B.SC. SEMESTER-II

BOTANY PAPER-II

(MORPHOLOGY OF ANGIOSPERM AND FLORICULTURE)

UNIT-II: (Reproductive Morphology)

1. Inflorescence: Definition, Racemose, Cymose and Special types

2. Flower: Definition, Structure of Typical flower, Variation in thalamus (Androphore, Gynophore and Gynandrophore)

3. Calyx and corolla: Cohesion. Forms of corolla and Aestivation.

4. Androecium: Parts, Cohesion, Adhesion and Fixation.

Inflorescence

- The arrangement of flowers on the floral axis (shoot system) of a plant is called inflorescence.
- The character of inflorescence has profuse taxonomic significance.
- This characteristic is found to be constant in a number of families and helps in taxonomic identifications, e.g., capitulum in Asteraceae, verticellaster in Lamiaceae (Labiatae), umbel in Apiaceae (Umbelliferae) etc.
- In some cases it helps to identify the genera like Hamelia of Rubiaceae with helicoid cyme and Heliotropium of Boraginaceae with scorpioid cyme etc.

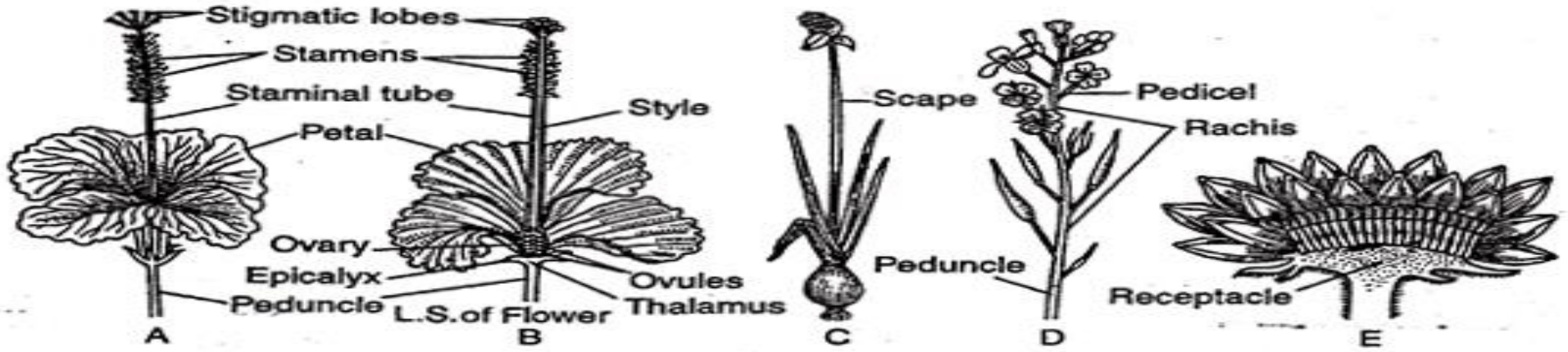


Fig. 2.79 : Different kinds of flower and inflorescence bearing regions : A. Peduncle of the china-rose, B. L.S. of flower of china rose, C. Scape of the onion, D. Peduncle and pedicel of the mustard, and E. Receptacle of the sunflower (shown in L.S. of Capitulum)

- The main axis or stalk of a solitary inflorescence is called the peduncle .
- In many cases, the main axis branches out and bears flower at the branch apex, the main axis is called peduncle and the stalk of individual flower is called pedicel.
- A long, simple or branched peduncle is called a rachis.
- The small central axis of a grass or sedge spikelet is called rachilla.
- The unbranched naked peduncle developing from the underground stem is called scape or radical peduncle .
- The flower with pedicel is called pedicellate flower and those without them are called sessile flower.
- The dilated or flattened peduncle is called receptacle .

- The stage or platform on which the floral parts situated is called thalamus.
- The conical receptacle is called torus.
- Inflorescence with unbranched peduncle is called simple inflorescence and if branched, it is called compound inflorescence.
- Sometimes, the flowers as well as inflorescences are subtended by an expanded leafy organ, called bract and flowers having bract is called bracteate flower and without bract it is called ebracteate flower.
- Sometimes, very small thin bract-like (leafy or scaly) structures are developed on flower stalk in between flower and bracts, called bracteoles or secondary bracts

Types of inflorescences:-

there are three major types of inflorescence:

I. Racemose (indefinite or indeterminate),

II. Cymose (definite or determinate) and

III. Mixed.

This type is also called indefinite or indeterminate or botryose inflorescence.

A racemose inflorescence is one whose rachis (simple or branched) never ends in a flower and it continues to elongate by means of a persistent growing point.

In this type, stalked or sessile flowers are produced directly or on its branches in a more or less indefinite succession.

- The flowers open acropetally (i.e., oldest flower towards the base and gradually the youngest flowers and buds towards the apex) or centripetally (i.e., the oldest flower towards the margin and the youngest one at the centre on a fleshy and dilated rachis called receptacle).

- The racemose inflorescence can be divided into two groups: Simple racemose and Compound racemose.

Simple Racemose Type:

In this type pedicellate (stalked) or sessile flowers are directly borne on the main axis.
Flowers pedicellate (stalked).

a. Raceme:

- The main axis has indefinite growth, where more or less equally pedicellate flowers are borne,

- e.g., radish, Raphanus sativus and mustard, Brassica nigra of Brassicaceae; Gynandropsis gynandra and Polanisia icosandra of Capparidaceae etc

b. Corymb:

- The main axis is comparatively shorter and the lower flowers have much larger pedicels than the upper ones, so that all the flowers are brought more or less at the same level,
- e.g., cherry, Prunus cerasus of Rosaceae ,Cassia sophera of Fabaceae; candytuft, Iberia amara of Brassicaceae etc.

c. Umbel:

- The main axis is much shortened and the flowers appear to develop from the same point.
- The older flowers are towards the periphery and the younger flowers towards the centre.
- Thus, it looks like an open umbrella.
- Flowers are usually bracteate and the bracts collectively form an involucre at the base of the pedicellate flowers,
- e.g., Indian pennywort, *Centella asiatica* and *Coriandrum sativum* of Apiaceae (Umbelliferae); *cherry, Prunus cerasus* during young stage.

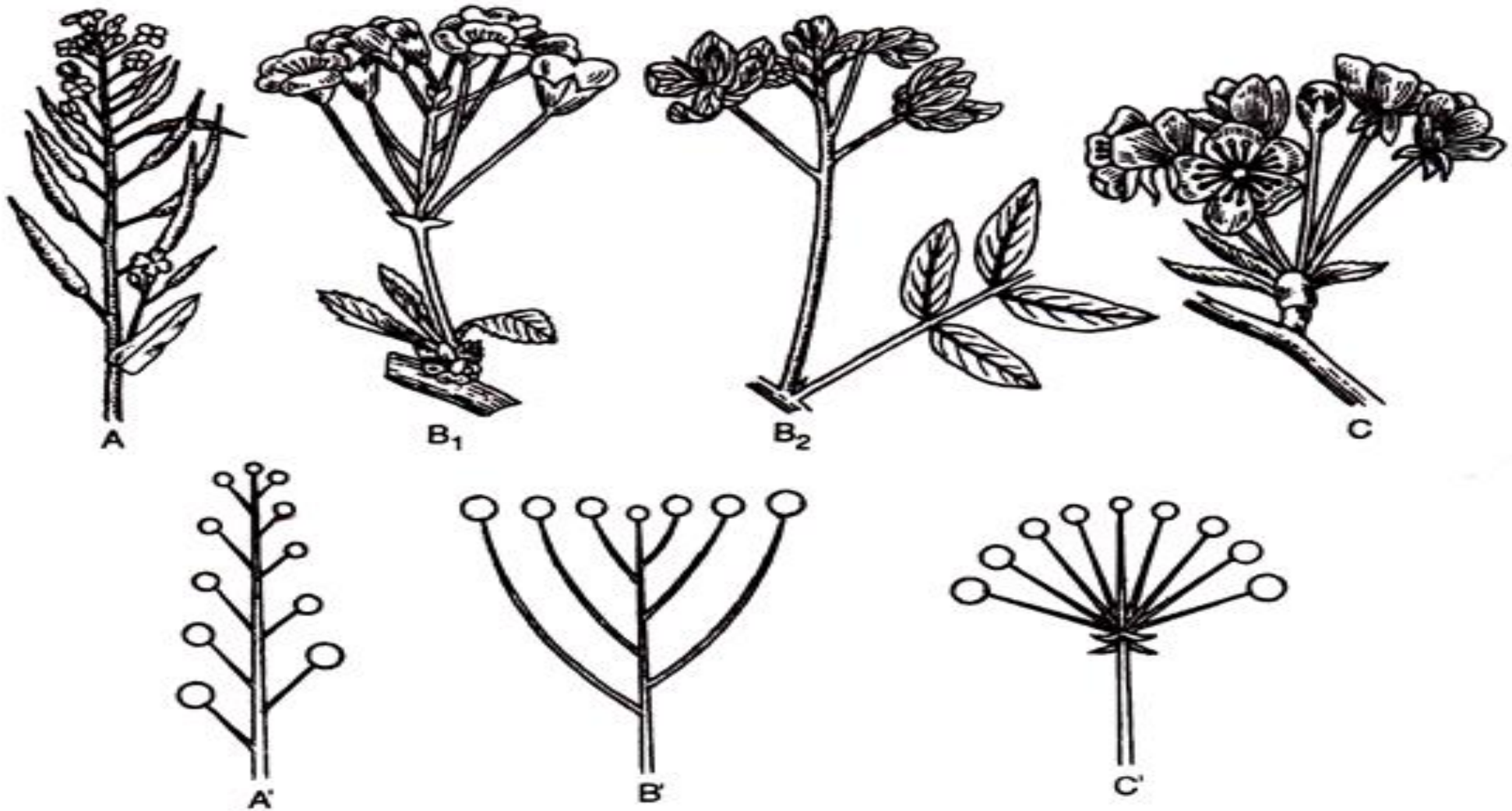


Fig. 2.81 : Simple racemose inflorescences : A. Raceme of *Brassica nigra*, A′. Outline of plant of raceme type, B_1. Corymb of Cherry (*Prunus cerasus*) at maturity, B_2. Corymb of *Cassia sophera*, B′. Outline of plant of corymb type, C. Umbel of Cherry (*P. cerasus*) when young, and C′. Outline of plant of Umbel type

Flowers Sessile:

Spike:

- The main axis is of indefinite growth, where sessile flowers are borne on it,

- e.g., long pepper, *Piper longum* of Piperaceae; prickly chaff-flowers, *Achyranthes aspera* of Amaranthaceae; basak, *Adhatoda vasica* of Acanthaceae; *tuberose, Polianthes tuberosa* of Amaryllidaceae; etc.

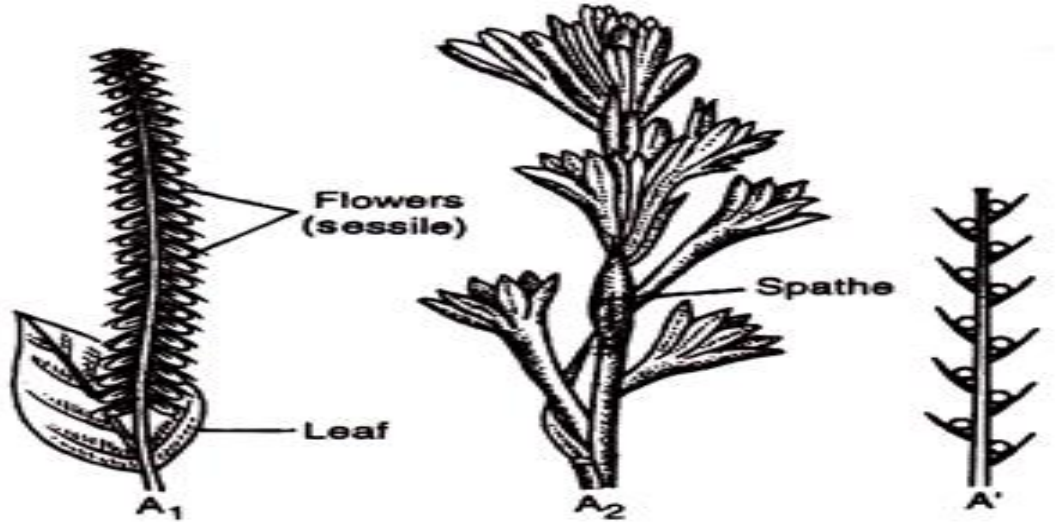


Fig. 2.82 : A_1. Spike of *Achyranthes aspera*, A_2. Spike of *Polyanthes tuberosa*, A'. Outline plan of spike

b. Spikelet or Locusta:

- It is a small spike where one or more flowers are borne on rachilla.
- Commonly, each spikelet bears many flowers as in wheat, Triticum aestivum but in paddy, Oryza sativa, it bears only one flower.
- In maize, Zea mays the male inflorescence consists of spikelet of two flowers.
- In grasses like Panicum sp. the entire inflorescence bears at its base two sterile bracts, the empty glumes.
- Above the empty glumes, there are one or more fertile glumes, the flowering glumes or lemmas. Each lemma, bears single sessile flower in its axil.
- Opposite the lemma a small glume is present, called palea. In wheat, *Triticum aestivum* of Poaceae;
- The spikelets are sessile and develop on an elongated axis, but in oat, *Avena sativa* of Poaceae, they are produced on a more or less branched axis.

