SEETHALAKSHMI RAMASWAMI COLLEGE (AUTONOMOUS)

ACCREDITED AT 'A' GRADE (3rd CYCLE) BY NAAC
AFFILIATED TO BHARATHIDASAN UNIVERSITY
TIRUCHIRAPPALLI – 620 002

LAB MANUAL FOR CHEMISTRY AND ZOOLOGY MAJOR

CRYPTOGAMS, GYMNOSPERMS, MORPHOLOGY, TAXONOMY, ANATOMY, CYTOGENETICS, PHYSIOLOGY, ECOLOGY AND PLANT PROPAGATION

Dr. M. Hemalatha
Assistant Professor

PREFACE

I have great pleasure in bringing out the Allied Practical Manual on the occassion of Golden Jubilee year (1963-2013) of our Department. The manual caters to the requirement of the syllabi of II B.Sc Allied for Chemistry and Zoology Major. The manual has been divided into 9 units dealing with Cryptogams (Algae, Fungi, Bryophytes and Pteridophytes), Gymnosperms, Morphology, Taxonomy, Anatomy, Cytogenetics, Ecology, Physiology and Plant Propagation. Large number of illustrations and labelling have been done. Model question paper of the practical, practical key and short notes of the practical key have been appended. These inclusions shall be useful to the students in the preparation of University Practical Examination.

I am extremely grateful to the management for their constant support. I wish to express my deep sense of gratitude to our beloved Principal, Dr. Kanaka Bhashyam, for the appreciative interest shown and encouragement given to me while preparing this manual. I sincerely thank the Department of Biotechnology (DBT) for their financial assistance under star college scheme. I wish to express my profound thanks to my colleagues who helped in making this manual a reality. Much needed moral support and encouragement is provided on numerous occasions by my whole family. I have great pleasure in dedicating this manual to my beloved students.

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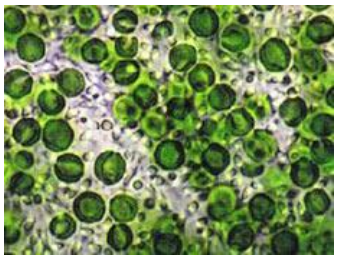
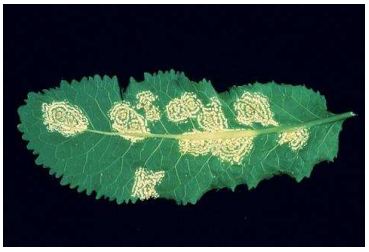
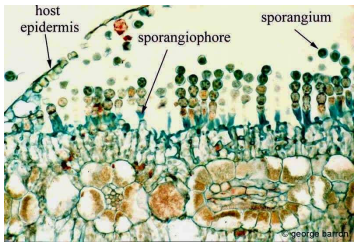
ALLIED PRACTICAL

FOR CHEMISTRY & ZOOLOGY MAJOR
(CRYPTOGAMS, GYMNOSPERMS, MORPHOLOGY, TAXONOMY, ANATOMY, CYTOGENETICS, PHYSIOLOGY, ECOLOGY AND PLANT PROPAGATION)

CONTENTS







CRYPTOGAMS

(Algae, Fungi, Bryophytes and Pteridophytes)

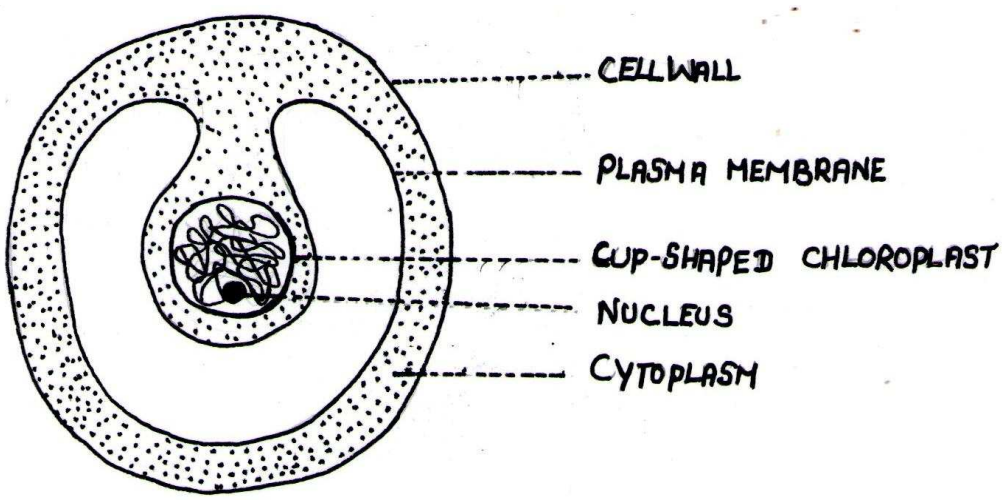
Class : Chlorophyceae

Order : Chlorococcales

Family : Chlorellaceae

Genus : *Chlorella*

- ***Chlorella*** is a **unicellular, non-motile, spherical free floating alga**.
- The cell membrane encloses **protoplast** and external to the cell membrane is a **thick cell wall**.
- There is a single **cup shaped parietal chloroplast**.
- In the cavity of chloroplast, lies the **nucleus**.
- **Pyrenoids** are absent.



Class : Oomycetes

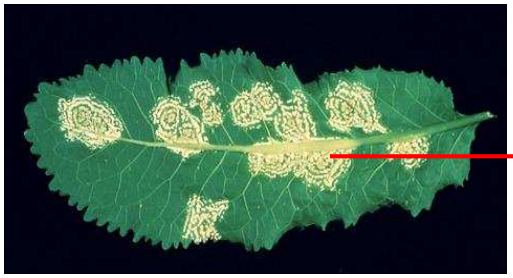
Order : Peronosporales

Family : Albuginaceae

Genus : *Albugo*

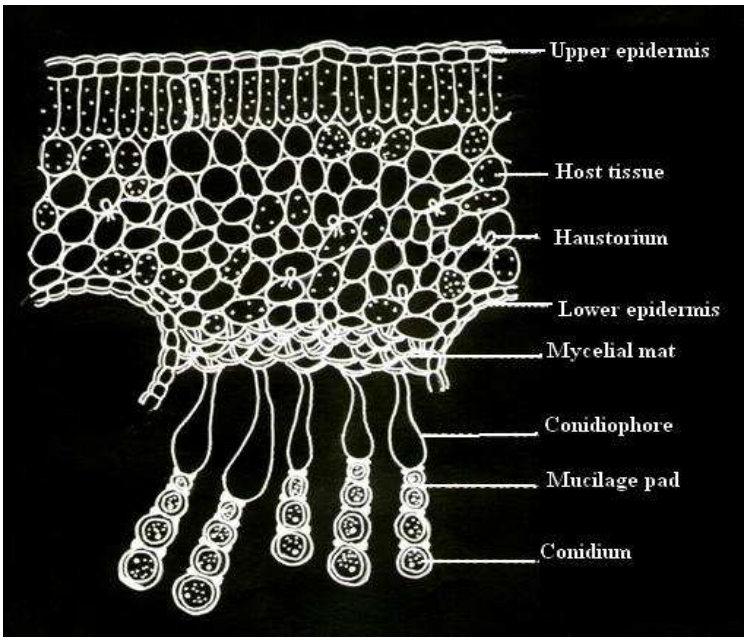
INFECTED LEAF:

- ***Albugo*** causes **"white rust"** or **"blister rust"** disease on the leaves of Amaranthaceae.
- The disease appears in the form of **shiny, white, smooth irregular blisters or patches**.



T.S. of infected leaf:

- The infected portion shows the **ruptured epidermis**.
- **Short, thick-walled, unbranched, club shaped conidiophores** are seen.
- Each **conidiophore** bears a chain of conidia in **basipetal succession**.
- Conidia are joined with each other with the help of **mucilage pad.**
- Conidium is a **small, smooth, spherical** and **multinucleate structure**.
- Each conidium may grow directly or develop many **biflagellate kidney shaped**, uninucleate **zoospores** and act as **zoosporangium.**



Division	**:**	Bryophyta
Class	**:**	Hepaticopsida
Order	**:**	Marchantiales
Family	**:**	Marchantiaceae
Genus	**:**	*Marchantia*

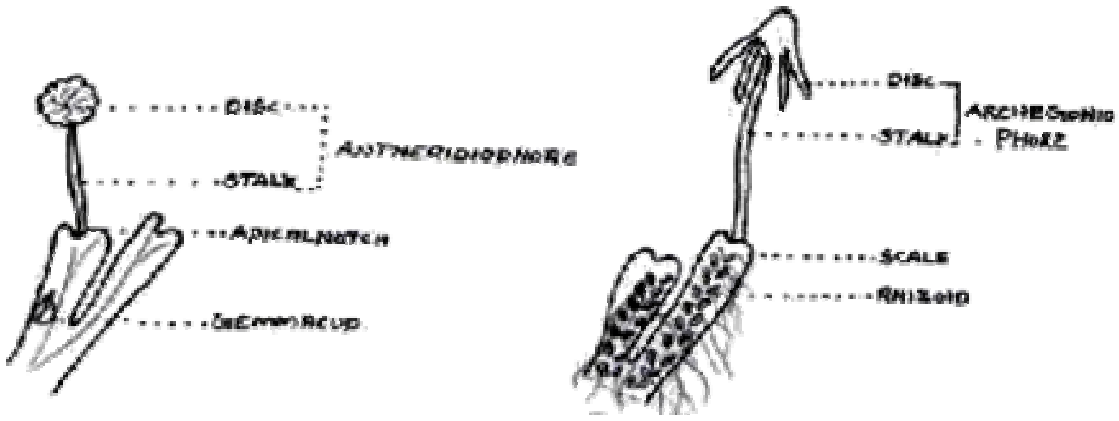
Dorsal view with antheridiophore:

- The thallus of *Marchantia* is **flat** and **dichotomously branched.**
- There is a conspicuous midrib marked by **hollow groove** and there small **rhomboidal areas**, with small dot like spot at the center – **airpore**.
- Thallus may bear **gemma cups** that contain special reproductive bodies called **gemma**.

Ventral view with archegoniophore:

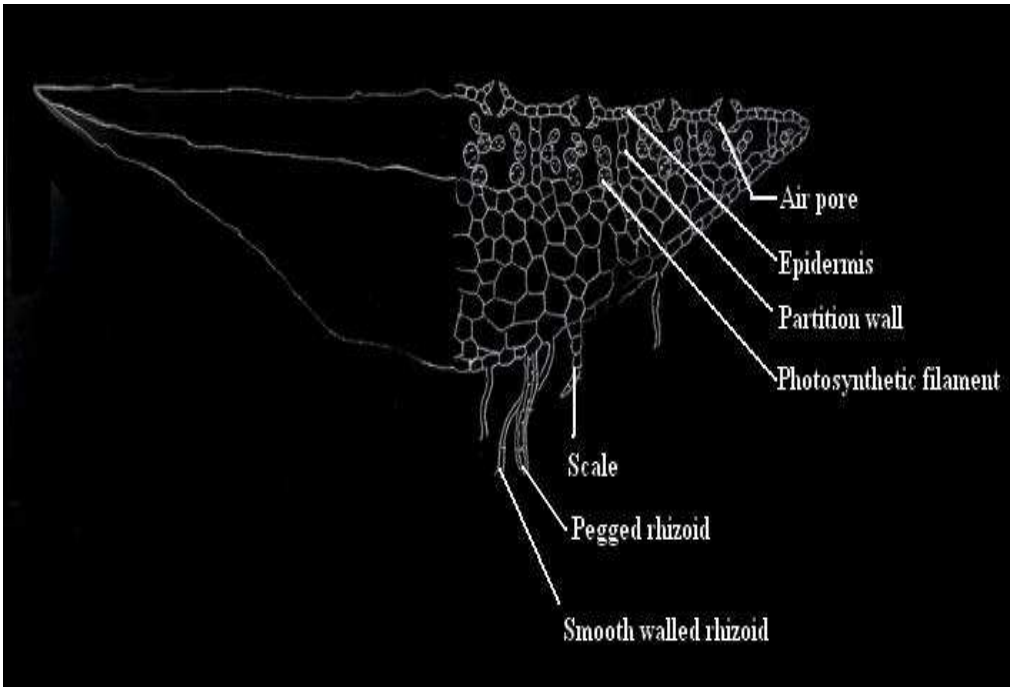
- From the ventral surface of the thallus arise numerous **rhizoids** and **scales**.
- The rhizoids are two kinds: **smooth walled** and **tuberculate** rhizoids.

Dorsal view with Antheridiophore **Ventral view with Archegoniophore**



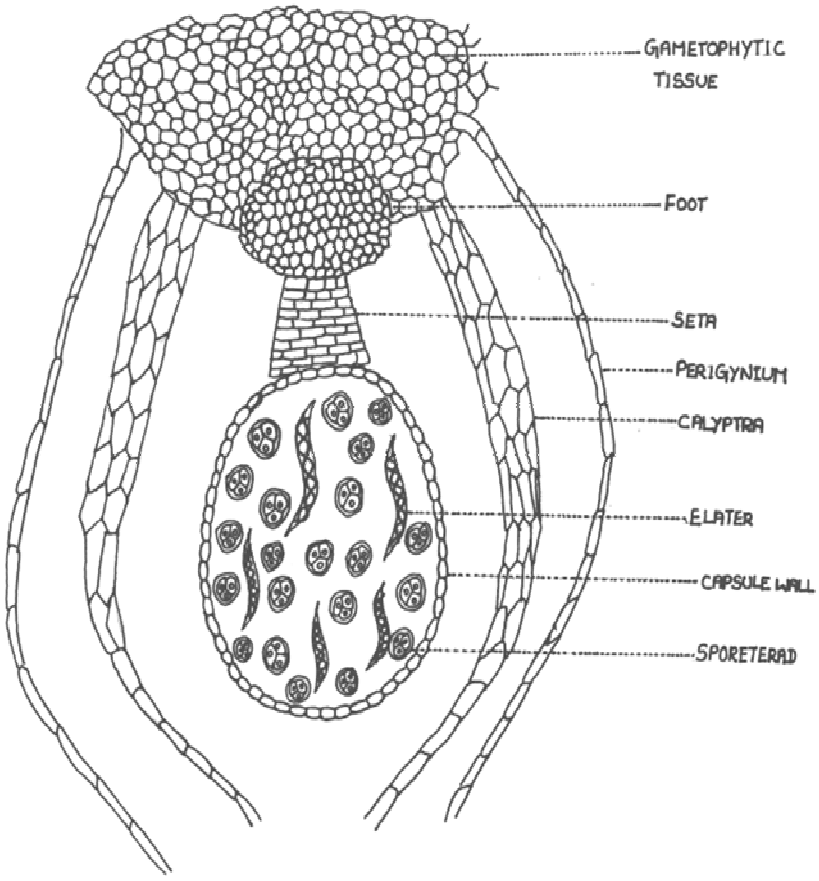
T.S. of Thallus:

- Upper **photosynthetic region** and lower **storage region**.
- Presence of **airpores** in the upper epidermis.
- Photosynthetic region shows **air chambers**, **partition wall, assimilatory filaments** with chloroplast.
- **Storage region** is made up of thin walled parenchyma cells.
- Lower epidermis shows **scales**, thin walled, unicellular **tuberculate** and **pegged rhizoids**.



