen, a label is pasted in the right hand lower corner of the sheet. This carries information regarding botanical name of the plant, common name, date, collector's name, place of collection, etc.

5. Arrangement of sheets- The sheets, are finally arranged in accordance with standard classification (preferably Bentham and Hooker's for Angiosperms or the most accepted ones for other groups of plants). The sheets are arranged into groups according to species, genera, families, classes, orders, series and sub - divisions, etc. Each group is placed in a separate envelope, slightly larger than the herbarium sheets (e.g. 17 x 12 or 17 x 11 inches). Each of such envelopes must be labelled and a proper index be written or pasted over it.

6. Care of sheets- Herbarium sheets are often attacked by museum pests, fungi, etc. To guard against them, specimen are fumed with carbon bisulphide, 3-4 times a year. Mounted specimen may also be treated with mercuric bichloride or copper sulphate. To prevent them from attack, powdered naphthalene balls or gajakene powder be also spread from time to time. This ensures durability and long life of the herbarium sheet.