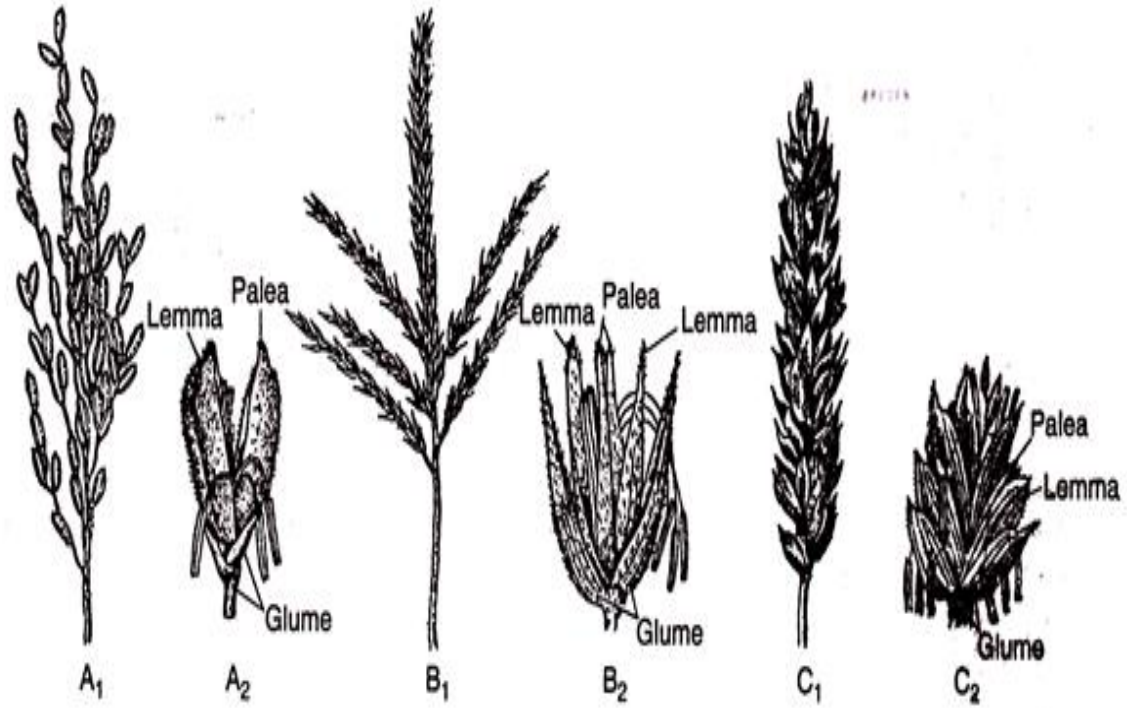


Fig. 2.83 : Inflorescences formed by spikelets : A_1. Inflorescence of rice, A_2. Single flowered spikelet of rice, B_1. Male inflorescence of maize, B_2. Two-flowered male spikelet of maize, C_1. Inflorescence of wheat, and C_2. Many flowered spikelet of wheat

c. Spadix:

- It is a spike with fleshy axis having both male and female flowers. Entire structure is surrounded by a large bract called spadix.

- In some aroids like Acorus calamus, the spathe is absent.

- The female flowers are always found towards the base of the axis and male flowers towards the apex, whereas the sterile flowers are situated between these two.

- The terminal portion is barren and called as appendix,
  e.g., *Colocasia antiquorum* of Araceae

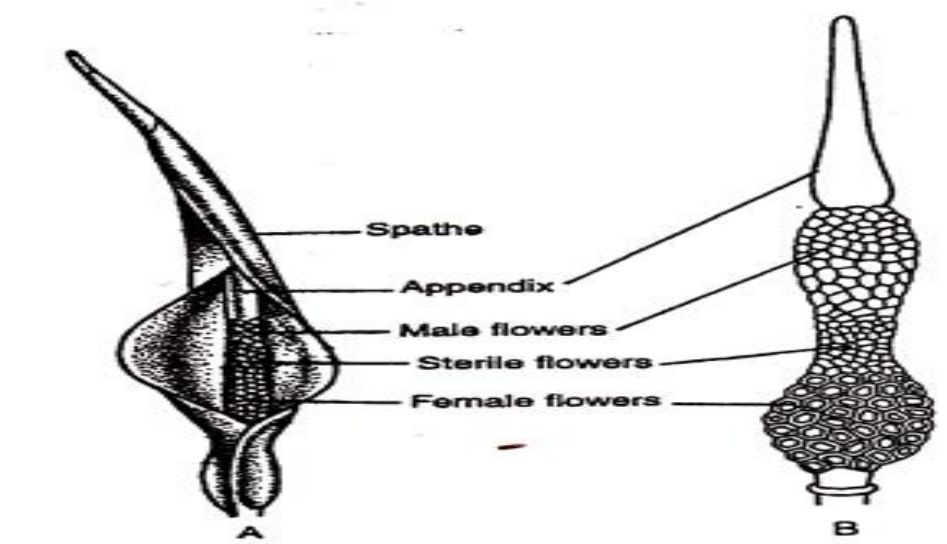


Fig. 2.85 : A. Spadix of *Colocasia antiquorum*, B. Spadix of *C. antiquorum* after removing the spathe

d. Catkin or Amentum:

It is the pendulous spike with fleshy and delicate axis which bears naked unisexual flower that falls as a unit at maturity.

Viz. hazel, Corylus sp. of Betulaceae; mulberry, Moms indica of Moraceae; Trewia nudiflora and Acalypha hispida of Euphorbiaceae; Oak, Quercus sp. of Fagaceae etc.

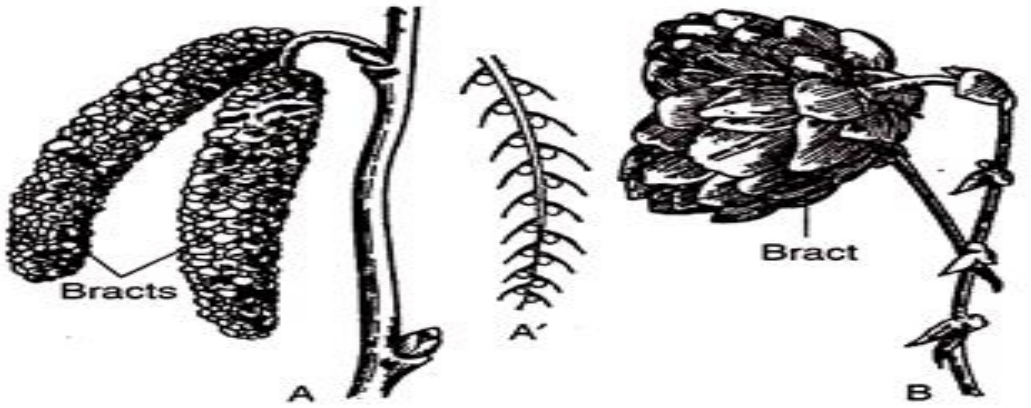


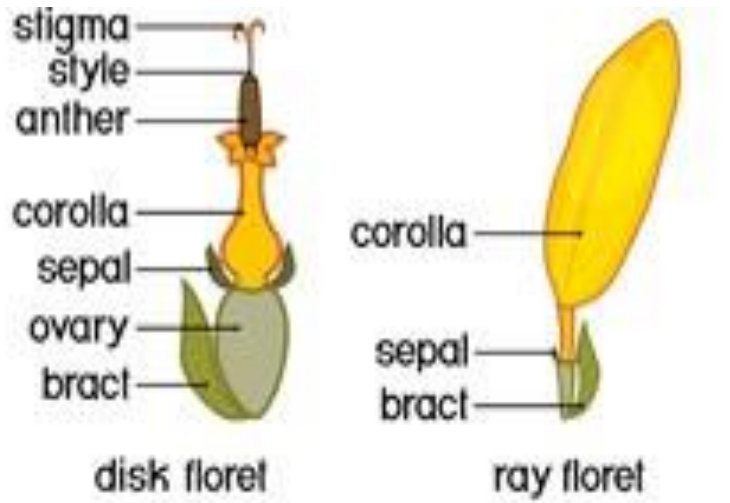
Fig. 2.86 : A. Catkin of *Corylus* sp. (Hazel), A'. Outline plan of Catkin, and B. Strobile of *Humulus* sp. (Hops)

e. Strobile:

It is a modified spike, where the pistillate flowers are borne singly in the axil of a persistent membranous bract,
e.g., *hops*, *Humulus lupulus* of Cannabinaceae etc.

(F) Capitulum or Anthodium or Head:

- In this type the main axis is much shortened and broadened out to form a flat or more or less convex receptacle on which numerous sessile and small florets are arranged in a centripetal manner i.e., youngest at the centre and oldest towards the periphery. Individual florets are bracteate.
- The cluster of florets is surrounded by a whorl of bracts collectively called involucre.
- Two kinds of florets are distinguished: ray florets those at the periphery with strap-shaped corolla.
- These florets are female and are always zygomorphic, arrange in one or two whorls.
- Disc florets are grouped at the centre and are bisexual and actinomorphic.
- This inflorescence is the characteristic feature of the family Asteraceae (Compositae),
- e.g., sunflower, *Helianthus annuus; Tridax procumbens*, *Eclipta alba* etc. of Asteraceae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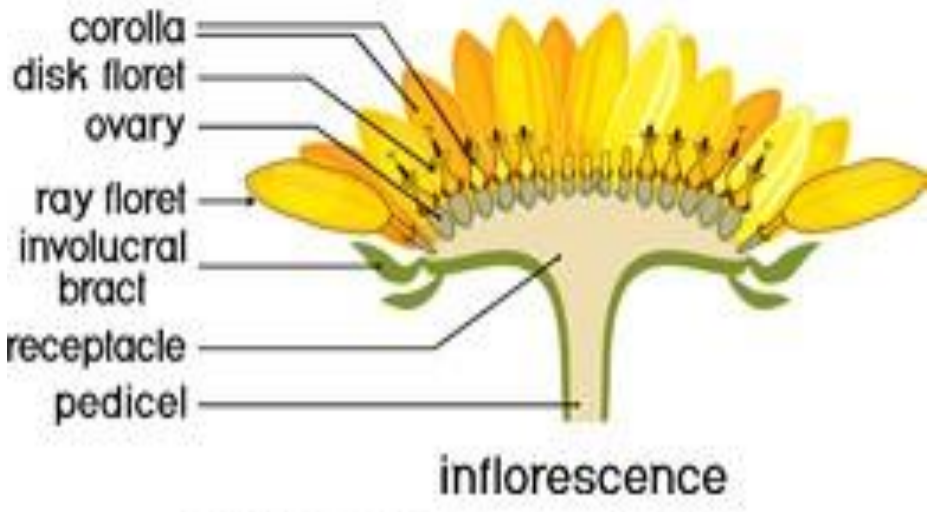
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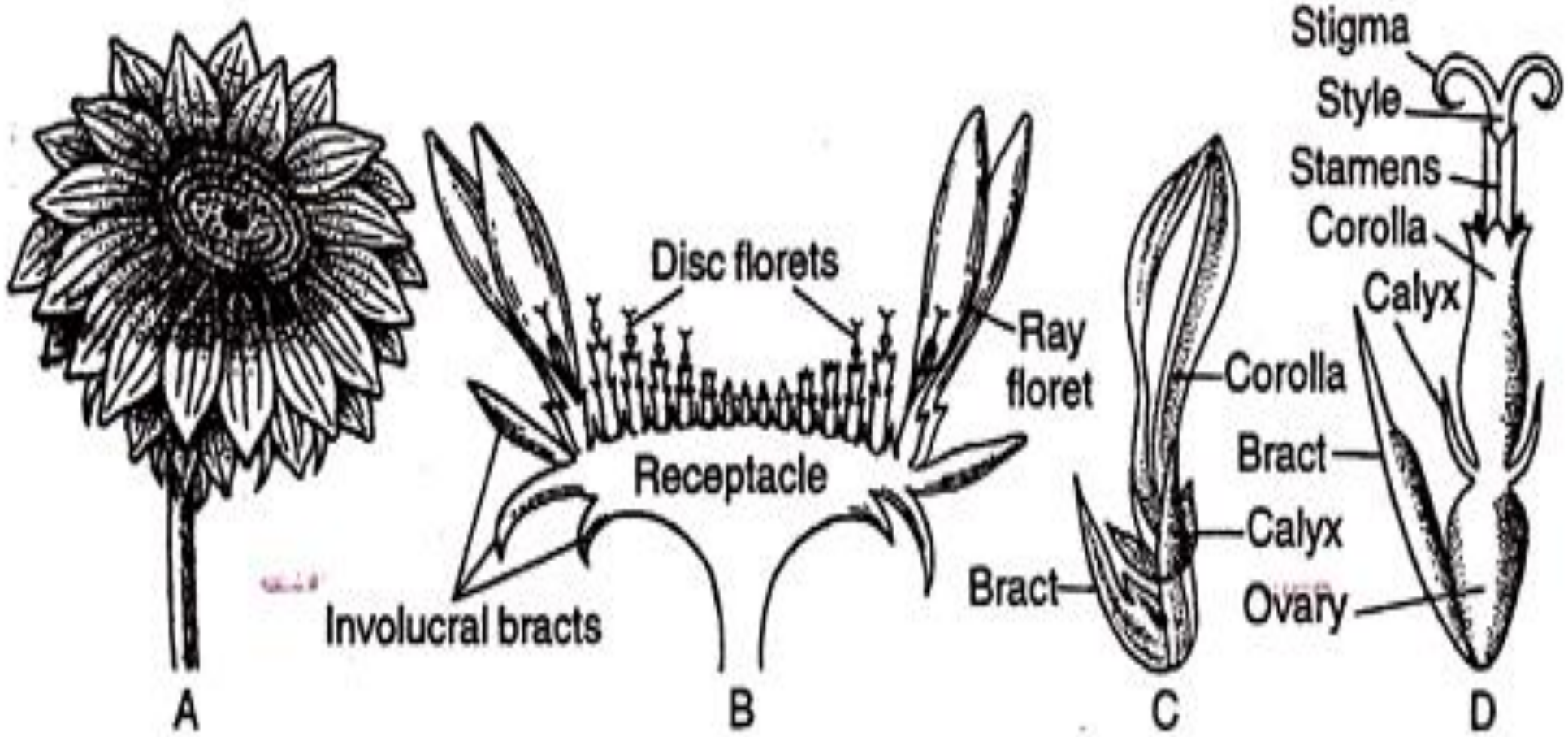


Fig. 2.87 : Capitulum of *Helianthus annuus* : A. Entire inflorescence. B. V.S. through inflorescence showing ray and disc florets, C. Single ray floret, and D. Single disc floret (bisexual flower)

g. Capitate:

- In this type, a dense cluster of sessile flowers arise upon a compressed rachis; thereby they give rise to a somewhat globose structure.