L.S. of Sporophyte:

- Each sporangium is enclosed by **calyptra** and **perigynium**.
- A group of sporangia is covered by **perichaetium**.
- The mature sporangium is differentiated into 3 parts: **(i) foot (ii) seta (iii) capsule**.
- Foot is meant for **anchorage** and **nutrition.**
- Seta is short and elongates at maturity, pushing the capsule out of calyptras and perigynium.
- Capsule is **oval** and encloses **spores** and **elaters.**
- Elaters are **hygroscopic** and meant for **dispersal**.



Class : Leptosporangiopsida

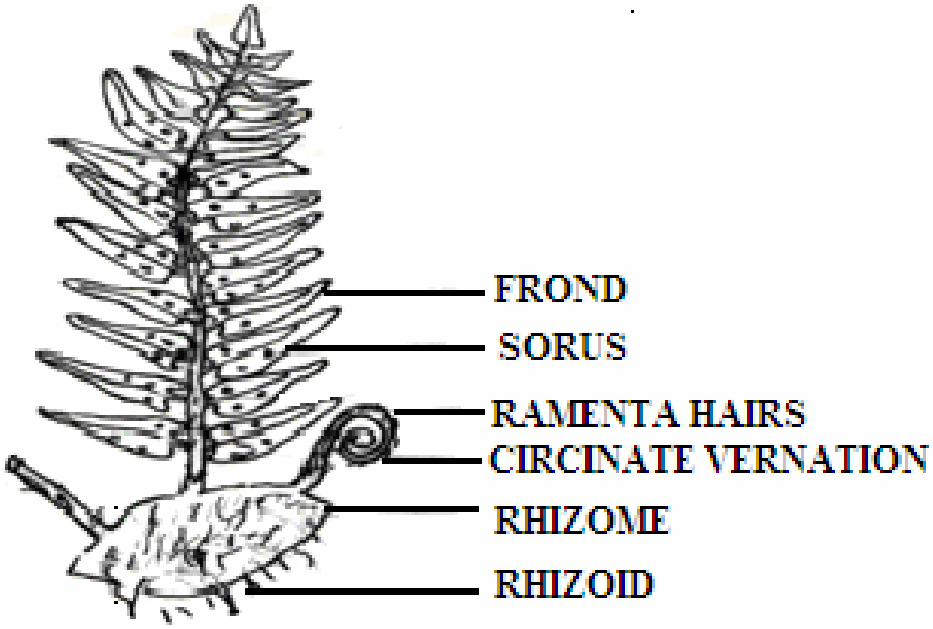
Order : Filicales

Family : Polypodiaceae

Genus : *Nephrolepis*

HABIT

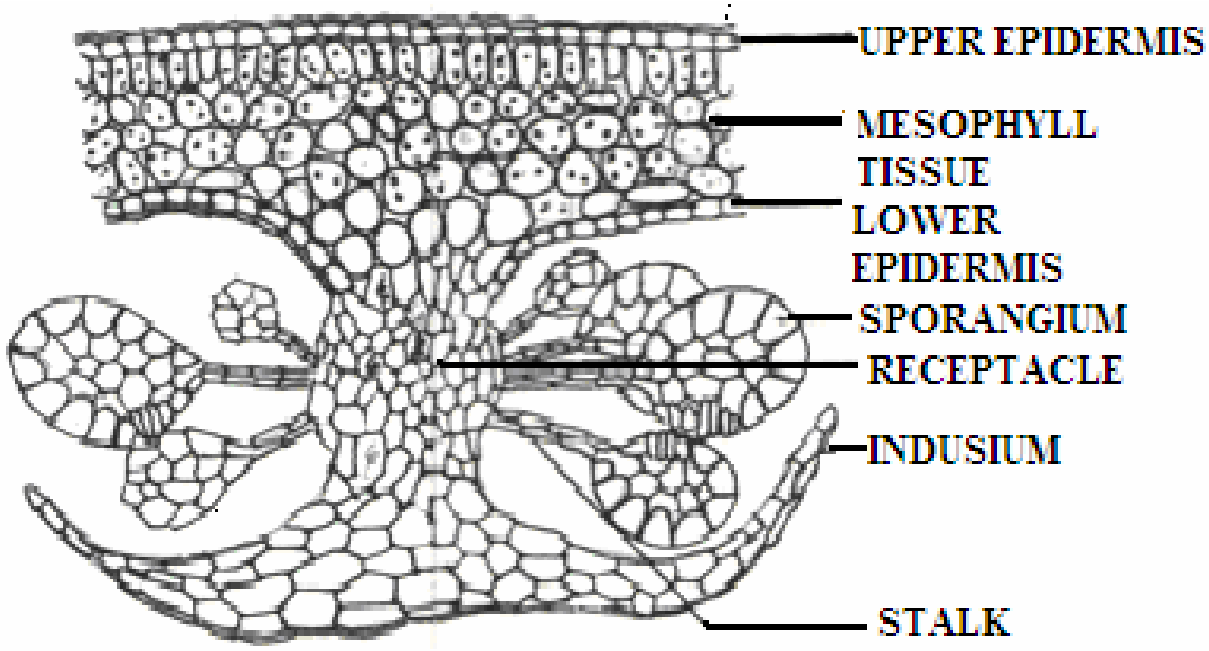
- The plant is a sporophyte differentiated into **root, stem, rhizome** and **fronds**.
- The rhizome is underground, creeping and covered with **ramental hairs**.
- **Adventitious roots** arise from underside of the rhizome.
- The young leaves are **circinately coiled** in bud condition.
- Each leaf act as **sporophyll** and bears a group of **sporangia** on the ventral surface referred as **sorus**.

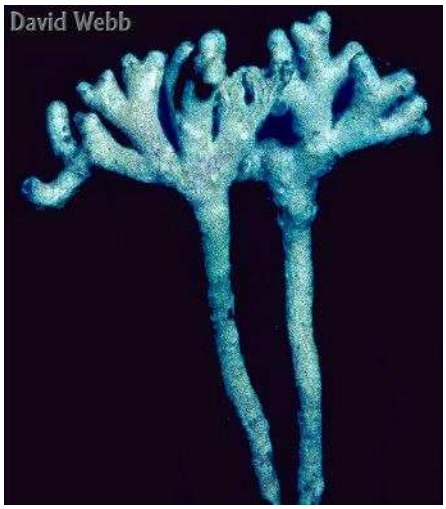


T.S. of sporophyll with sori:

The vertical section of the sporophyll shows the following structure:

- The sporophyll has a swollen receptacle called **placenta**.
- Each sporangium has a long stalk with **capsule.**
- The sporangial wall has **thick annulus** and thin **stomium.**
- Each sporangium encloses unicellular **haploid spores**.
- The sori are enclosed by **indusium.**



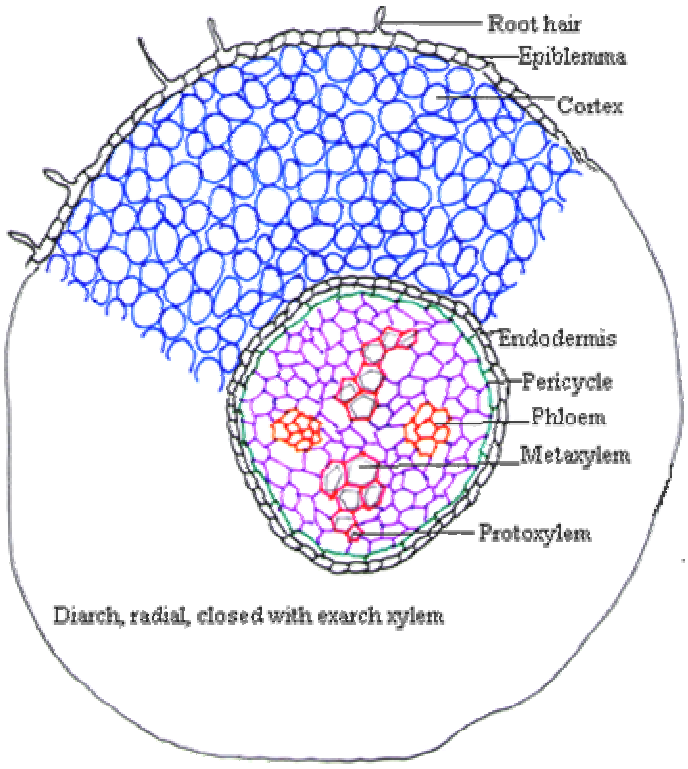


GYMNOSPERMS

Class	**:**	Cycadopsida
Order	**:**	Cycadales
Family	**:**	Cycadaceae
Genus	**:**	*Cycas*

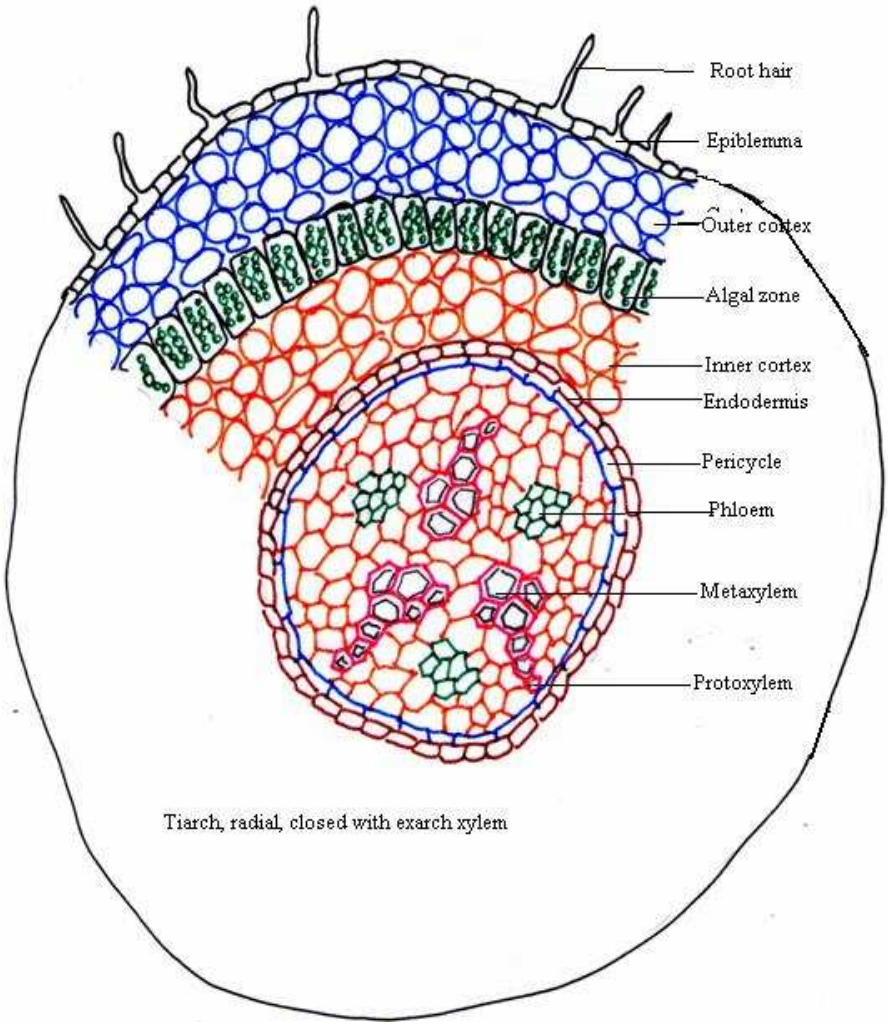
T.S. of Young Root:

- The young root has a **circular** outline.
- It is differentiated into outer **epiblema, cortex** and **stele**.
- Epiblema is single-layered, composed of **thin-walled cells**.
- Cortex is **broad, parenchymatous and multilayered**.
- Some of the cortical cells have **starch** and **tannin**.
- **Endodermis** is uniseriate.
- **Pericycle** is single layered.
- Stele is **radial, closed, diarch** with **exarch xylem**.



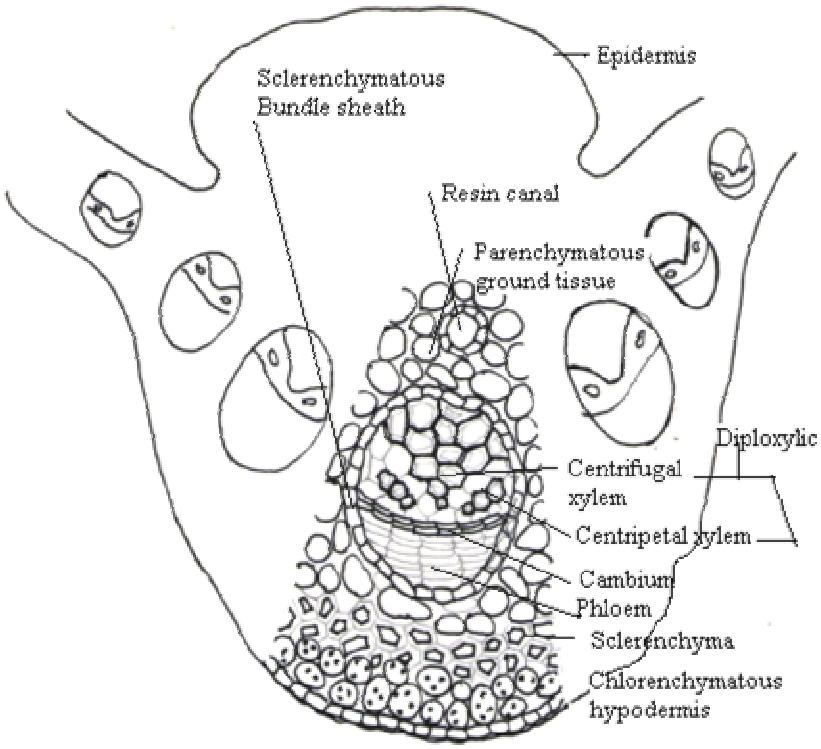
T.S. of Coralloid Root:

- The structure of coralloid root is similar that of the normal root of *Cycas*.
- Except the presence of **algal zone** made up of **radially** elongated cell.
- The middle portion of cortex has the **blue green algae** like ***Anabaena*** and ***Nostoc***.
- Vascular bundles are **closed, radial, triarch** with **exarch xylem**.