- e.g., *Acacia nilotica*, *Mimosa pudica*, *Albizzia lebbek* , *Trifolium* sp. etc. of Fabaceae.

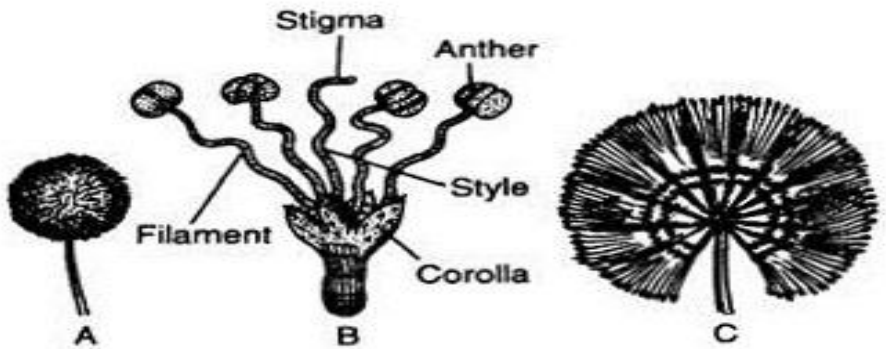


Fig. 2.88 : A. Capitate inflorescence of *Mimosa pudica*, B. Single flower of *M. pudica*, and C. Capitate inflorescence of *Albizzia lebbek*

Compound Racemose Type:

- In this type, pedicellate (stalked) or sessile flowers are borne on the branches of the main axis.

a. Compound Raceme or Panicle:

- In this type, each branch of the main axis develop a cluster of stalked flowers like the raceme.
- Viz *Mangifera indica* of Anacardiaceae; *mahagony, Swietenia mahagoni* of Meliaceae; *Andrographis paniculata* of Acanthaceae; litchi, *Litchi chinensis* of Sapindaceae etc.

b. Compound Corymb:

- When branches of the main axis bear corymbs, it is called compound corymb,
- e.g., *Spiraea corymbosa* and *Pyrus torminalis* of Rosaceae etc.

c. Compound Umbel:

- It consists of many, small umbels instead of a single umbel. Small bracts of secondary umbels together form an involucre,
- e.g., carrot, *Daucus carota*; coriander, *Coriandrum sativum*; *Chaerophyllum temulum* and many other members of Apiaceae.

d. Compound Spike:

- When branches of the main axis bear spikes, it is called compound spike,
- e.g., *Amaranthus viridis* and *A. spinosus* of Amaranthaceae.

e. Compound Spadix:

- In this type, the fleshy axis is repeatedly branched and each branch bears sessile unisexual flowers.
- When young, the entire inflorescence or each branch separately enclosed in a spathe,
- e.g., coconut, *Cocos nucifer*; betel nut, *Areca catechu*; date palm, *Phoenix sylvestris* and many other members of Arecaceae.

f. Compound Capitulum:

- In this type, the capitulum is composed of many small capitula, surrounded by involucre of bracts,
- e.g., *Echinops echinatus* of Asteraceae.

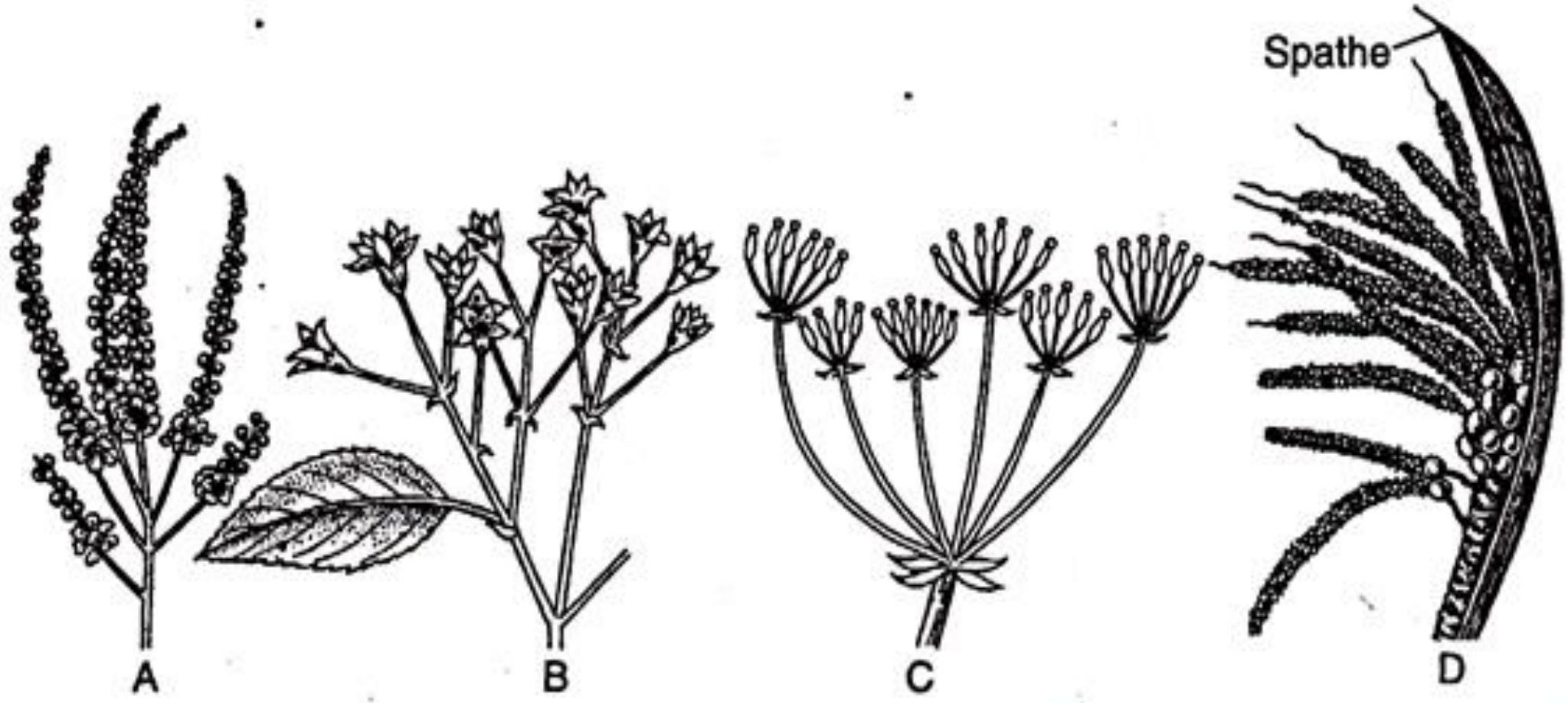


Fig. 2.89 : Different types of Compound racemose inflorescence : A. Compound raceme (panicle) of *Peltophorum* sp., B. Compound corymb of *Pyrus torminalis*, C. Compound umbel of *Chaerophyllum temulum*, and D. Compound spadix of *Cocos nucifera*

I. Cymose Inflorescence:

- This type is also called definite or determinate inflorescence.
- A cymose inflorescence is one whose rachis (simple or branched) becomes terminated by a flower bud at an early stage and subsequent buds are developed gradually towards the lower side of the axis.
- The flowers open basipetally i.e., oldest flower at the apex and gradually the youngest flowers and buds towards the base or centrifugally i.e., the oldest flower towards the centre and the youngest one at the periphery on a fleshy and dilated rachis, called receptacle.

The cymose inflorescences are divided into the following four types:

a. Solitary:

- It is the simplest type of cymose. Here the rachis is unbranched and always terminated by a flower,
- e.g., *Magnolia grandiflora* and *Michelia champaca* of Magnoliaceae; china-rose, *Hibiscus rosa-sinensis* of Malvaceae etc.

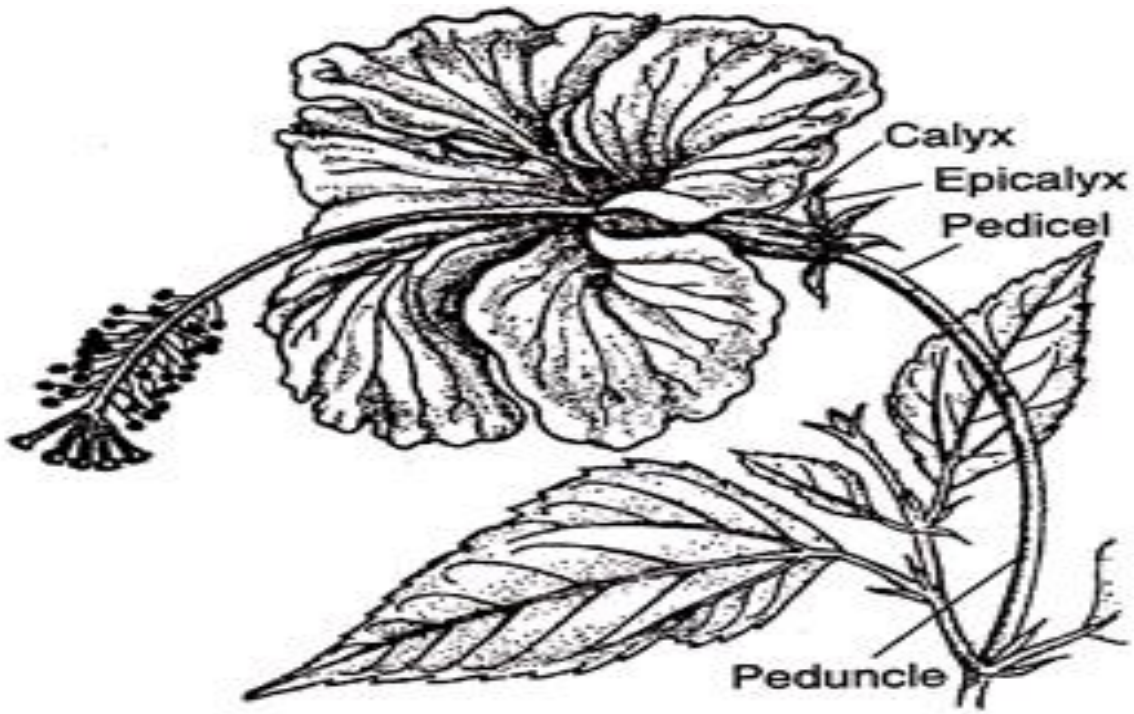


Fig. 2.90 : Solitary flower of *Hibiscus rosa-sinensis*

b. Uniparous Cyme or Monochasial Cyme or Monochasium:

- In this type, the primary axis ends in a flower and gives rise to only one daughter axis, which behaves as the mother.It is of two types:

i. Helicoid Cyme or Bostryx:

- In this type, the flowers are developed on one side, either clockwise or anti-clockwise of the subsequent daughter axes,

- e.g., *Hamelia patens* of Rubiaceae; forget-me-not, Myosotis palustris of Boraginaceae; day lily, *Hemerocallis fulva* of Liliaceae etc.

- A tight, modified helicoid cyme, in which pedicels are short on the developed side, is often called cincinnus.

ii. Scorpioid Cyme:

- In this type, the flowers are developed alternately on either side of the successive daughter axes,
- Thereby it appears as a zigzag structure,
- e.g., *Heliotropium ovalifolium* of Boraginaceae, *Ranunculus bulbosus* of Ranunculaceae etc.

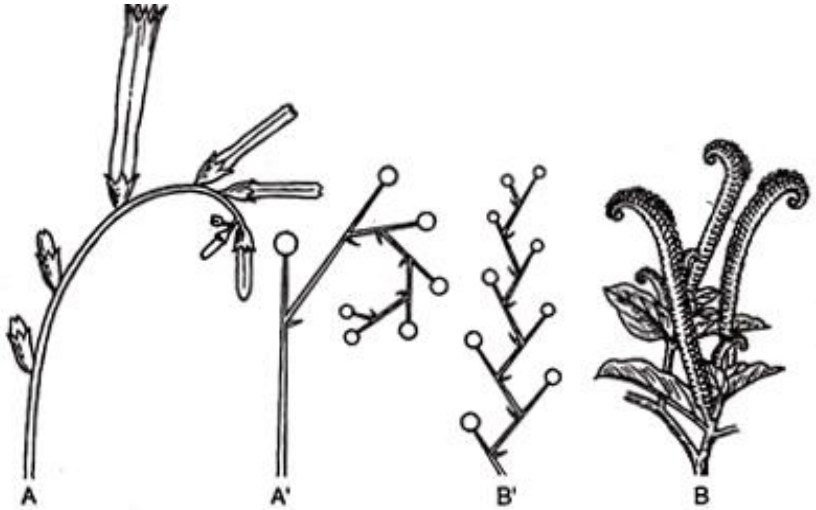


Fig. 2.91 : Monochasium : A. Helicoid cyme of *Hamelia*, A'. Helicoid cyme (diagrammatic), B'. Scorpioid cyme (diagrammatic), B. Scorpioid cyme of *Heliotropium*

c. Biparous Cyme or Dichasial Cyme or Dichasium:

- In this type, the primary axis ends in a flower and develops two daughter axes with apical flower bud from a single node, a little distance behind the apex,

- e.g., jasmine, *Jasminum sp*. and *Nyctanthus arbor-tristis* of Oleaceae; *Clerodendrum viscosum* of Verbenaceae ; *Dianthus chinensis* of Caryophylaceae etc.

d. Muciparous Cyme or Polychasial Cyme or Polychasium or Pleiochasium:

- In this type, the primary axis ends in a flower and develops more than two daughter axes with apical flower bud from a single node, a little distance behind the apex.

- The daughter axes, in their turn, also behave like mother,

- e.g., *Kleinhovia hospita* and *Dombeya mastersii* of Sterculiaceae; *Calotropis procera* of Asclepiadaceae; *Viburnum tinus* of Caprifoliaceae etc.

- (The multiparous cyme often looks alike to racemose umbellate inflorescence, but is distinguished by the presence of oldest flower at the centre).

Fig. 2.92 : A. Dichasium of *Dianthus chinensis*, B. Polychasium of *Viburnum tinus*.

Special types of cymose inflorescence:

The special types of cymose inflorescence are of the following four types:

a. Verticillaster:

- It is a condensed cymose inflorescence, each occurs in the axil of opposite leaves having sessile or slightly stalked flowers. Each inflorescence is initially a dichasial cyme and the two lateral sides become reduced to two scorpioid cymes

- The entire inflorescence appears like a cluster of sessile flowers forming a false whorl at the node,

- e.g., *Leucas linifolia*, *Leonurus sibiricus* etc. of Lamiaceae (Labiatae). This is a distinguished character of the family Lamiaceae.

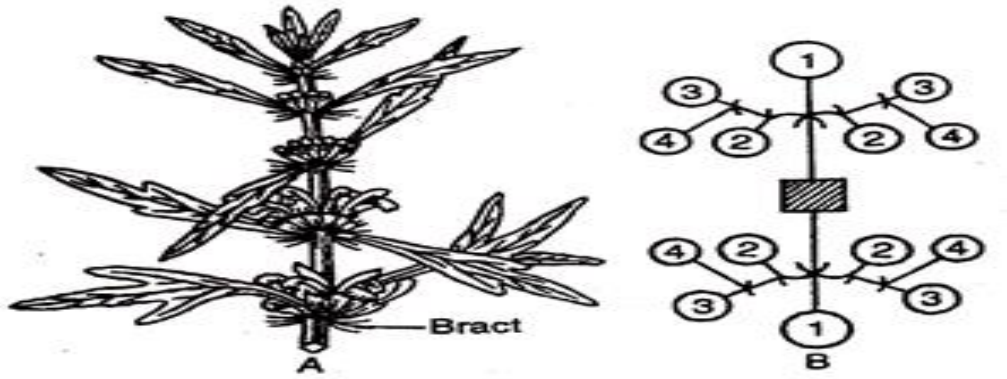


Fig. 2.93 : A. Verticillaster inflorescence of *Leonurus sibiricus*, and B. Outline plan of Verticillaster inflorescence

b. Cyathium:

- It is a specialised cymose inflorescence, but looks like a single flower.
- The axis becomes suppressed to form a convex receptacle.
- In the centre of the receptacle, there is a long-stalked, naked female flower with tricarpellary gynoecium, surrounded by a large number of male flowers arranged in a scorpioid cyme.
- The male flowers consist of a single stamen, joined to a short stalk i.e., the pedicel and each one develops in the axil of a hairy bracteole.
- The entire inflorescence is surrounded by a cup-shaped green involucre formed by the union of bracts.
- The involucre is with one or two nectar glands on its outer wall or often without gland. The flowers are developed in centrifugal manner i.e., from inner to outer side,
- e.g., *Pedilanthus tithymaloides*, Euphorbia microphylla, *Poinsettia pulcherrima* and some other members of Euphorbiaceae.

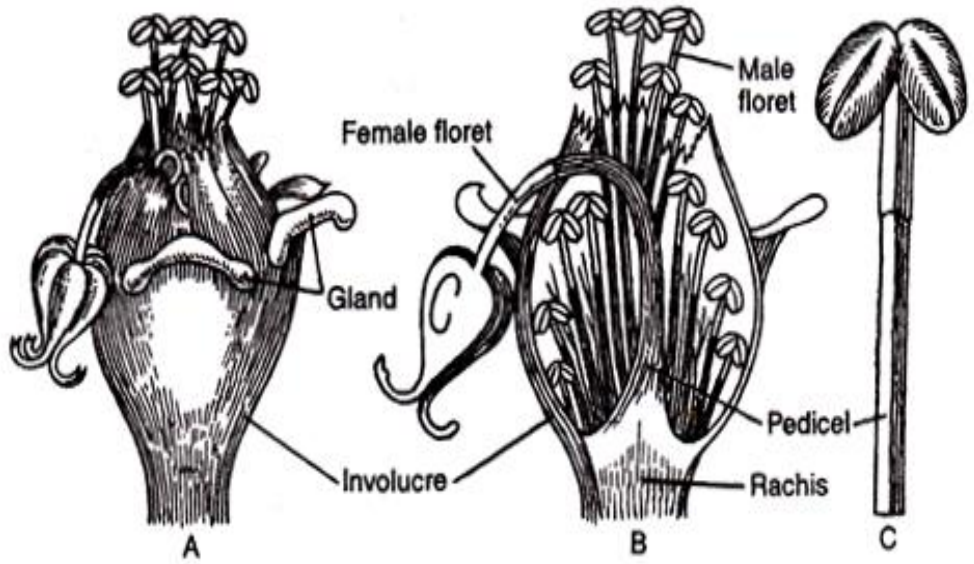
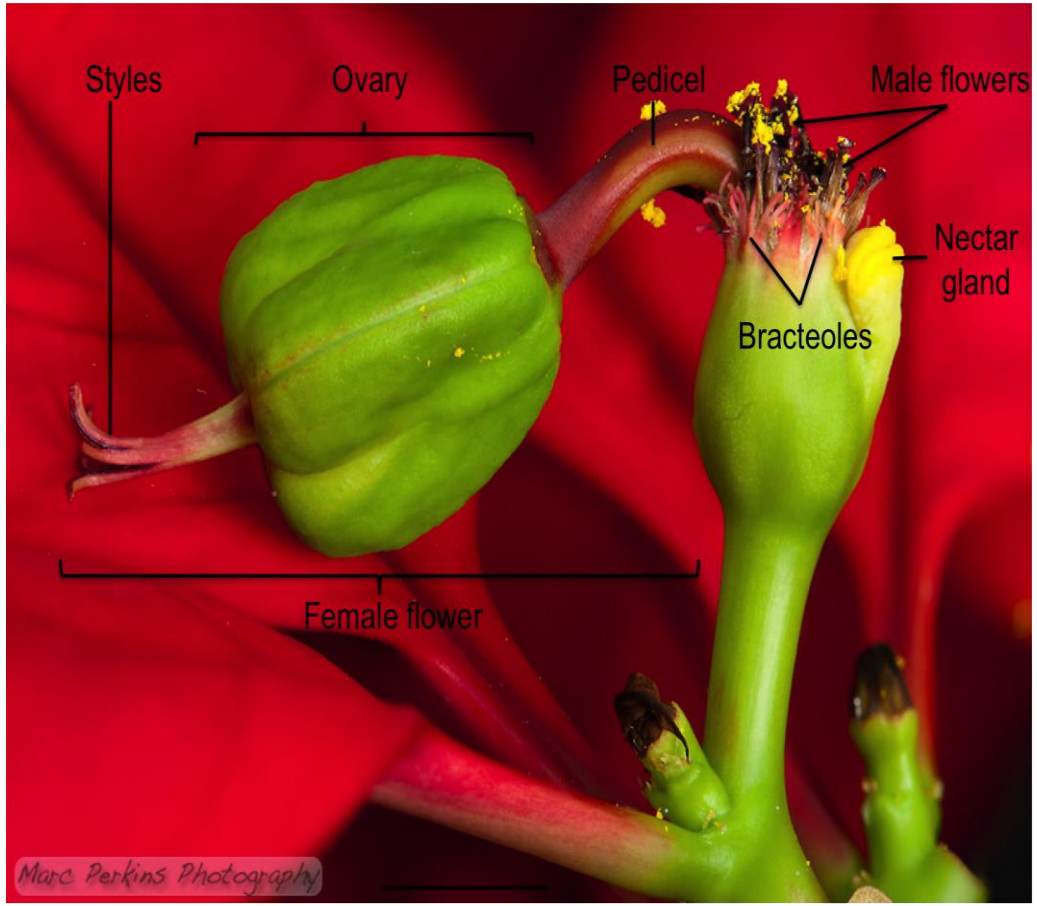


Fig. 2.94 : Cyathium of *Poinsettia pulcherrima* : A. External view, B. L.S. showing male and female florets with bracteoles in between, and C. A male floret



c. Hypanthodium:

- In this type, a hollow sphere-like receptacle (syconium) is formed by the fusion of the rachis of three closely placed cymes. The spherical receptacle is like a closed fleshy vessel with a small opening at the apex.
- Three types of unisexual flowers (male, fertile female and sterile female) are arranged on the inner surface of the receptacle in cymose groups,
- e.g., fig., *Ficus cunia* and banyan, *F. benghalensis* of Moraceae.

d. Coenanthium:

- It is like hypanthodium, but the receptacle is somewhat saucer-shaped with margins curved upwardly,
- e.g., pickaback plant, *Dorstenia cordifolia* of Moraceae.