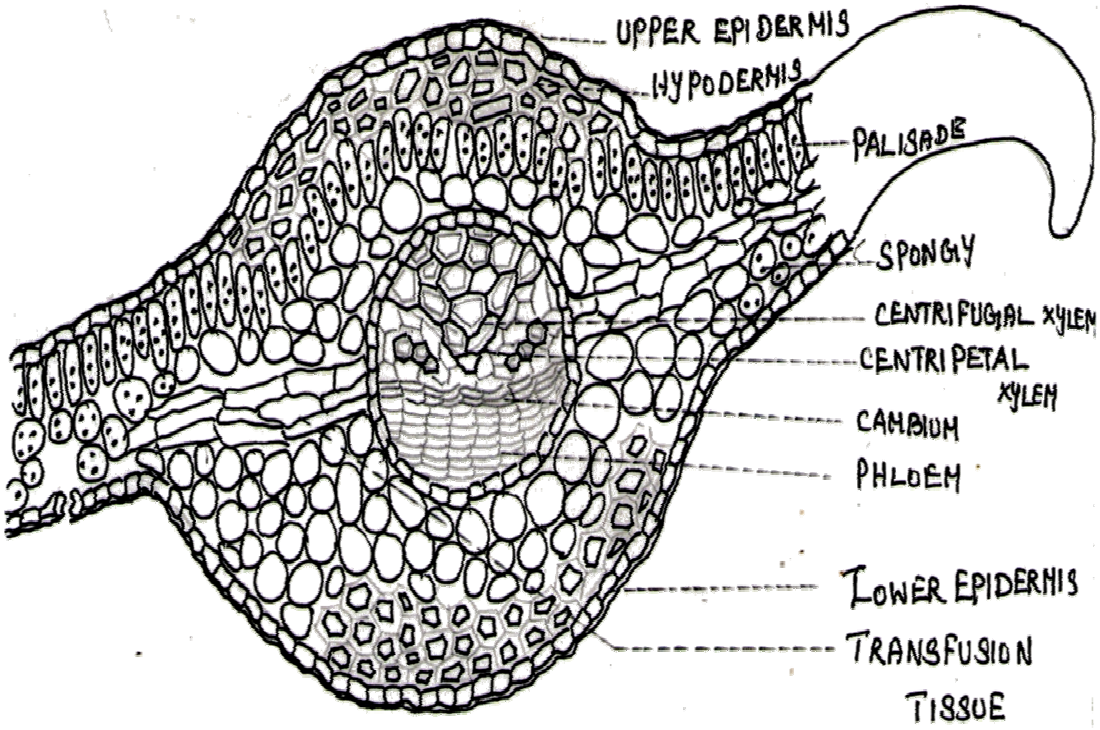
T.S. of Rachis

- It is **shield** shaped.
- The outer most layer is epidermis, **cuticularised**.
- Hypodermis is multilayered and differentiated into outer **chlorenchyma** and inner **sclerenchym**a.
- The ground tissue is **parenchymatous**.
- Numerous **mucilage ducts** are seen in the ground tissue.
- Vascular bundles are arranged in an **inverted omega-shaped**.
- **Each bundle is conjoint, collateral, open, pseudomesarch** and **diploxylic** with **centripetal** and **centrifugal xylem.**



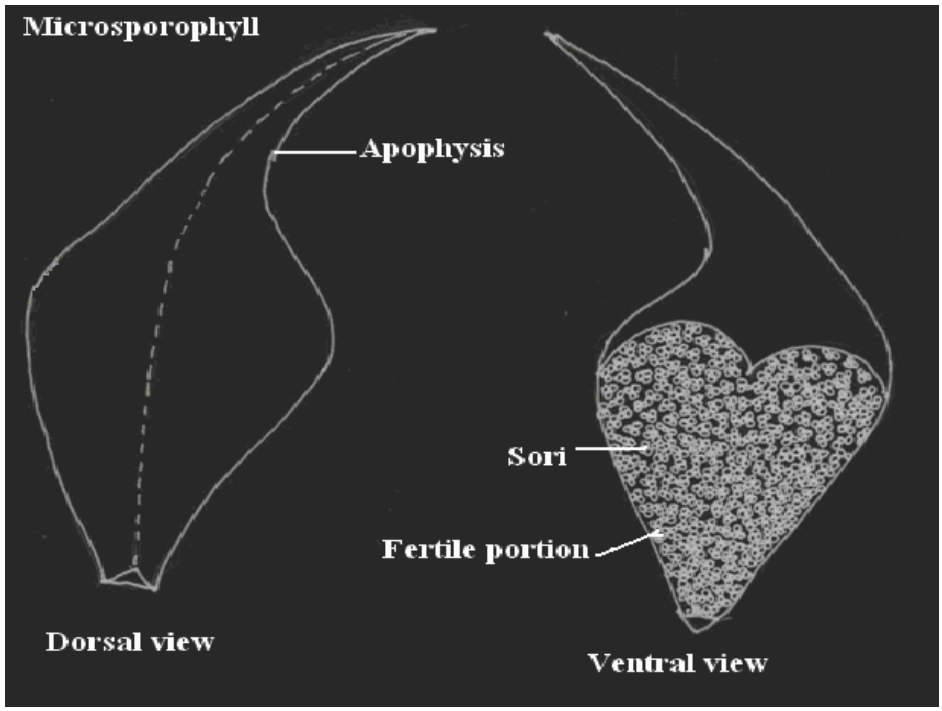
T.S. of Leaflet

- The leaf has a **swollen midrib** and narrow flat wings.
- The outermost layer is **cuticularised** with epidermis.
- Sclerenchymatous hypodermis is present on both sides.
- There is a centrally located vascular bundle which is **conjoint, collateral, open, pseudomesarch** and **diploxylic.**
- **Xylem** shows a large **"V" shaped centripetal xylem and groups of centrifugal xylem.**
- Mesophyll is differentiated into palisade and spongy parenchyma.
- Presence of **transfusion tissue** between palisade and spongy parenchyma helping in lateral conduction.



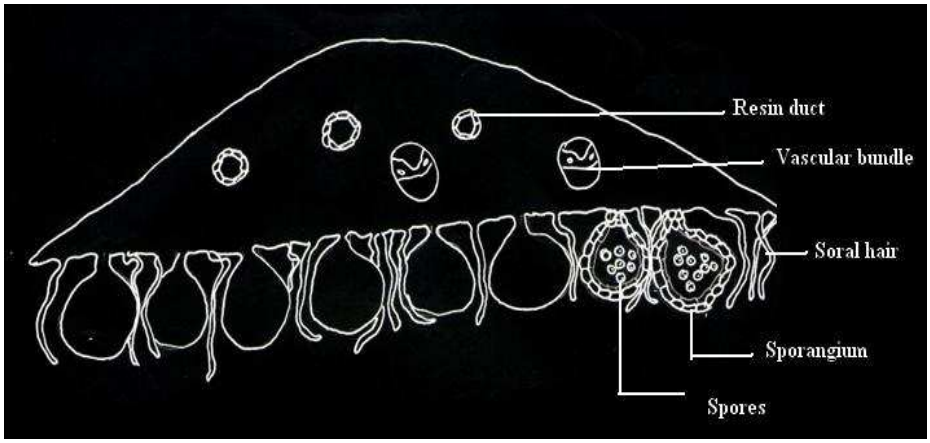
MICROSPOROPHYLL

- Each microsporophyll is narrow at the base and towards the tip.
- It is broader in the middle portion.
- The sterile upper portion is called **apophysis**.
- They are wedge shaped structure.
- The ventral surface bears the **sorus.**
- Presence of **soral hairs.**



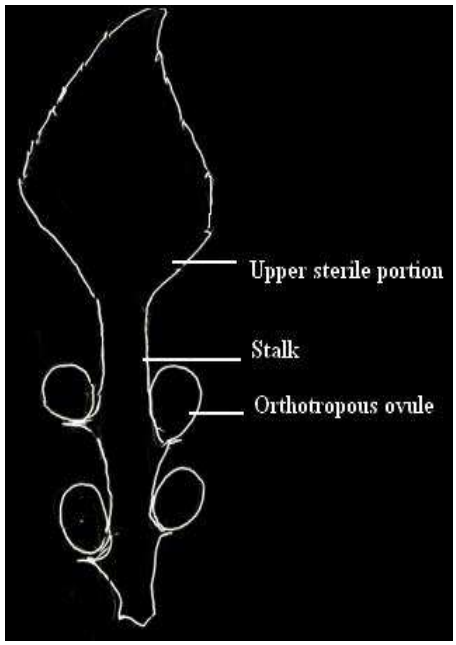
T.S. of Microsporophyll

- The outline is triangular.
- A large number of **mucilaginous ducts** are seen in ground tissue.
- The **sporangia** are attached on the lower surface.
- The **microsporangia** are cut **longitudinally**.
- Sporangia are **oval, sac-like** with a short stalk.
- Sporangia enclose a large number of **microspores**.
- Intermixed with sporangia are several **unicellular soral hairs**.



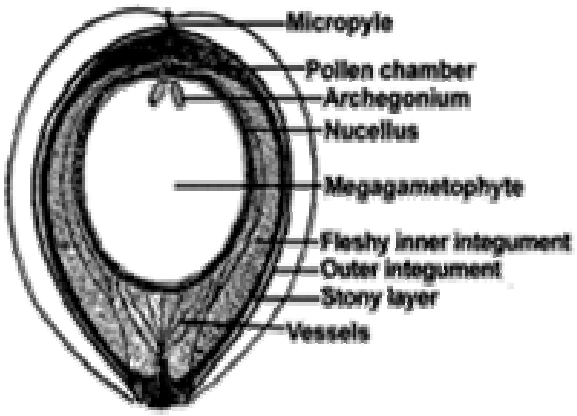
MEGASPOROPHYLL

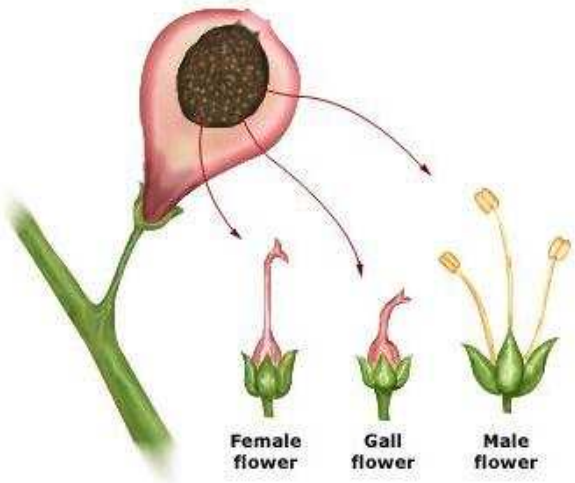
- The megasporophyll are loosely arranged and never form a cone.
- It **is large**, 6-8 inchces long.
- Its upper portion is **broadly pinnate** and **tapers** to a point.
- The stalk like lower portion bears **orthotropous ovules** in two distichous, lateral rows.
- The whole sporophyll is covered with dense **brownish, woolly hairs.**
- Each megasporophyll is leaf-like pinnately dissected while the lower narrow portion bears ovules on either side.



L.S. of Ovule

- The ovules are **orthotropous.**
- It has an integument having **3 layers.**
- Outer and inner **fleshy layer** and middle **stony layer**.
- The nucellus is covered by the integument except in the region above where **micropyle** is present.
- A few cells at the apex of the ovule, some cells nucellus, is dissolved to form the **pollen chamber**.
- The centre of the ovule is filled with tissue of **female gametophyte** which is surrounded by the **nucellus**.





Hypanthodium inflorescence (ficus)

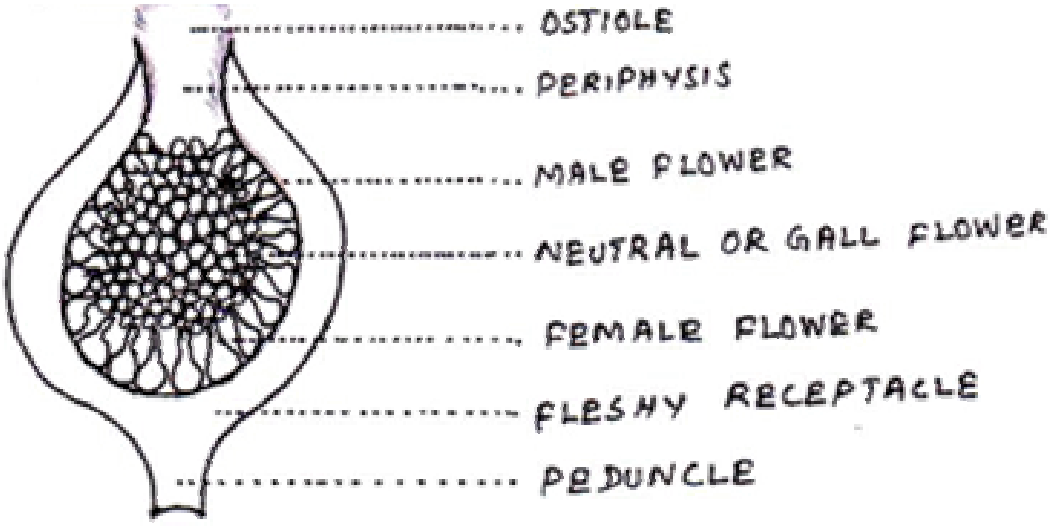
MORPHOLOGY

SPECIAL TYPES OF INFLORESCENCE

HYPANTHODIUM

E.g. *Ficus*

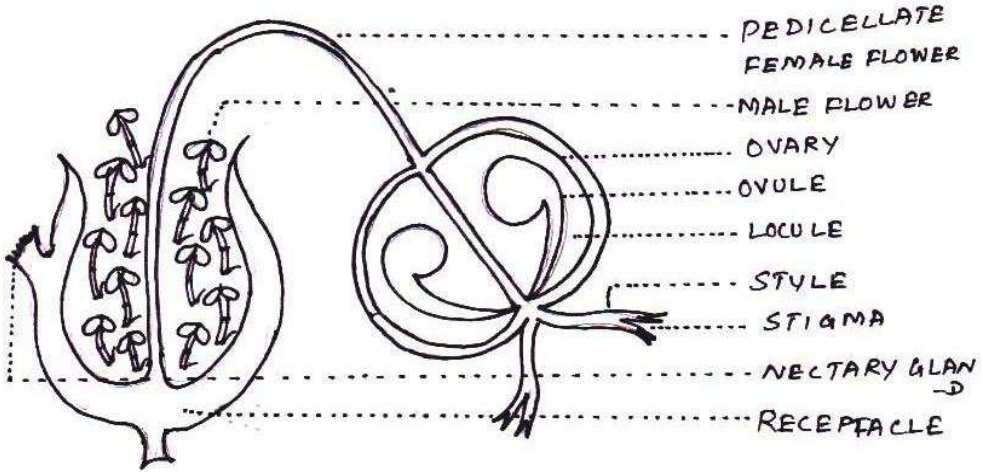
- **Hypanthodium** is the characteristic inflorescence of fig.
- It is the modification of **capitulum**.
- The receptacle is convex at the beginning becomes concave and hollowed out into a **flask shaped** structure.
- Numerous small, **sessile flowers** are arranged along the inner wall of the **receptacle**.



CYATHIUM

E.g. *Euphorbia heterophylla*

- **Cyathium** is a highly condensed inflorescence like a flower.
- It consists of highly reduced, **solitary, central flower** surrounded by five, **scorpiod** reduced **male flower**.
- It is the characteristic inflorescence of **Euphorbiaceae**.



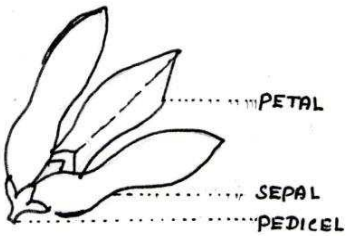
TAXONOMY

FAMILY: ANNONACEAE

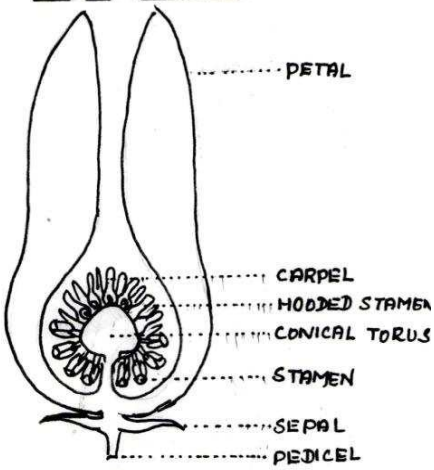
Annona squamosa

- **Arborescent** habit.
- Alternate, exstipulate, **distichous** leaves.
- Leaf opposed **fascicle**.
- Bisexual, **trimerous**, **hemicyclic**, **hypogynous** flower.
- **Sepaloid, spathulate** petals.
- Numerous free stamens and carpels arranged spiral on the **conical torus**.
- Dithecous, **hooded anther**.
- Numerous carpels, **apocarpous** and superior ovary.
- Each carpel is **unilocular** with one ovule on **basal** placentation.
- **Aggregate** fruit.

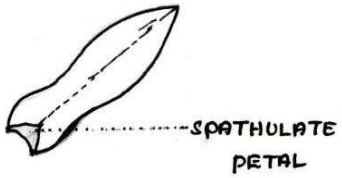
ENTIRE FLOWER



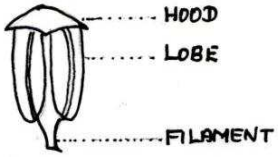
L.S OF FLOWER



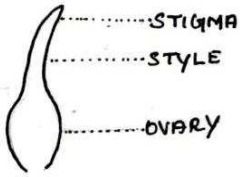
PETAL



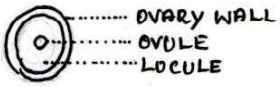
STAMEN



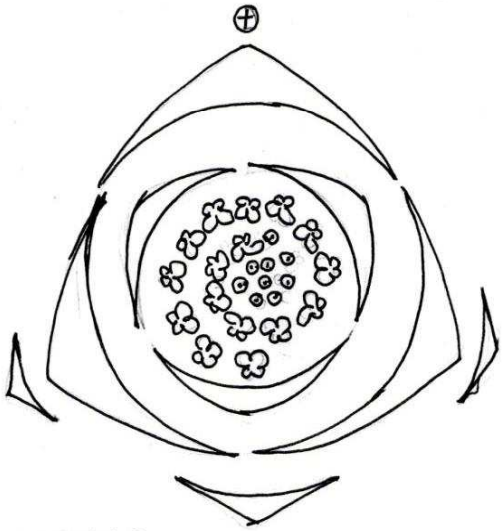
CARPEL



T.S OF OVARY



FLORAL DIGRAM



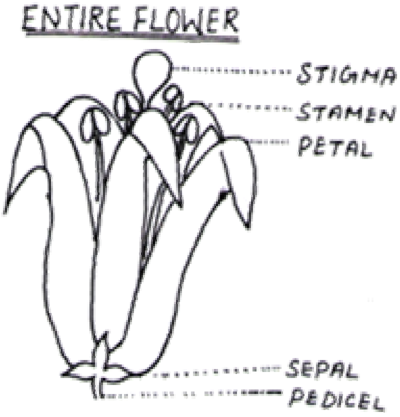
FLORAL FORMULA

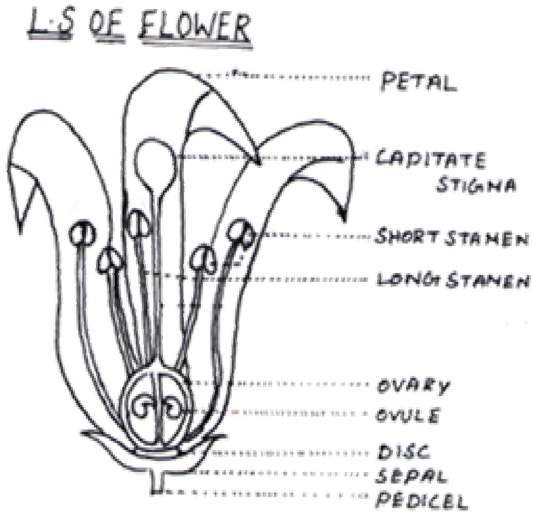
$Br, Brl, \varphi \oplus, K_3, C_3, A_{\infty}, \underline{G}_{\infty}$

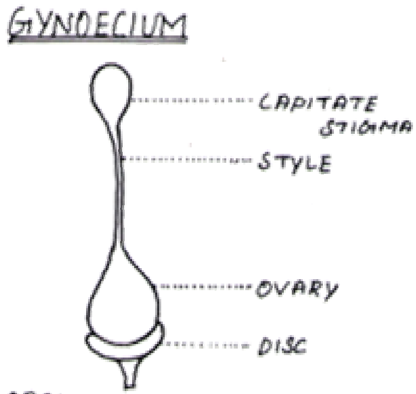
FAMILY: RUTACEAE

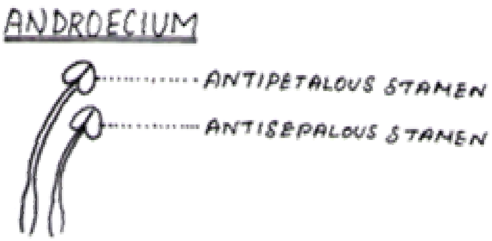
Murraya exotica

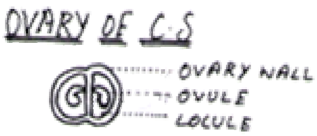
- **Unarmed** stem.
- **Exstipulate** compound leaves, **aromatic gland dotted** with inter marginal reticulate venation.
- **Cymose** clusters.
- Bisexual, regular, pentamerous, **hypogynous** flower.
- Ten stamens, **obdiplostemonous**, outer five long antipetalous and inner five short antisepalous stamen.
- Anther dithecous, **introrse**.
- Bicarpellary, **syncarpous**, **bilocular**, superior ovary with ovule in each locule on **axile** placentation.
- **Hypogynous disc** is present.