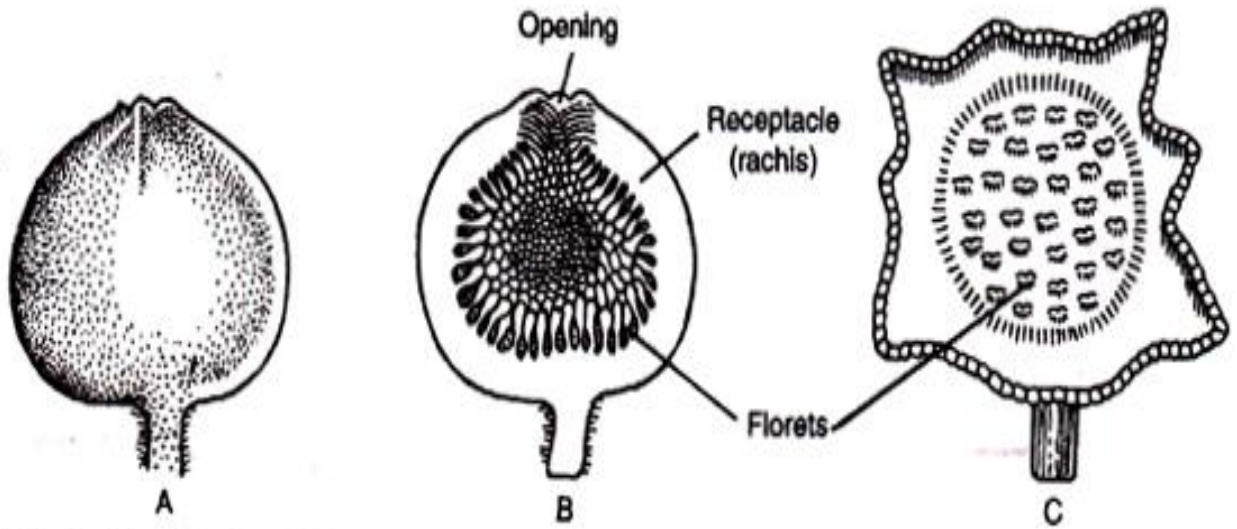
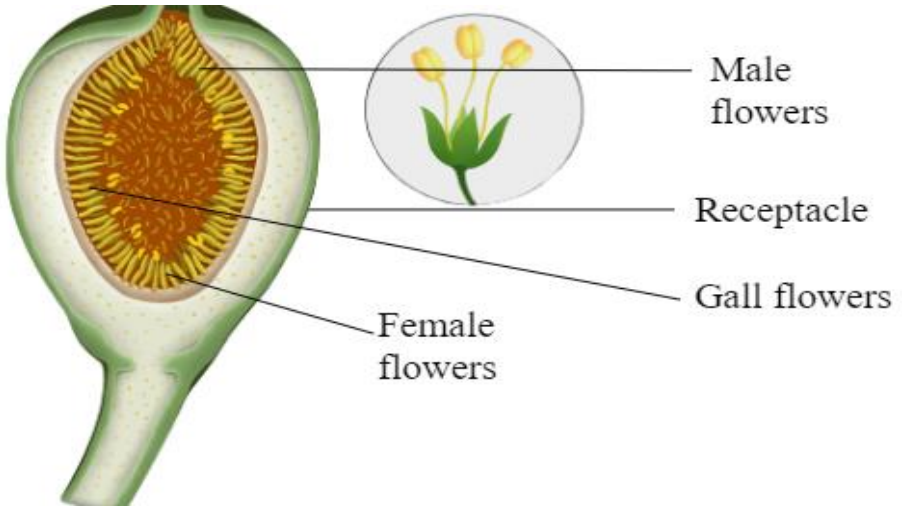
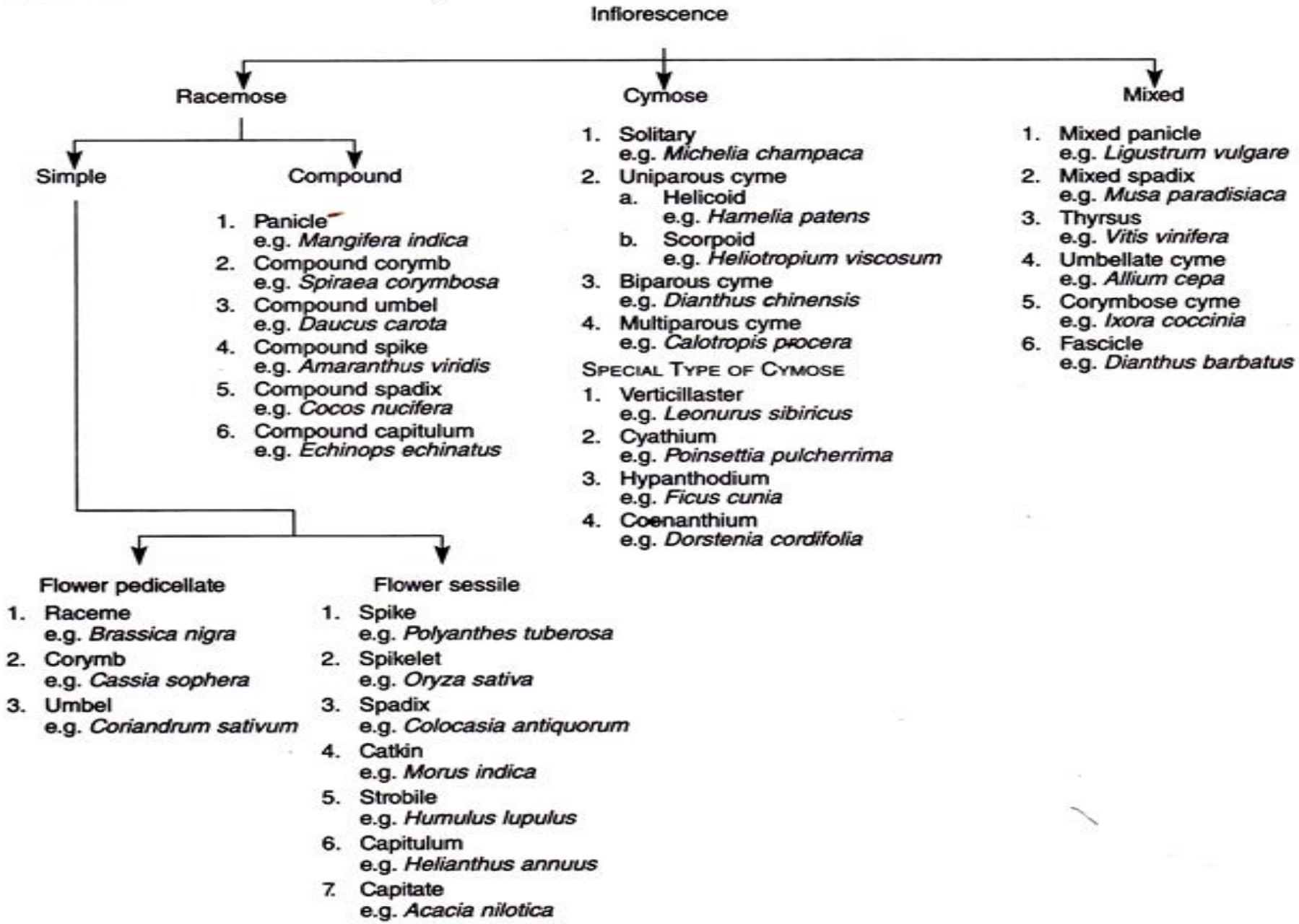


Fig. 2.95 : A. Hypanthodium inflorescene (external view) of fig. (*Ficus cunia*), B. L.S. of hypanthodium showing opening and florets inside, and C. Coenanthium of *Dorstenia cordifolia* showing florets on saucer-shaped receptacle




Inflorescence
Racemose
Cymose
Mixed
Simple
Compound
1. Panicle
e.g. Mangifera indica
2. Compound corymb
e.g. Spiraea corymbosa
3. Compound umbel
e.g. Daucus carota
4. Compound spike
e.g. Amaranthus viridis
5. Compound spadix
e.g. Cocos nucifera
6. Compound capitulum
e.g. Echinops echinatus
1. Solitary
e.g. Michelia champaca
2. Uniparous cyme
a. Helicoid
e.g. Hamelia patens
b. Scorpoid
e.g. Heliotropium viscosum
3. Biparous cyme
e.g. Dianthus chinensis
4. Multiparous cyme
e.g. Calotropis procera
Special Type of Cymose
1. Verticillaster
e.g. Leonurus sibiricus
2. Cyathium
e.g. Poinsettia pulcherrima
3. Hypanthodium
e.g. Ficus cunia
4. Coenanthium
e.g. Dorstenia cordifolia
1. Mixed panicle
e.g. Ligustrum vulgare
2. Mixed spadix
e.g. Musa paradisiaca
3. Thyrsus
e.g. Vitis vinifera
4. Umbellate cyme
e.g. Allium cepa
5. Corymbose cyme
e.g. Ixora coccinia
6. Fascicle
e.g. Dianthus barbatus
Flower pedicellate
1. Raceme
e.g. Brassica nigra
2. Corymb
e.g. Cassia sophera
3. Umbel
e.g. Coriandrum sativum
Flower sessile
1. Spike
e.g. Polyanthes tuberosa
2. Spikelet
e.g. Oryza sativa
3. Spadix
e.g. Colocasia antiquorum
4. Catkin
e.g. Morus indica
5. Strobile
e.g. Humulus lupulus
6. Capitulum
e.g. Helianthus annuus
7. Capitate
e.g. Acacia nilotica

2. Flower:

Definition:_Modified shoot called as flower.

Flower develops on the mother axis (stem) in the form of floral bud.

A typical angiosperm flower has following parts:

1. Bract:
It is a leaf like structure in whose axil a flower often develops.

2. Pedicel:
It is the stalk of the flower which may be short, long or even absent.

3. Bracteoles:
They are scaly appendages present on pedicel.

4. Receptacle (Thalamus or Torus):

It is the swollen or expanded tip of the pedicel which bears four whorls i.e. calyx, corolla, androecium and gynoecium. Of these, calyx and corolla are collectively called as helping or accessory whorls, while androecium and gynoecium are together known as essential or reproductive whorls.

5. Floral whorls:

(a) Calyx:

It is the first or outermost protective whorl. Individual member of calyx is called a sepal which is generally green.

(b) Corolla:

It is the second or attractive whorl present inner to calyx. Each member of corolla is called a petal.

c) Androecium:

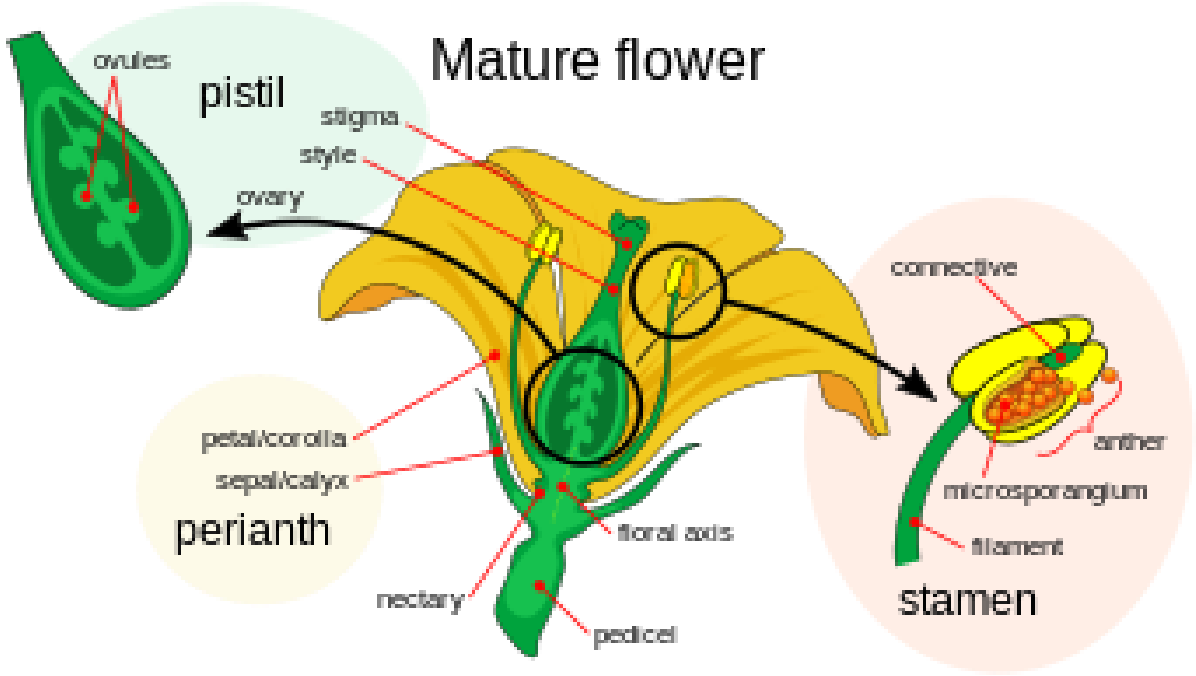
It is the third or male whorl. It is a collection of male parts called stamens. Each stamen is a modified leaf or microsporophyll. Each stamen consists of 3 parts –

filament, anther and connective.

Each anther has two anther lobes and each lobe usually contains two pollen sacs or micro-sporangia filled with pollen grains or microspores

(d) Gynoecium or Pistil:

- It is the fourth or female whorl, arid its functional units are called carpels (megasporophylls).
- A typical carel consists of ovary, style and stigma. Ovary is the swollen basal part of the carpel that contains one or more ovules.
- Each ovule connected to the ovary wall through a special tissue called palacenta.



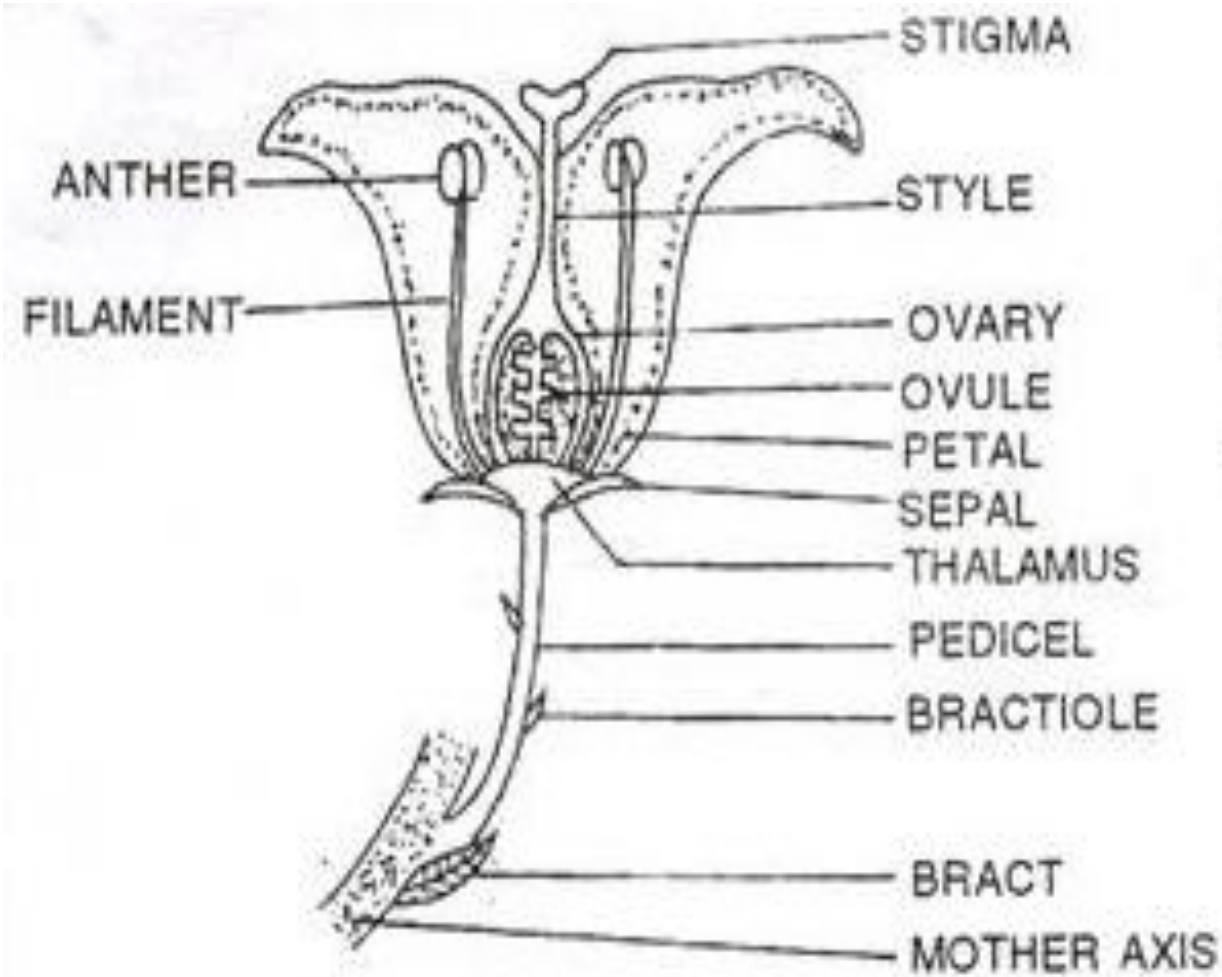


Figure 6.1 Parts of a flower in V.S.