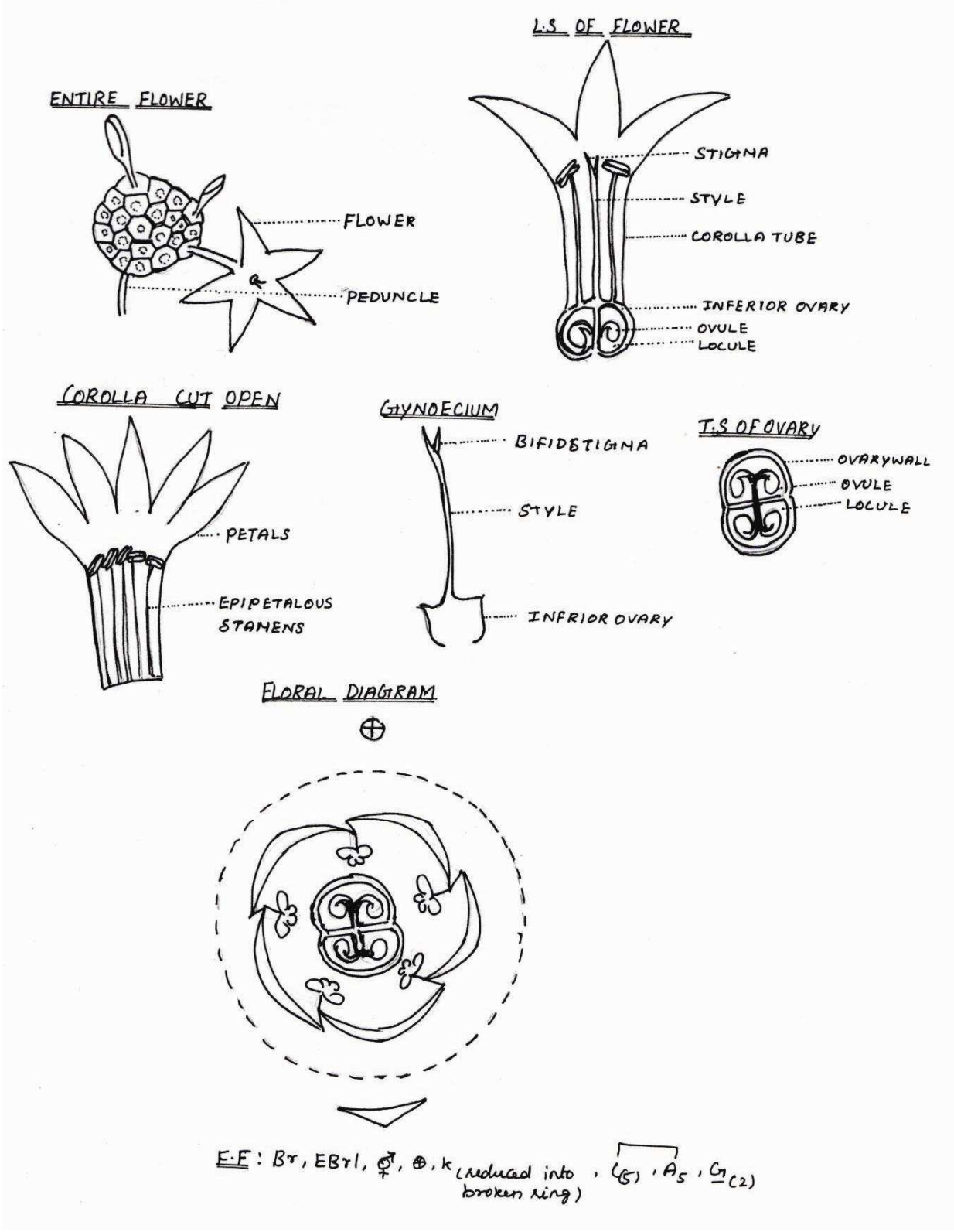


F.F : Br, Ebrl, ⚥, ⊕, $K_{(5)}$, C_5, A_{5+5}, $G_{(2)}$

FAMILY: RUBIACEAE

Morinda tinctoria

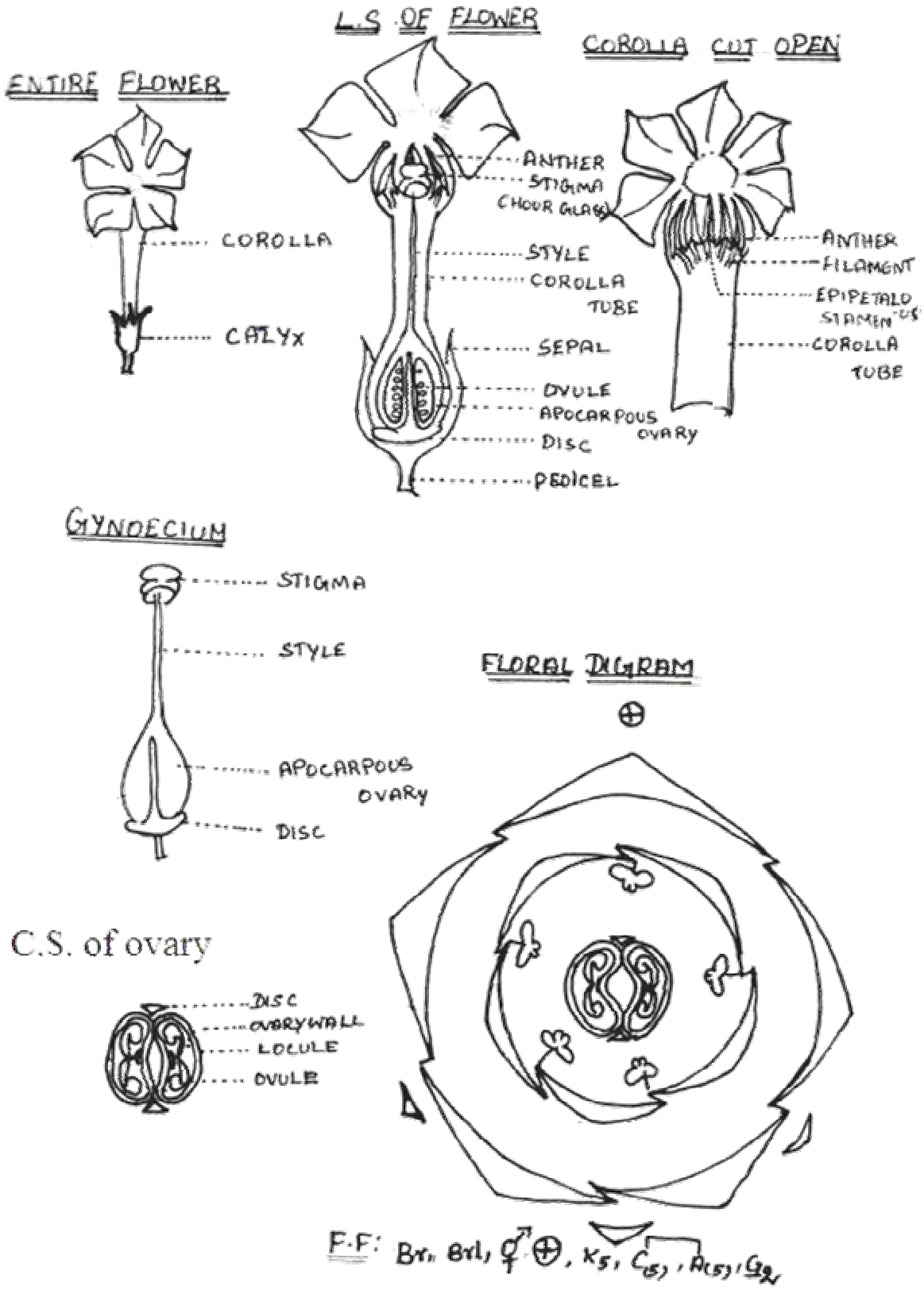
- Simple **opposite, decussate, interpetiolar stipulate** leaves.
- **Axillary head** inflorescence.
- Bisexual, actinomorphic, pentamerous, **epigynous** flower.
- **Calyx** reduced into a **ring**.
- Five, **epipetalous** stamen.
- Five, gamopetalous **twisted** corolla.
- Bicarpellary, syncarpous, **bilocular**, **inferior** ovary on **axile** placentation.
- **Bifid** stigma.
- **Multiple** fruit.


ENTIRE FLOWER
FLOWER
PEDUNCLE
L.S OF FLOWER
STIGMA
STYLE
COROLLA TUBE
INFERIOR OVARY
OVULE
LOCULE
COROLLA CUT OPEN
PETALS
EPIPETALOUS STAMENS
GYNOECIUM
BIFIDSTIGMA
STYLE
INFRIOR OVARY
T.S OF OVARY
OVARYWALL
OVULE
LOCULE
FLORAL DIAGRAM
E.F : Br, EBrl, ♂, ♀, K (reduced into broken ring), C(5), A5, G(2)

FAMILY: APOCYNACEAE

Vinca rosea

- Simple, **opposite, decussate**, shiny leaves.
- **Axillary** paired **cyme**.
- Bisexual, actinomorphic, pentamerous, **hypogynous** flower.
- Five, gamopetalous, **hypocrateriform** corolla.
- **Corolline corona** is present.
- Five, **epipetalous** stamen.
- Bicarpellary, **apocarpous**, superior ovary, many ovules on **marginal** placentation.
- **Hour-glass** shaped stigma.
- Double **follicle** fruit.

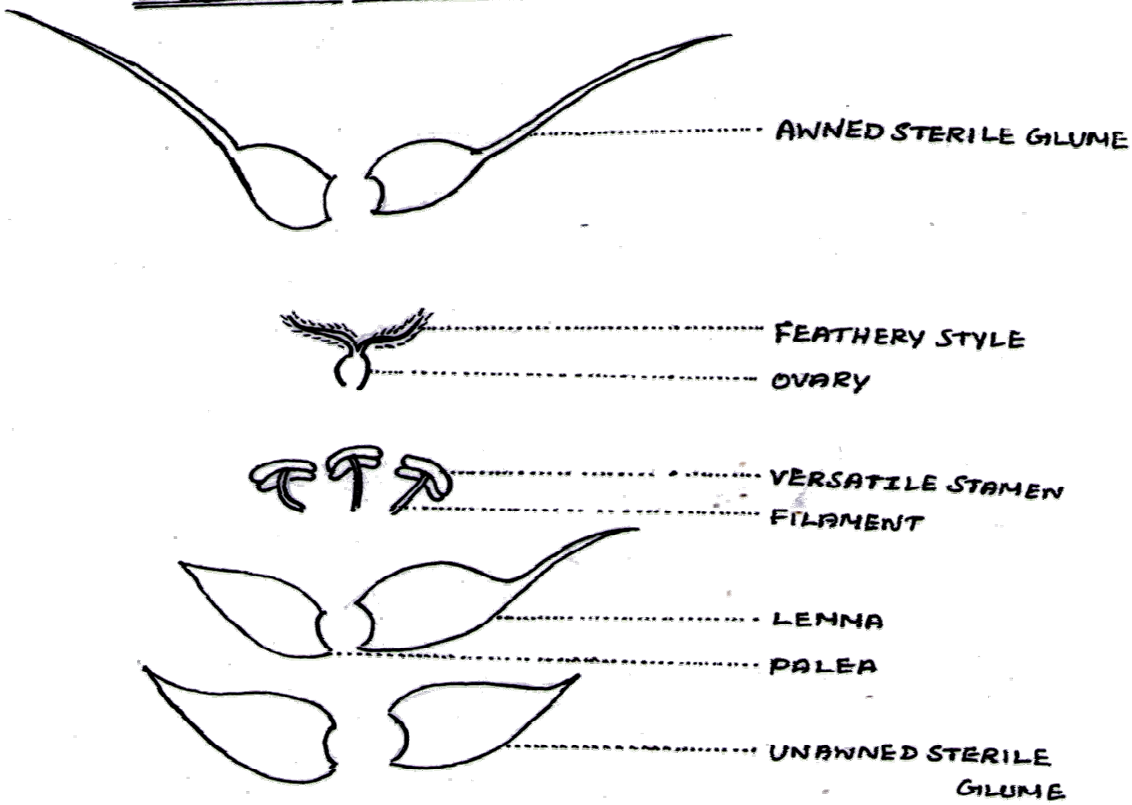

ENTIRE FLOWER
COROLLA
CALYX
L.S OF FLOWER
ANTHER
STIGMA
CHOUR GLASS
STYLE
COROLLA TUBE
SEPAL
OVULE
APOCARPOUS OVARY
DISC
PEDICEL
COROLLA CUT OPEN
ANTHER
FILAMENT
EPIPETALO STAMENOUS
COROLLA TUBE
GYNOECIUM
STIGMA
STYLE
APOCARPOUS OVARY
DISC
FLORAL DIGRAM
C.S. of ovary
DISC
OVARY WALL
LOCULE
OVULE
F.F: Br, Brl, ♀ ⊕, K5, C(5), A(5), G2

FAMILY: GRAMINEAE

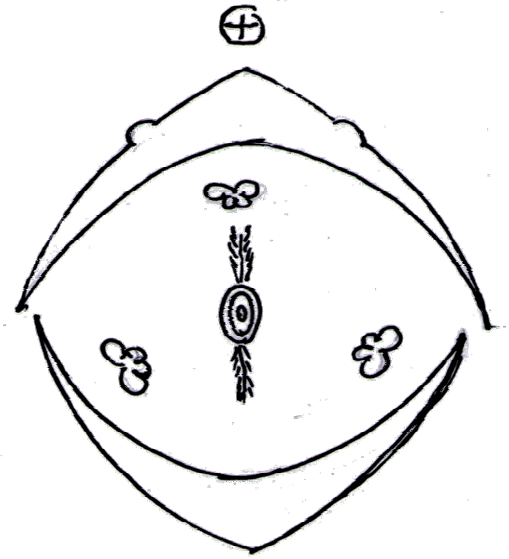
Chloris barbata

- Cylindrical **hollow stem** with **swollen nodes**.
- **Sessile**, alternate leaves with **parallel** venation.
- Leaves have leaf sheaths and **ligules**.
- Inflorescence with **spikelet**.
- Perianth is modified and reduced into **lodicules**.
- Anthers are **versatile**.
- Stigma is **plumose**.
- Fruit is **caryopsis**.

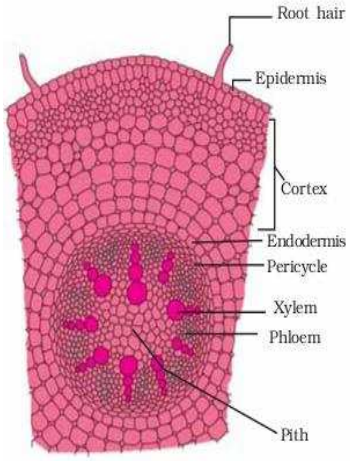
DISSECTED SPIKELET

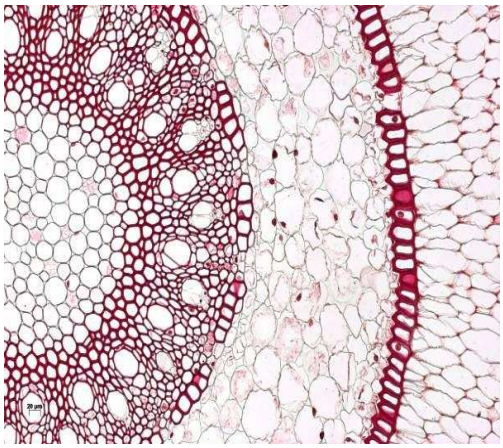


FLORAL DIAGRAM

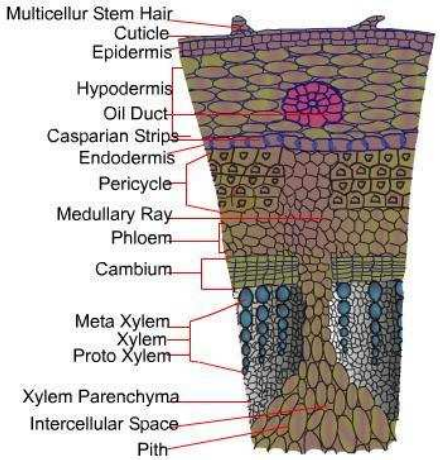


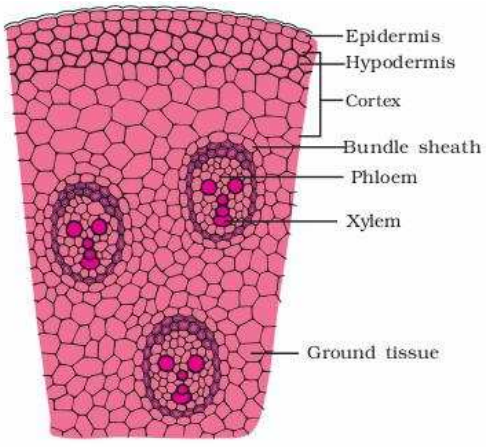
E.E: Br, Br l, ♂, ♀, P(0), A_3, $\underline{G}_{(3)}$


Root hair
Epidermis
Cortex
Endodermis
Pericycle
Xylem
Phloem
Pith



ANATOMY


Multicellur Stem Hair
Cuticle
Epidermis
Hypodermis
Oil Duct
Casparian Strips
Endodermis
Pericycle
Medullary Ray
Phloem
Cambium
Meta Xylem
Xylem
Proto Xylem
Xylem Parenchyma
Intercellular Space
Pith

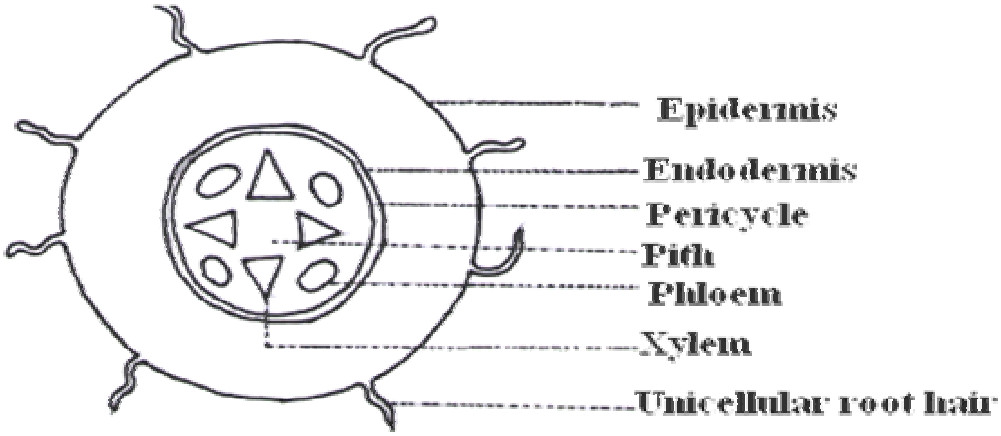

Epidermis
Hypodermis
Cortex
Bundle sheath
Phloem
Xylem
Ground tissue

T.S.OF DICOT ROOT

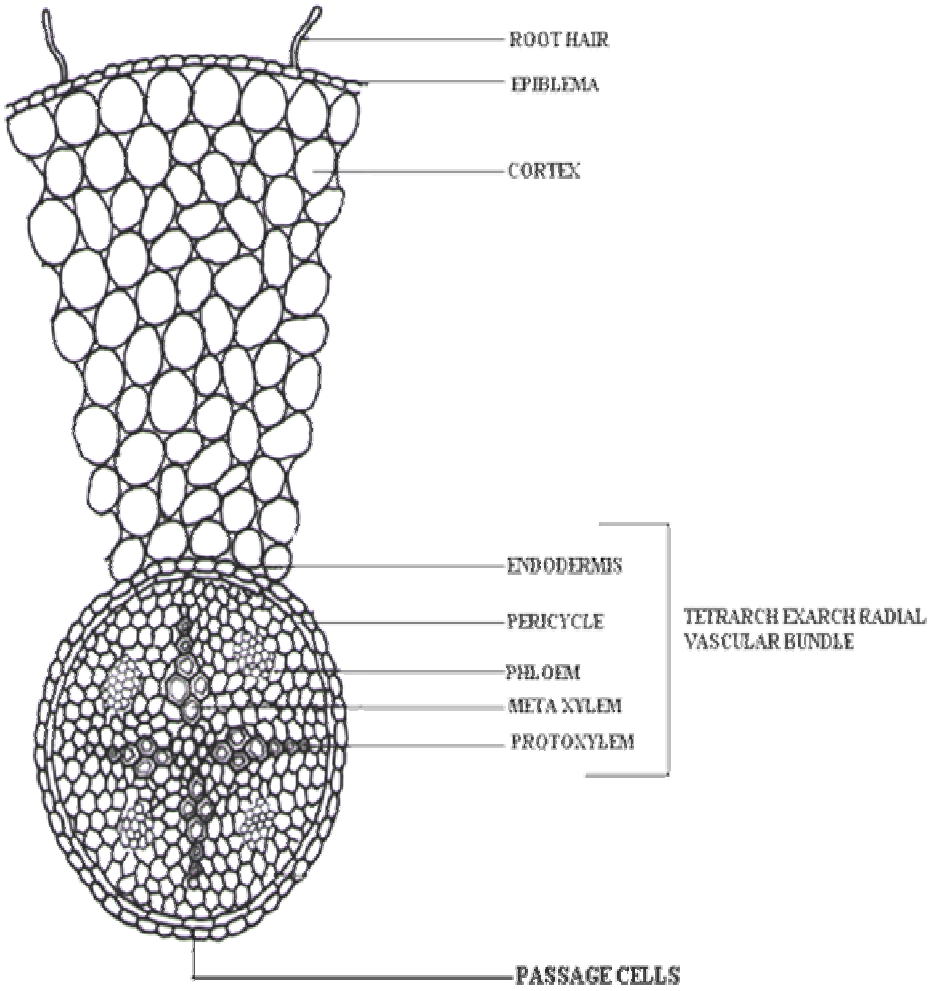
E.g. Bean

- Epidermis is single layered, **unicellular** root hairs without cuticle.
- Cortex is broad and **homogenous parenchymatous**.
- Endodermis is single layered with **casparian strips**.
- **Uniseriate** pericycle.
- Vascular bundles are **radial, open**, **tetrarch** with **exarch xylem**.
- **Pith** is small and **parenchymatous**.

Ground Plan



A Portion Enlarged

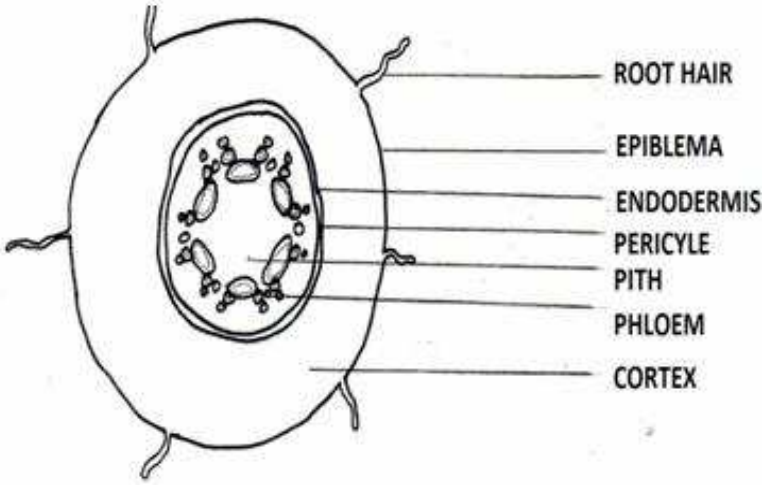


T.S.OF MONOCOT ROOT

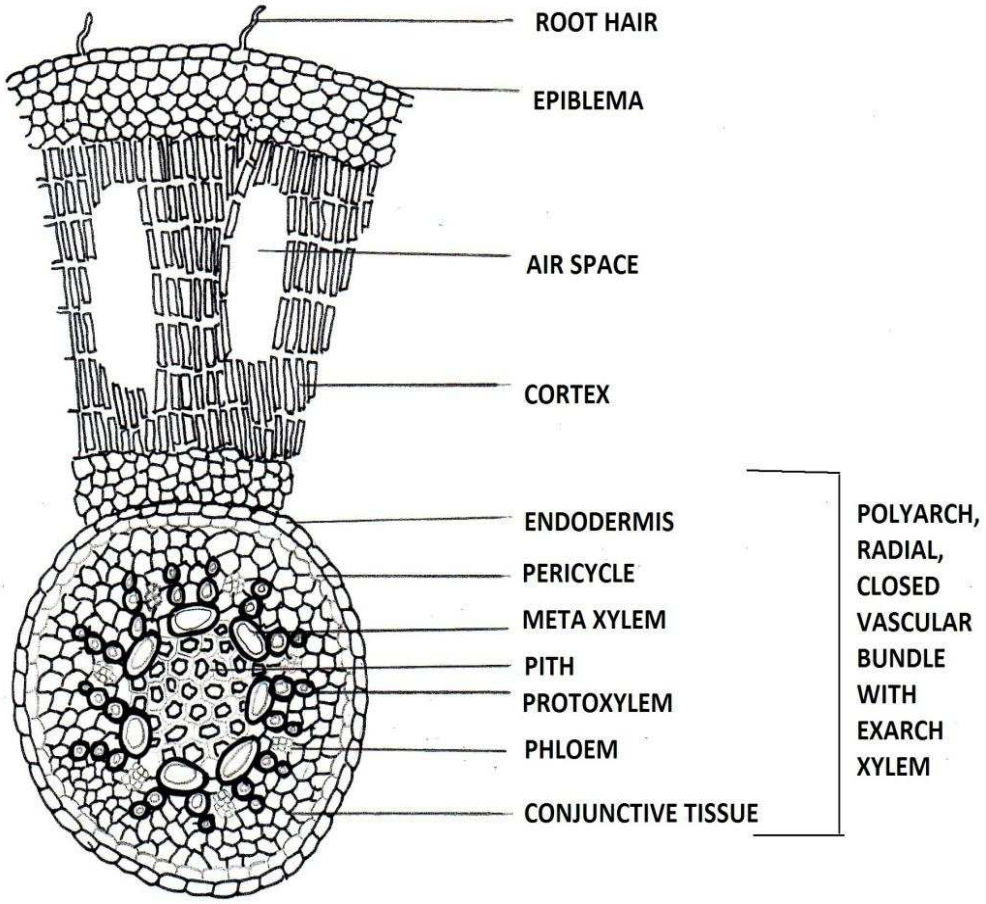
E.g. *Canna*

- Epidermis is **single layered**, **unicellular** root hairs with out cuticle.
- Cortex is broad, parenchymatous enclosing **large air spaces**.
- **Endodermis is distinct**, uniseriate with thin wall **passage cells** opposite to protoxlem groups.
- **Pericycle** is single layered and **parenchymatous**.
- Vascular bundles are **polyarch, radial, closed** with **exarch xylem**.
- Pith is **sclerenchymatous**.

Ground Plan



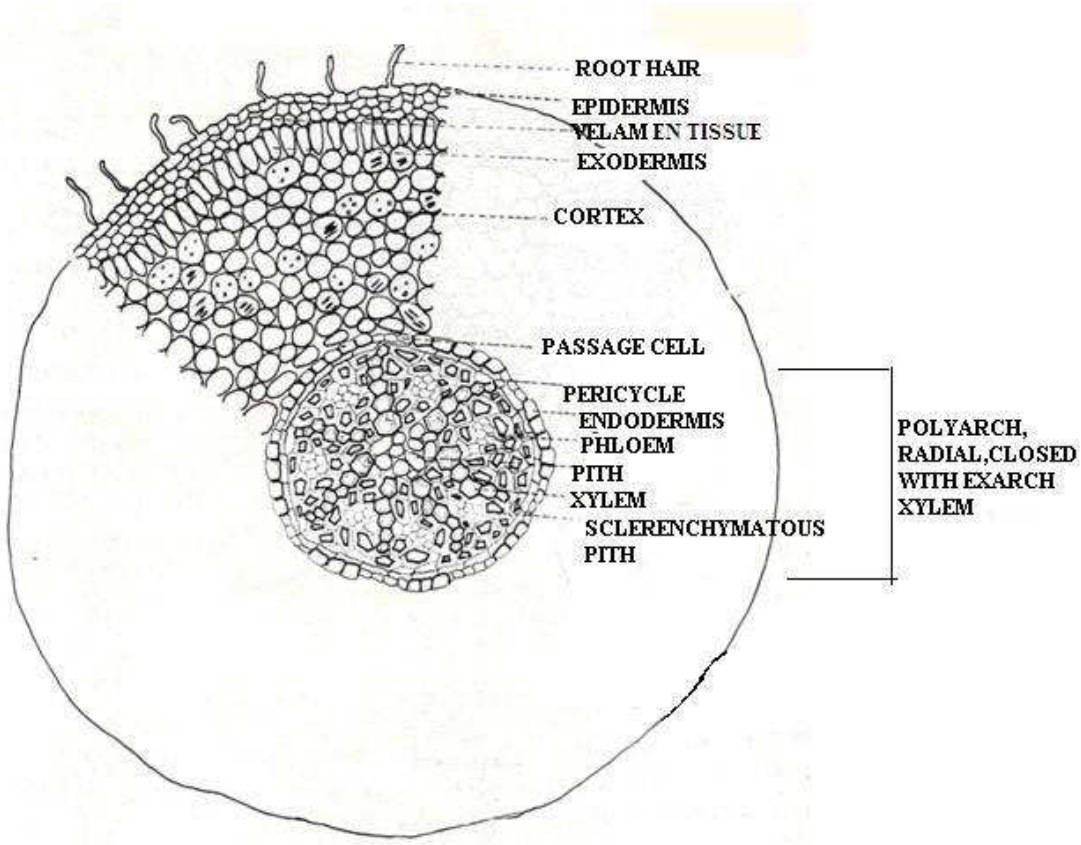
A Portion Enlarged



T.S.OF EPIPHYTIC ROOT

E.g. *Vanda*

- Epidermis is single layered, **unicellular root hairs** without cuticle.
- **Chlorophyllous velamen tissue** is present below the epidermis.
- It is followed by **single layered exodermis**.
- Cortex is **broad**, parenchymatous with plenty of **starch grains** and **raphides**.
- Endodermis is **uniseriate** and parenchymatous with **passage cell**.
- Pericycle is uniseriate and **parenchymatous**.
- Vascular bundle is **polyarch, closed, radial** with **exarch xylem**.
- Pith is **large** and **sclerenchymatous**.
- **Conjunctive tissue** is sclerenchymatous.

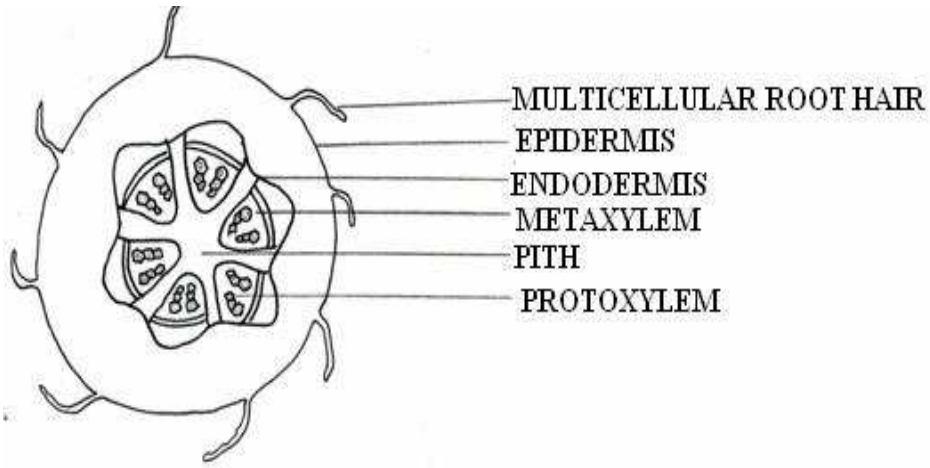

ROOT HAIR
EPIDERMIS
VELAMEN TISSUE
EXODERMIS
CORTEX
PASSAGE CELL
PERICYCLE
ENDODERMIS
PHLOEM
PITH
XYLEM
SCLERENCHYMATOUS PITH
POLYARCH, RADIAL, CLOSED WITH EXARCH XYLEM

T.S.OF DICOT STEM

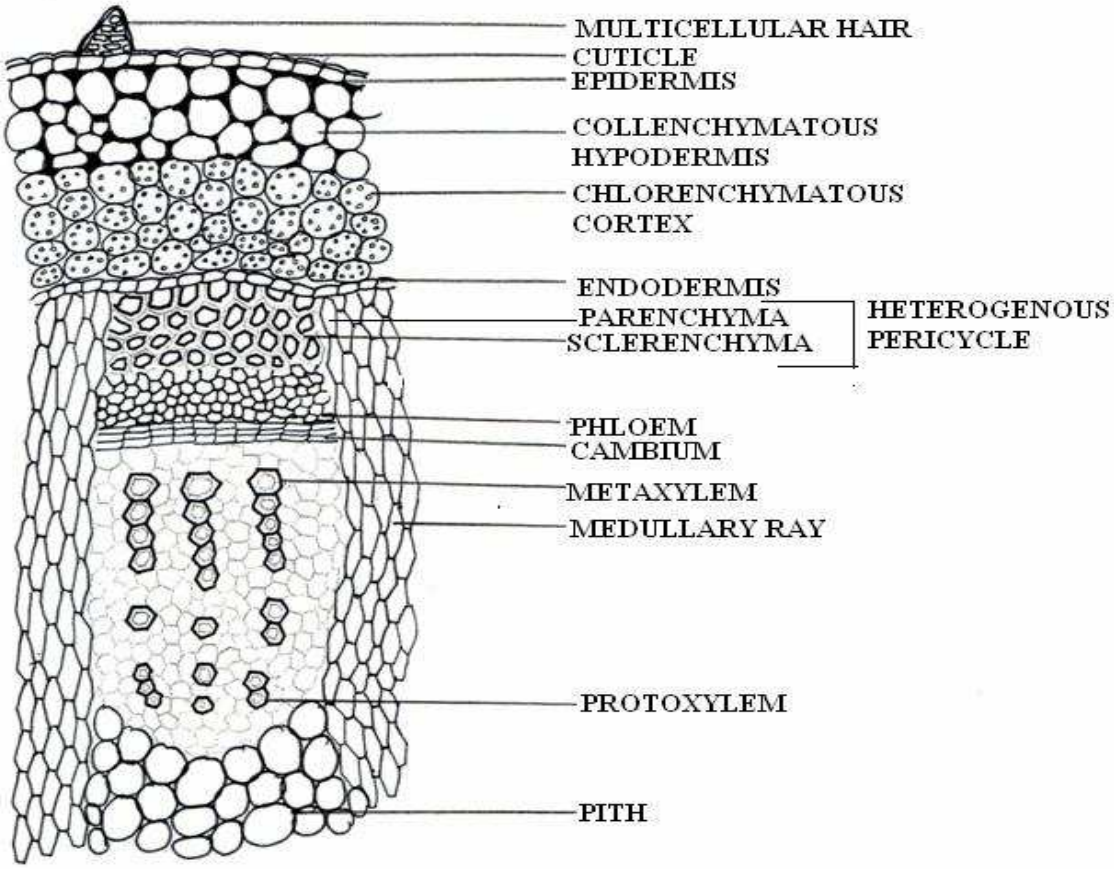
E.g. *Tridax*

- Epidermis is single layered, **cuticularised** with **multicellular hairs**.
- Cortex is **heterogenous**, the outer collenchymatous and inner chlorenchymatous.
- The **endodermis** is **wavy** in outline.
- Pericycle is **multilayered** and **heterogenous**.
- Sclerenchymatous pericycle forms the **bundle cap**.
- Vascular bundle are **open, collateral** and **conjoint**.
- Xylem is **polyarch** and **endarch**.
- **Medullary rays** are present between the bundles.
- Pith is **broad** and **parenchymatous**.