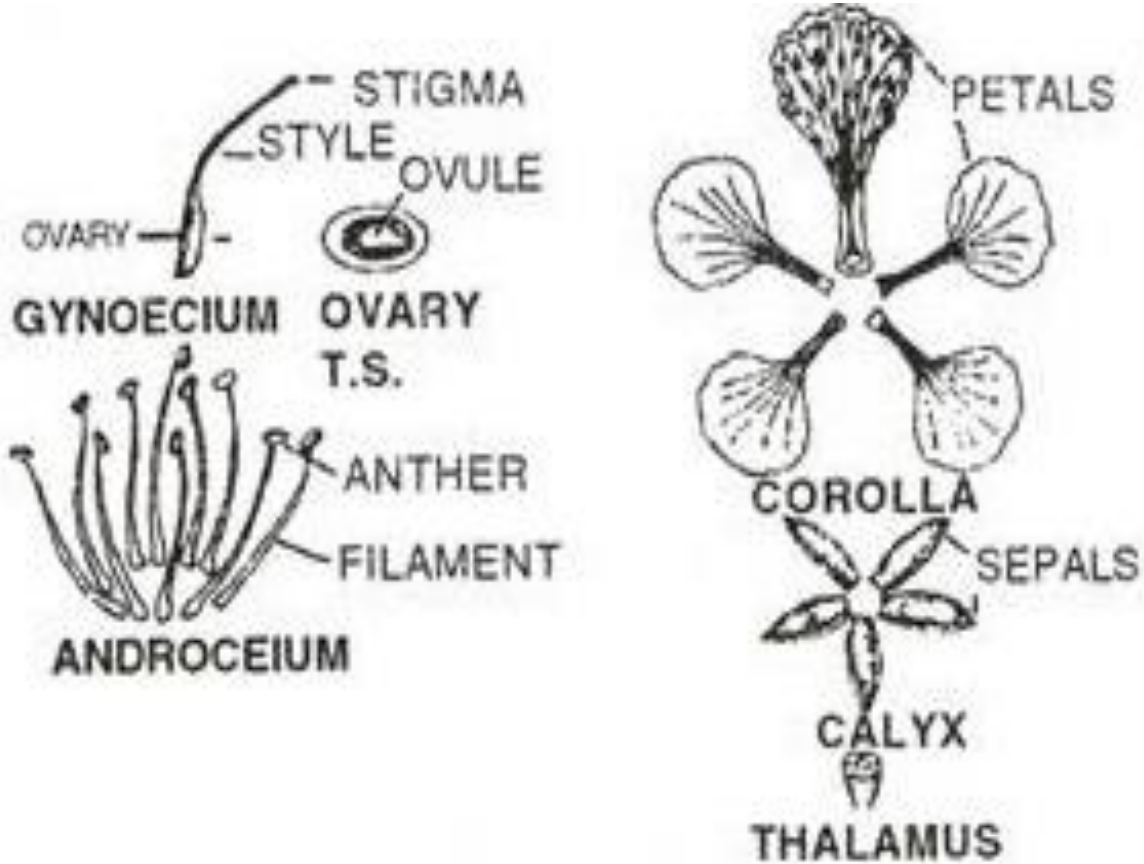


Figure 6.2 A flower dissected out

Bracts:
Bracts are specialized leaves from the axil of which bracteate flowers arise

Epicalyx:
Whorl of bracteoles arising at the base of tie calyx,
e.g., cotton, lady's finger, strawberry.

Calyx:
The calyx is the outermost whorl which consists of sepals.

1. Colour:

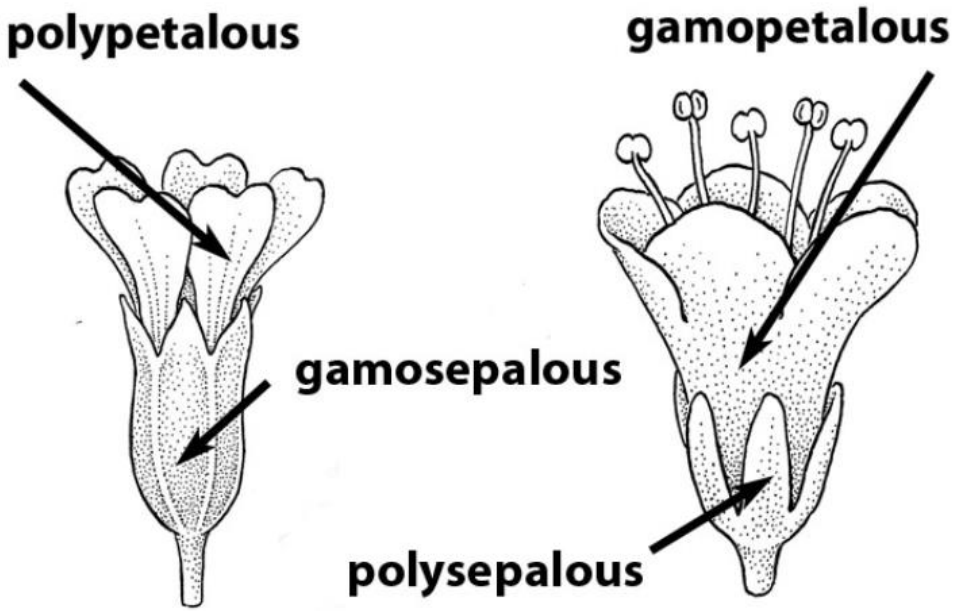
(a) Sepaloid: When sepals are green.

(b) Petaloid: When sepals are coloured, e.g., *Mirabilis, Delphinium*

2. Fusion:

(i) Polysepalous – When sepals are free, e.g., Mustard

(b) Gamosepalous – When sepals are united, e.g., *Datura, Hibiscus*



sepal and petal fusion

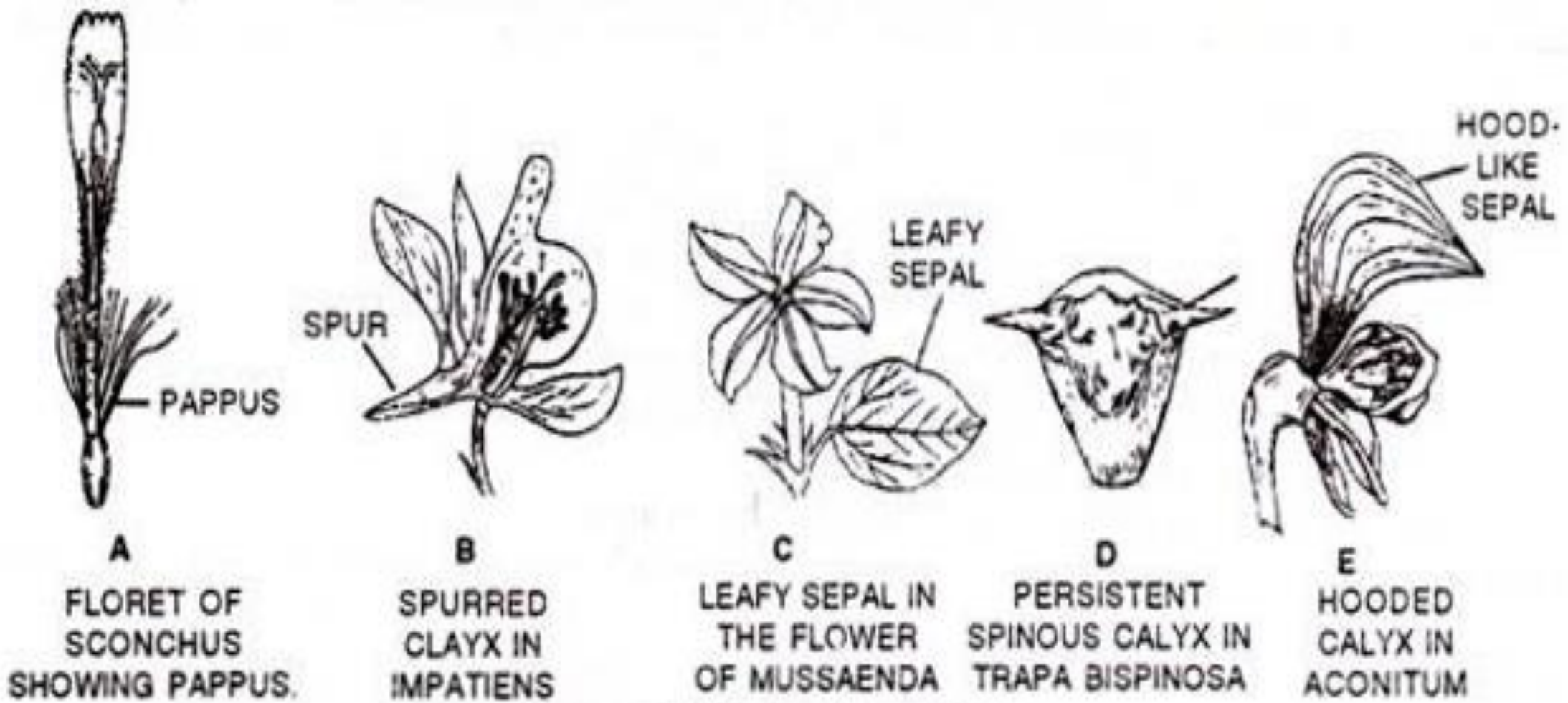


Figure 6.6. Modifications of Calyx

Corolla:

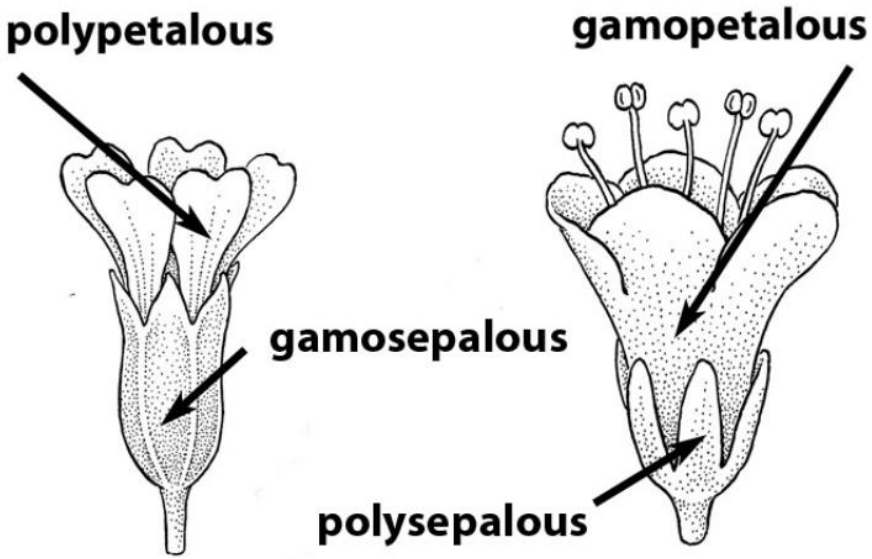
- Corolla is the second floral whorl present inner to calyx and meant for attracting agents of pollination.
- It consists of individual units called petals.
- Each petal is differentiated into a narrow claw and an expanded limb

1. Colour:

(a) Petoloid – Coloured petals other than green.
(b) Sepaloid – Petals green like sepals,e.g., *Magnolia. Polyalthia*.

2. Fusion:

(a) Polypetalous – Petals free, e.g. Brassica.
(b) Gamopetalous – Petals united, e.g., *Datura*, *Petunia*.



sepal and petal fusion

3. Shape:

I. Polypetalous and Regular:

(a) Cruciform – Corolla with four petals arranged in form of a cross,
e.g., Brassica, Iberis etc.

(b) Caryophyllaceous – Corolla with five petals arranged in such a manner that the limbs lie right angles to the claws,
e.g., *Silene*, *Dianthus* etc.

(c) Rosaceous – Petals five or more without any claws i.e., sessile,
e.g., Rose, tea, apple etc.