Ground plan



A Portion Enlarged



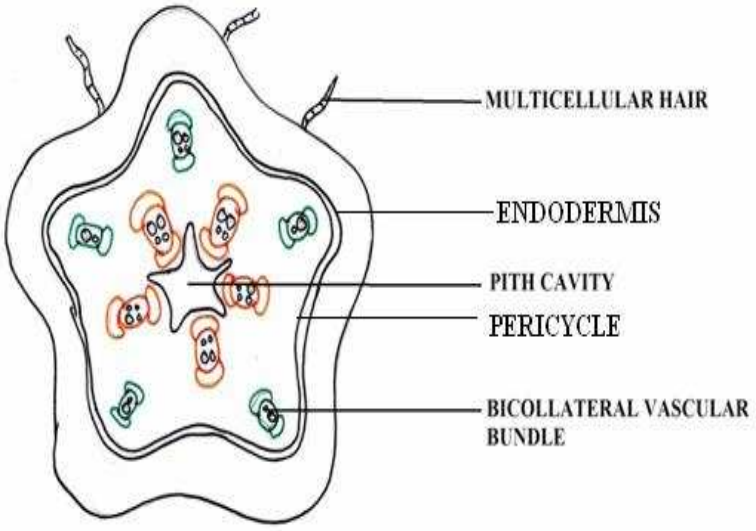
open, collateral, **conjoint, polyarch** with **endarch xylem**

T.S.OF DICOT STEM

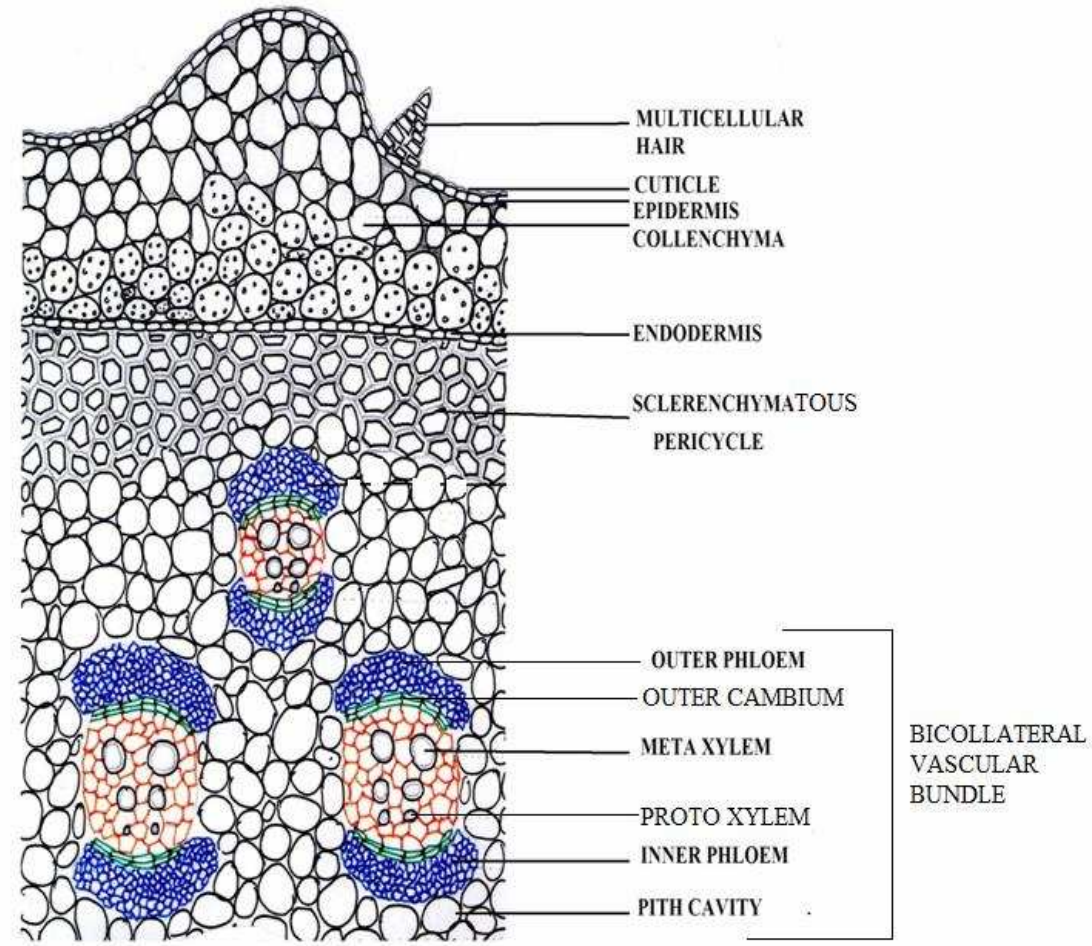
E.g. *Cucurbita*

- The stem has **five ridges** and **five furrows**.
- Epidermis is single layered, **cuticularised** with **multicellular hairs**.
- Cortex is **heterogenous**-collenchymatous below the ridges and chlorenchymatous below the furrows.
- Endodermis is distinct.
- Pericycle is **multilayered** and sclerenchymatous.
- Vascular bundles are **ten** in number arranged in two of five each.
- The **outer five bundles** are **smaller** below the **ridges** and **inner five bundles** are **larger** below the **furrows**.
- The vascular bundles are **open, bicollateral** with **endarch xylem**.
- Pith is **hollow**.

Ground Plan



A Portion Enlarged

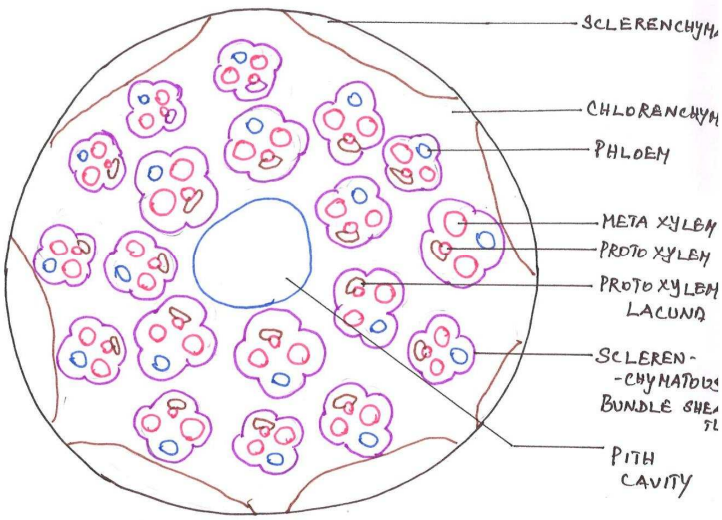


T.S.OF MONOCOT STEM

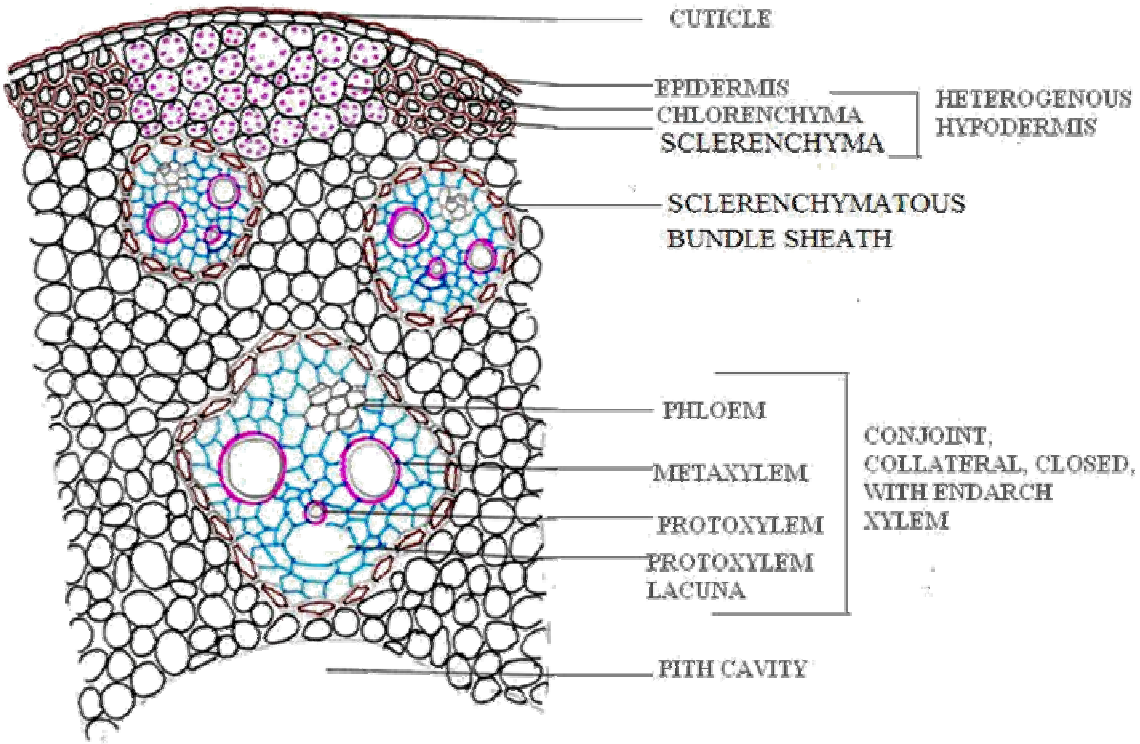
E.g. *Bambusa*

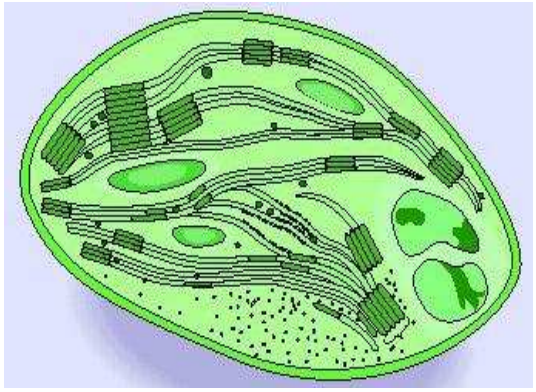
- Epidermis is single layered covered with **cuticle**.
- The hypodermis has alternate patches of **chlorenchyma** and **sclerenchyma**.
- Vascular bundles are scattered in the **ground tissue** which is **parenchymatous**.
- Vascular bundles are **conjoint, closed, collateral** with **endarch xylem**.
- Xylem is **"Y" shaped** with 2 metaxylem and 1 protoxylem associated with a **protoxylem lacuna**.
- Vascular bundle has a **sclerenchymatous bundle sheath**.
- Presence of **hollow pith**.