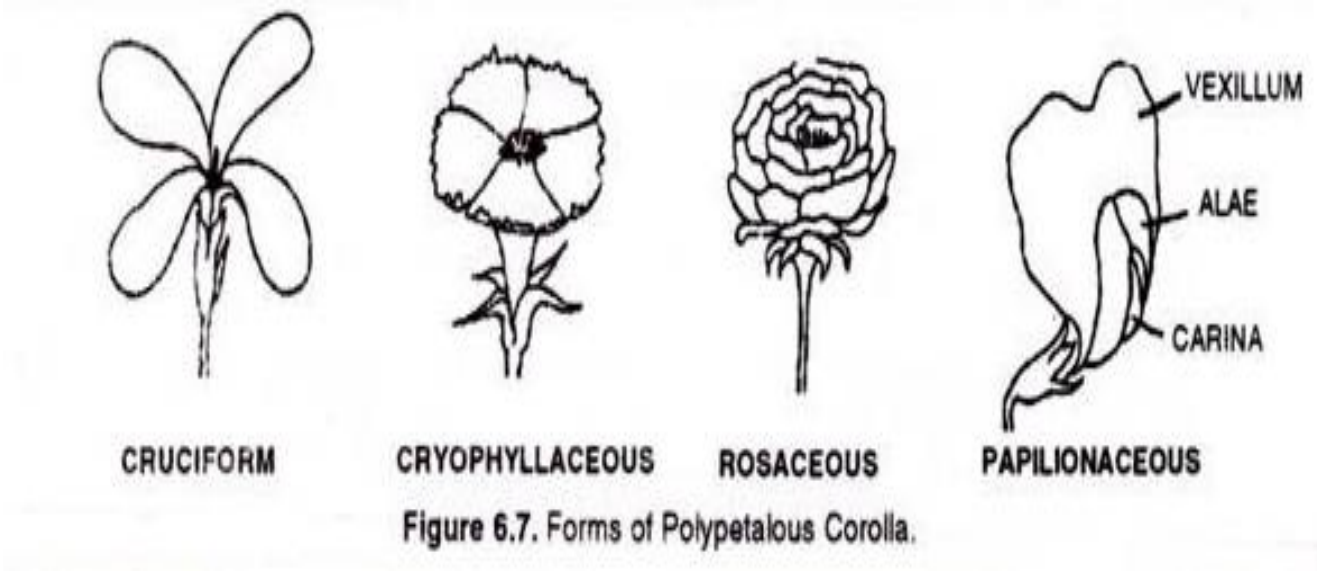


Figure 6.7. Forms of Polypetalous Corolla.

II. Polypetalous and Irregular:

(a) Papilionaceous:

Here corolla with five petals appears butterfly shaped.

The posterior large petal is called standard or vexillum, two lateral petals are called wings or alae and two innermost fused petals are called keel or carina.

It is the characteristic of family Papilionaceae

III. Gamopetalous and Regular:

(a) Tubular – tube-like or cylindrical corolla, e.g., disc florets of sunflower.

(b) Campanulate-bell-shaped corolla, e.g., *Campanula, Physalis*.

(c) Infundibuliform-furmel-shapedcorolla, e.g.,*Petunia, Datura*

(d) Rotate – wheel-shaped corolla, e.g., *Calotropis*, brinjal.

(e) Hypocrateriform-Salver-shaped corolla, e.g., *Vinca*.

(f) Urceolate-Um-shapedcorolla, e.g.,*Bryophyllum*

IV. Gamopetalous and Irregular:

(a) Ligulate-Strap-shaped corolla,
e.g., ray florets.

(b) Bilabiate – two-lipped corolla where lips remain always open,
e.g., *Salvia*, *Ocimum* etc.

(c) Personate – two-lipped corolla where lips remain closed by a projection called Palate
e.g., *Antirrhinum* (snapdragon), *Lindenbergia.*

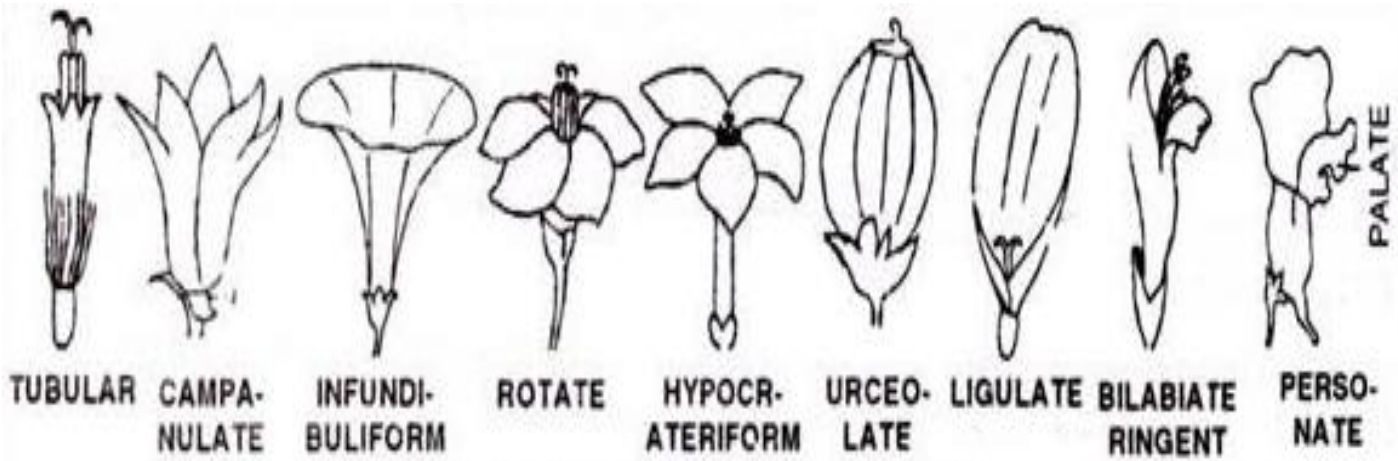


Figure 6.8. Forms of Gamopetalous Corolla

4. Aestivation of Corolla and Calyx:

Aestivation is the mode of arrangement of sepals or petals in relation to one another in a floral bud. It is useful in classification and identification of plants.

It is of following types:

(i) Valvate:

The edges of sepals or petals touch or most not ‘ouch each other but do not overlap, e.g., mustard, coriander etc.

(ii) Twisted (contorted):

One edge of petal or sepal regularly overlaps the margin of the next one, e.g., petals of china rose.

iii) Imbricate:

The overlapping becomes irregular. Out of five members, one is outer, one is inner and the rest three remain in twisted condition.

It has two sub-types:

a. Ascending Imbricate:

Posterior petal is innermost i.e. being overlapped by the lateral petals, e.g., Cassia.

b. Descending Imbricate (vaxillary):

The posterior petal is outermost and largest that overlaps the lateral petals (wings). They in turn enclose the two anterior smallest petals (keels). It is also called papilionaceous.

(iv) Quincuncia:

It is a modified imbricate type with 2 outer, 2 inner and one remain twisted, e.g., *Ipomoea,* guava etc.

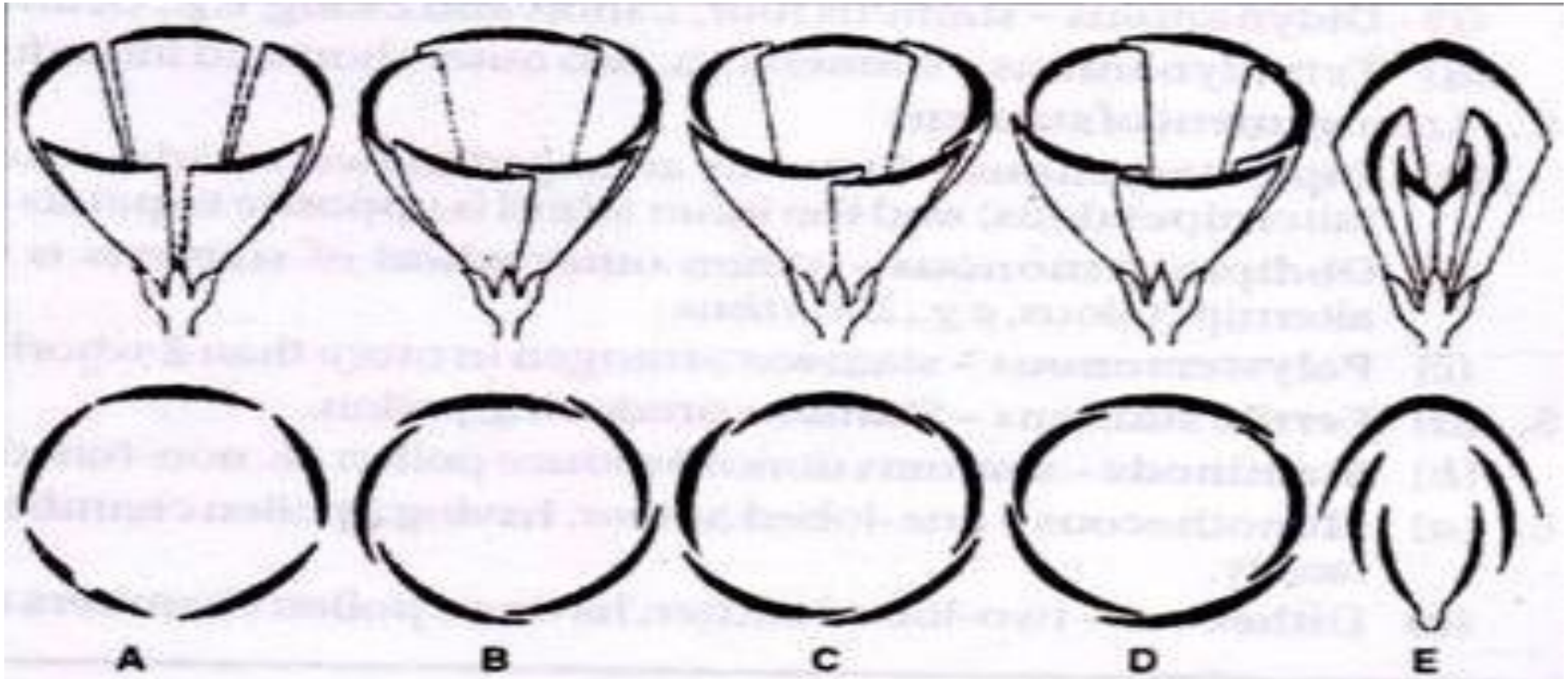
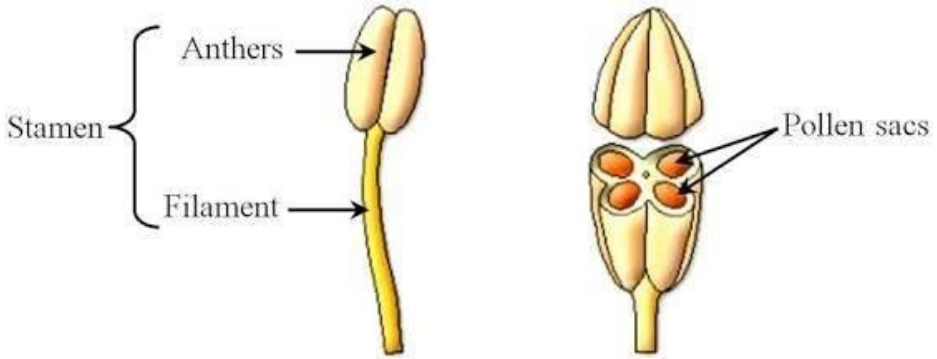


Figure 6.9. Different types of aestivation of Calyx and Corolla A. Valvate, B. Twisted, C. Imbricate (Ascending), D. Quincuncial E. Vaxillary

4. Androecium: Parts, Cohesion, Adhesion and Fixation.

- Androecium, the male reproductive whorl of flower, is composed of stamens.
- A stamen (microsprophyll) is made up of chiefly two parts:
- a large terminal portion, anther, and a stalk known as the filament.
- Each anther consists usually of two lobes connected together by a suture known as connective.
- Each anther lobe contains two cavities called pollen sacs, in which pollen-grains are produced .



Structure of stamen

1. Number:

(a) Monandrous – one stamen

(b) Diandrous – two stamens

(c) Triandrous-three stamens

(d) Polyandrous- many stamens

2.

(a) Inserted–stamens remain inside the corolla tube, e.g., *Petunia*.

(b) Exserted – stamens are longer and exposed out the corolla tube, e.g., *Hibiscus*, *Acacia*.

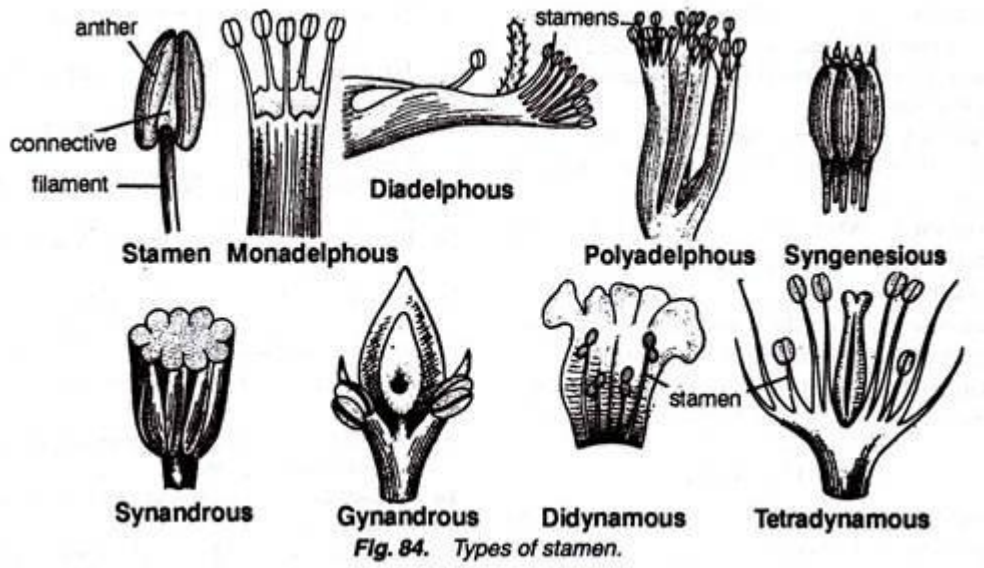


Fig. 84. Types of stamen.

3. Length of Stamens:

(a) Isostemonous-when all stamens of a flower are of equal lengths, e.g., *solarium.*

(b) Heterostemnous – when length of stamens are unequal, e.g., *Cassia*

(c) Didynamous – stamens four, 2 short and 2 long, e.g., *Ocimum*

(d) Tetradynamous – stamens six, two outer short and inner four long, e.g., *Brassica.*

4. Arrangement of stamens:

(a) Diplostemonous – Stamens arranged in two whorls, outer whorl alternate with the petals (alternipetalous) and the inner whorl is opposite to petals (antipetalous), e.g., *Cassia.*

(b) Obdiplostemonous – When outer whorl of stamens is antipetalous and inner whorl is alternipetalous, e.g., *Dianthus.*

(c) Polystemonous – stamens arranged in more than 2 whorls.

5. **(a) Fertile stamens**-Stamens producing pollen.

(b) Staminode- stamens do not produce pollen i.e. non-functional, e.g., Salvia, Cassia.

6. **(a) Monothecous** -one-lobed anther, having 2 pollen chambers (bisporangiate), e.g., Malvaceae family.

(b) Dithecous-two-lobed anther, having4 pollen chambers (tetrasporangiate), e.g., Mustard.

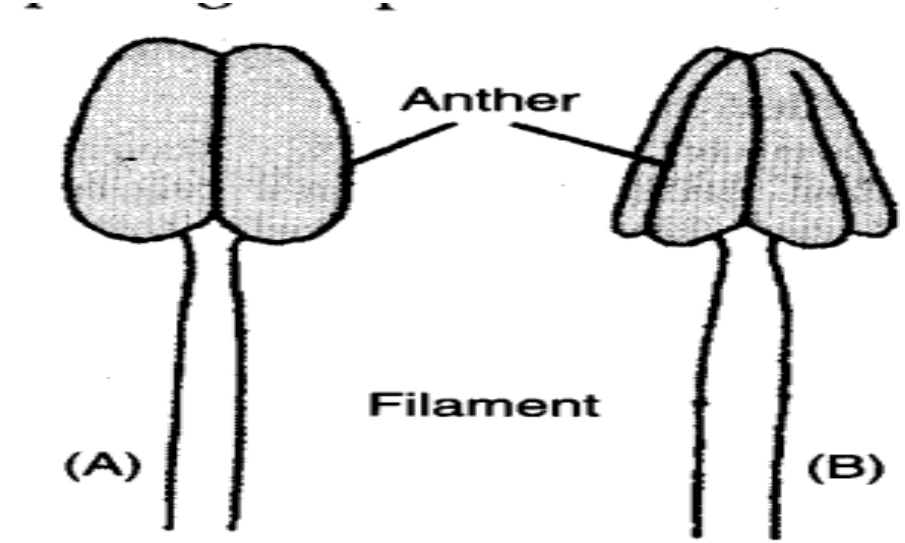


Fig. Anther lobes

7. Cohesion of Stamens:

(a) Adelphous-When filaments are united but anthers remain free.

It is of three types

i. Monoadelphous – Filaments of all stamens united in one bundle, e.g., *Hibiscus.*

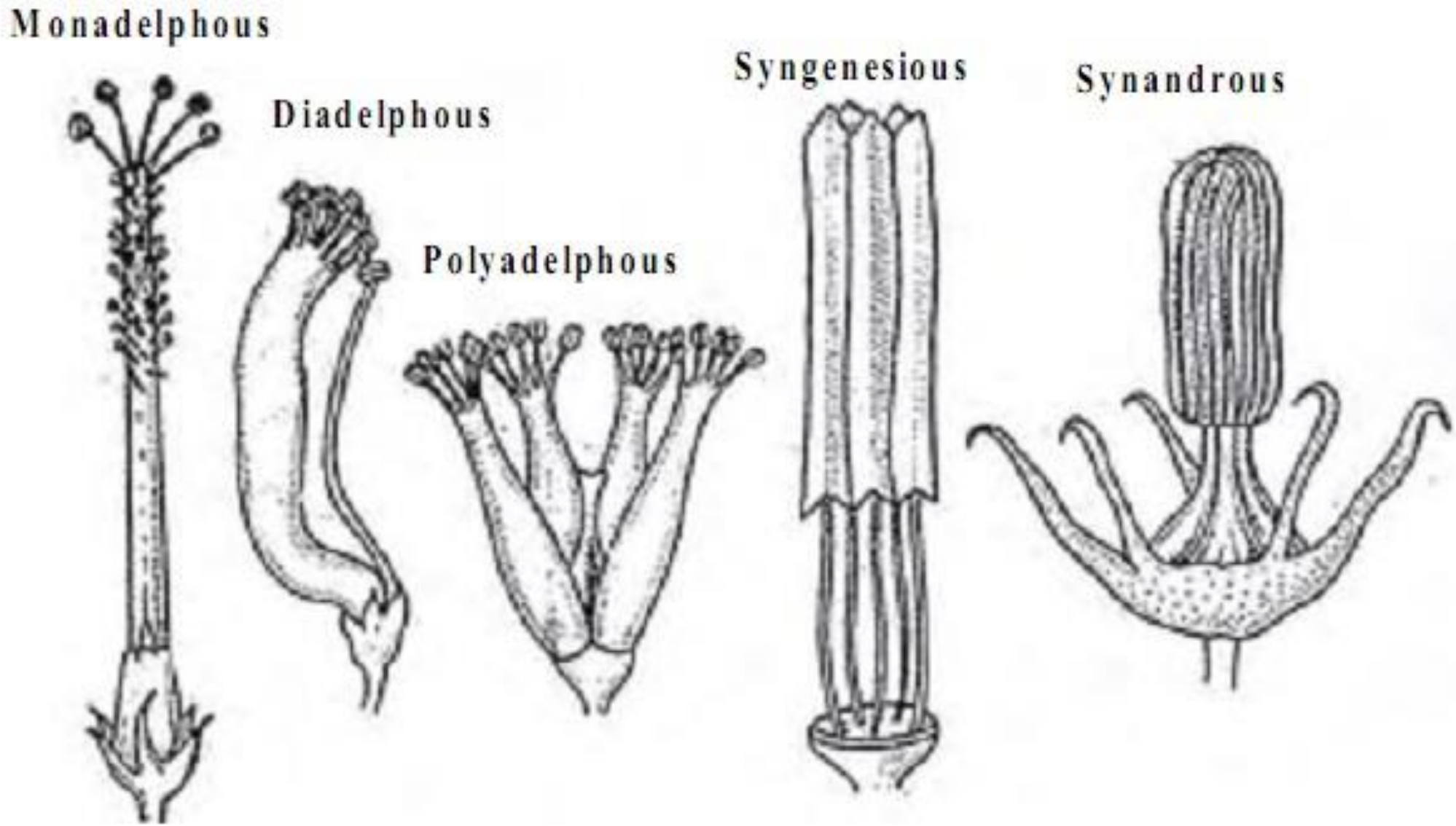
ii. Diadelphous – Filaments of stamens are united to form two bundles, e.g., Pea.

iii. Polyadelphous – Filaments of stamens are united to form many bundles, e.g., *Citrus, Castor,* Cotton etc.

b) Syngenesious – When anthers of stamens are fused and filaments remain free, e.g.,*Helianthus, Tridax*.

(c) Synandrous – When stamens are fused throughout their length, e.g., Cucurbita.

(d) Polyandrous – When stamens are free from one another, e.g., *Ranunculus*, *Iberis* etc.


Monadelphous
Diadelphous
Polyadelphous
Syngenesious
Synandrous

8. Adhesion of stamens:

(a) Epipetalous – Fusion of stamens with petals, e.g., *Datura*, *Ixora*, *tobacco*, potato etc.

(b) Epitepalous (epiphyilous) – Stamens (used with tepals, e.g., *Asparagus*, *Asphodelus* etc.

(c) Gynandrous – Stamens fused with pistils, e.g *Calotropis*.

The Flower (Flower—A Modified Shoot)

Fig:- Epipetalous

9. Fixation of anthers.

(a) Basifixed (Innate) – Filament attached to the base of the anther, e.g., *Brassica*, *Datura*.

(b) Dorsifixed- Filament attached to the dorsal (back) side of the anther, e.g. *Passiflora*, *Sesbonia*, *Annona* etc.

(c) Adnate-Filament attached along the entire length of anther, e.g. *Magnolia*, *Nicotiana*,*Michelia*, *Nelumbium* etc.

(d) Versatile – Filament attached to a point on the back or base of anther so as to let it swing freely, e.g., *Delo- nix*, grasses etc.

(e) Divergent (divaricate) – When two anther lobes separate due to enlarged connective, e.g., *Tilia*.

(f) Distractile – When two anther lobes are far apart, e.g., *Salvinia*

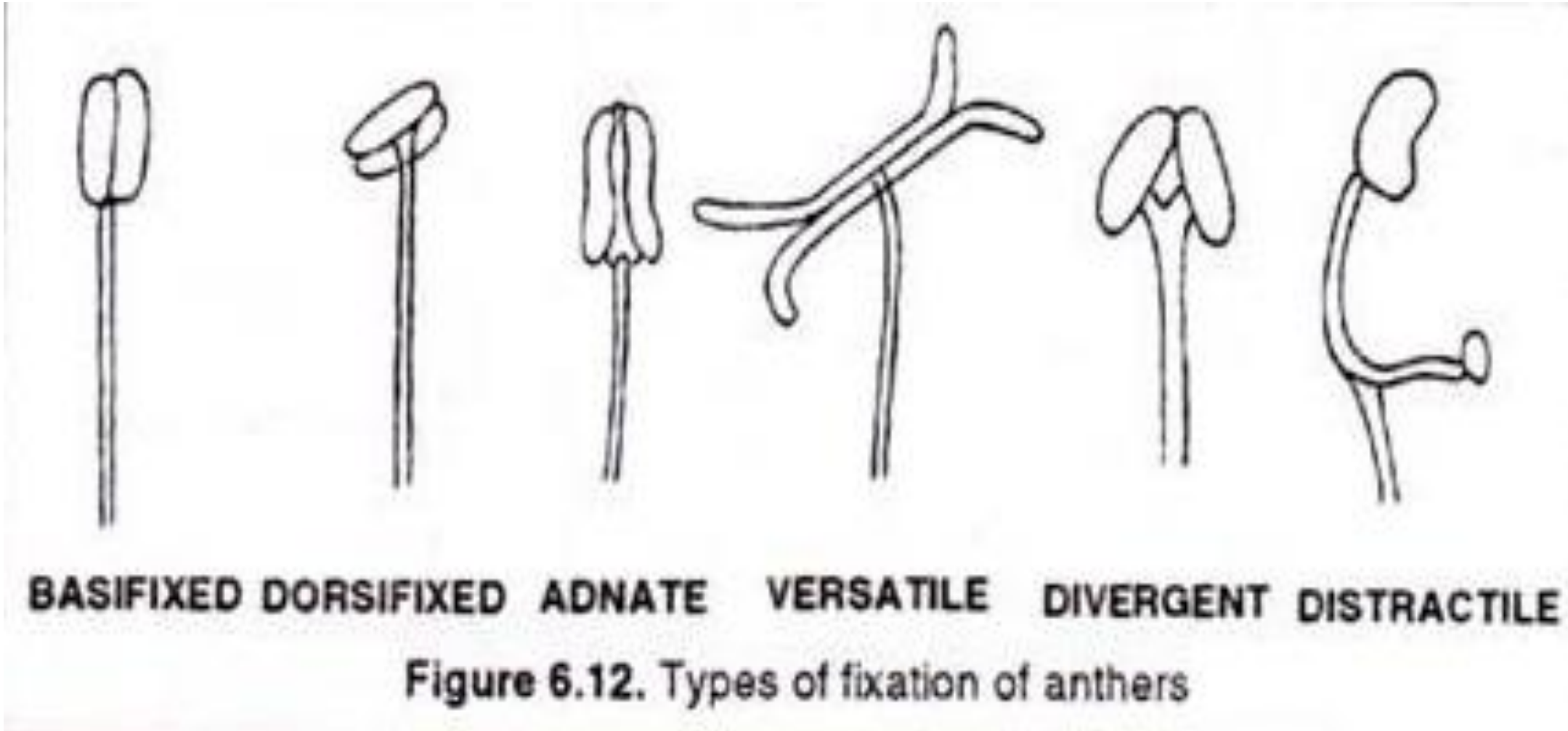


Figure 6.12. Types of fixation of anthers

THE END