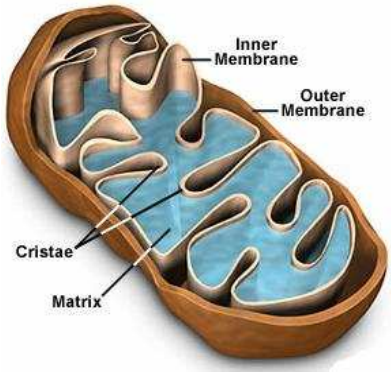
Ground Plan



A Portion Enlarged



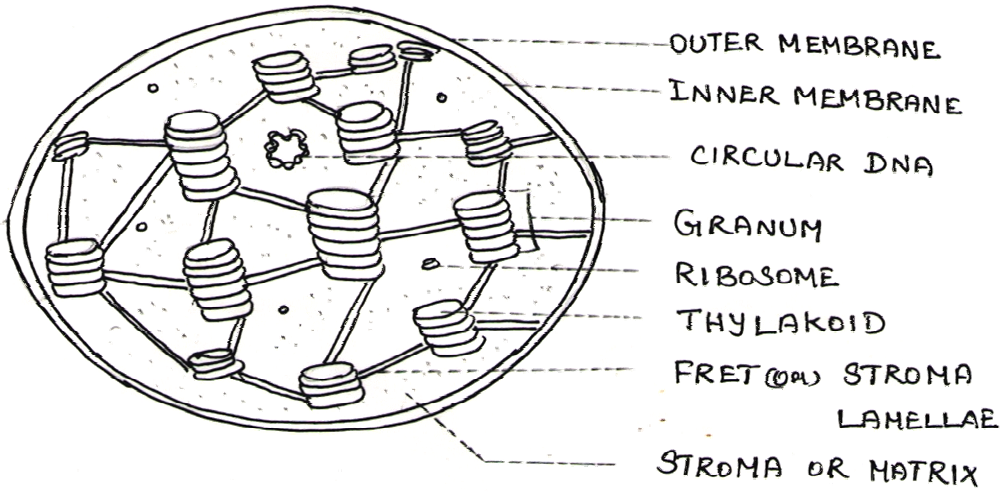




CYTOGENETICS

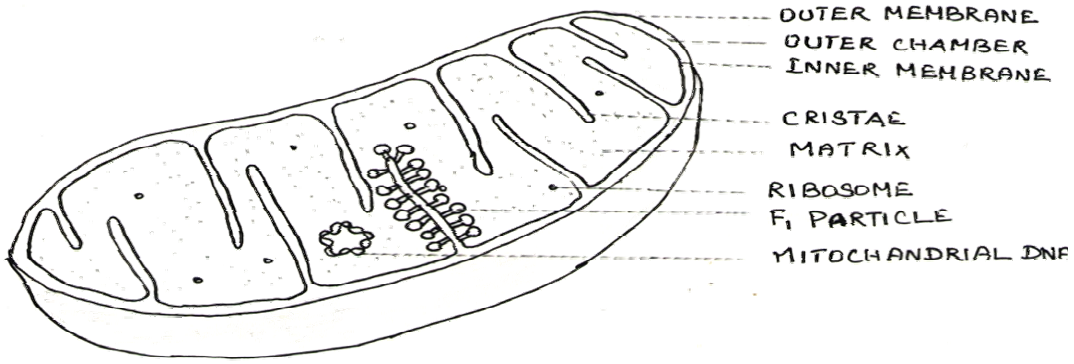
ULTRA STRUCTURE OF CHLOROPLAST

- Cytoplasmic organelle of plant cell.
- Bounded by two **lipo-proteinaceous** membranes.
- Inner space filled with colloidal substance-**stroma**.
- Closed flat sacs-**thylakoids** arranged one above the other **granum**.
- Grana found in stroma, interconnected by **frets**.
- **Quantasome** pigment present on the thylakoid membrane.
- Function-**photosynthesis**.



ULTRA STRUCTURE OF MITOCHONDRIA

- **Granular or rod** like cytoplasmic organelle-**power house** of the cell.
- Covered by **2 unit membranes** separated by a space.
- Inner membrane has finger like projection- the **cristae**.
- Inner region is the **matrix**.
- Inner and outer membrane contains **ETP or F_1 particles**.
- Functions: **Respiration** and **energy supply**.



MONOHYBRID CROSS

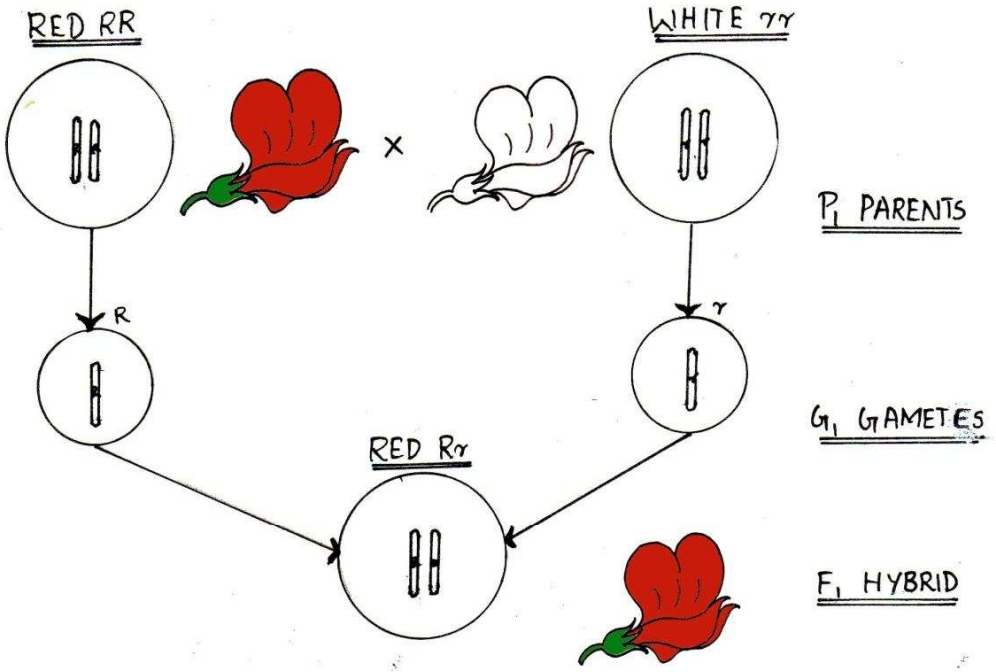
- A cross between the two parents differing in **a single pair of contrasting character** is known as monohybrid cross.

Example:

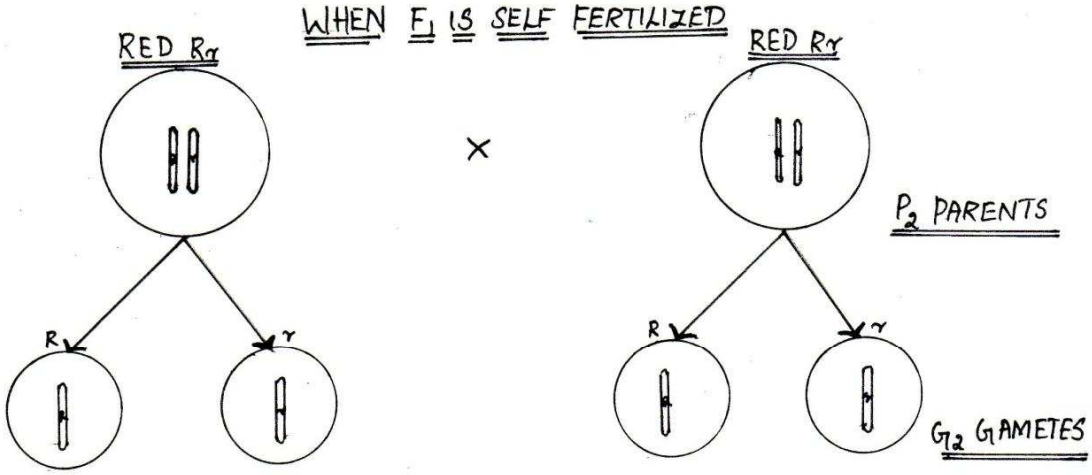
- Two pea plants, one with a **tall stem** and another with **dwarf stem** were considered as parental plants.
- They were crossed and seeds were collected from this plant.
- The seeds were sown and a group of plants were raised.
- These plants constituted the **first filial generation**.
- All the **F_1 plants** were **tall**.
- The F_1 plants were inbred.
- The seeds were collected and the next generation, **F_2 was raised**.
- In the F_2 generation the two types of plants were found.
- They were **tall** and **dwarf**.

Phenotypic ratio: 3 tall: 1 dwarf

Genotypic ratio: 1TT: 2Tt: 1tt



WHEN F_1 IS SELF FERTILIZED



PHENOTYPIC RATIO:

SQ. NO: 1, 2, 3 – 3 RED

SQ. NO: 4 – 1 WHITE

3 RED : 1 WHITE

F_2 HYBRID

♂ R	♂ r
♀ R: RR	Rr
♀ r: Rr	rr

GENOTYPIC RATIO:

SQ. NO:- 1 - HOMOZYGOUS RED [RR]

SQ. NO:- 2, 3 - HETEROZYGOUS RED [Rr]

SQ. NO:- 4 - HOMOZYGOUS WHITE [rr]

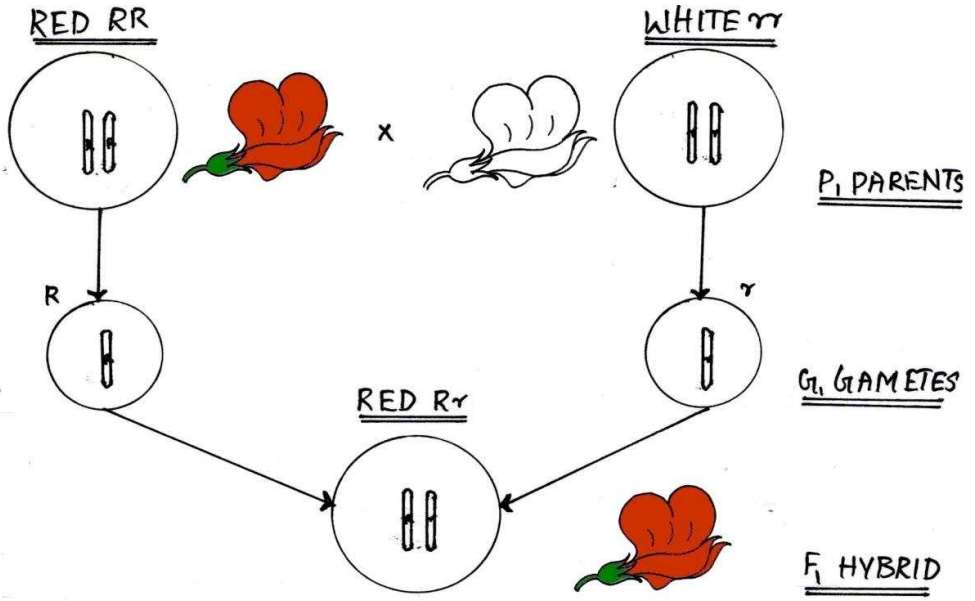
1 RR : 2 Rr : 1 rr

MONOHYBRID BACK CROSS

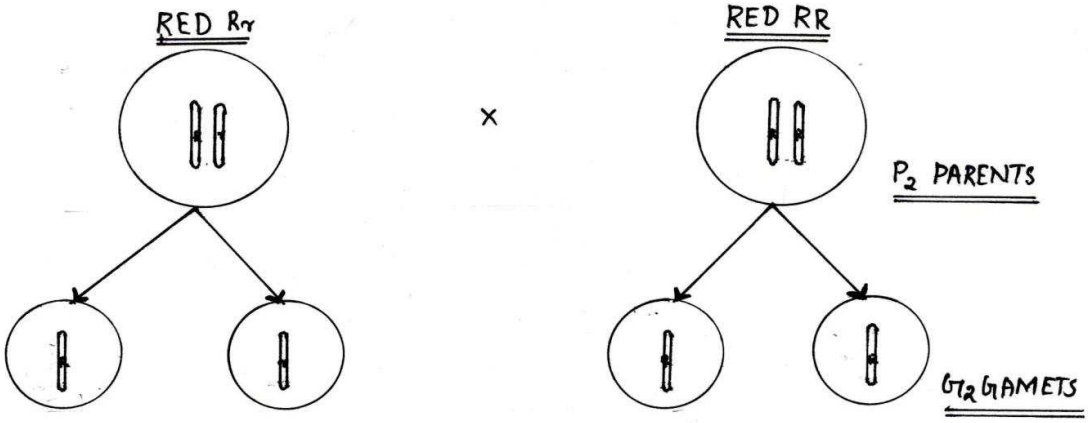
- Back cross is the **cross of F_1 hybrid** with **anyone of its parents**.
- When the **F_1 hybrid** is crossed with the **dominant parent**, the cross is called as dominant back cross.

Example:

- In monohybrid back cross, when contrasting varieties (**Tall** and **dwarf**) are crossed, a **hybrid (Tt)** is formed when the hybrid is crossed back with dominant parent.
- Phenotypic ratio of all the plants is tall and the genotypic ratio is **2TT:1Tt**.



WHEN F_1 IS CROSSED WITH DOMINANT PARENTS



PHENOTYPIC RATIO:

SR.NO: 1, 2, 3, 4 - RED

ALL ARE RED

F_2 HYBRID

♂ \ ♀	R	r
R	RR	Rr
R	RR	Rr

GENOTYPIC RATIO:

SR.NO: 1, 3 - 2 HOMOZYGOUS RED [RR]

SR.NO: 2, 4 - 2 HETEROZYGOUS RED [Rr]

2 RR : 2 Rr

1RR : 1Rr

MONOHYBRID TEST CROSS

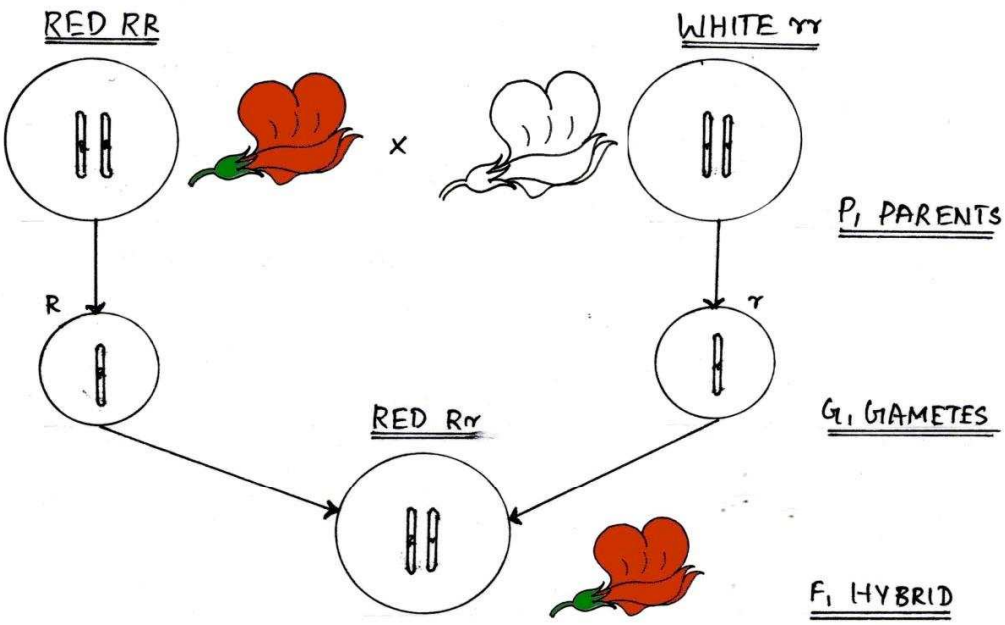
- Test cross is the **cross between the F_1 hybrid with its recessive parent**.

Example:

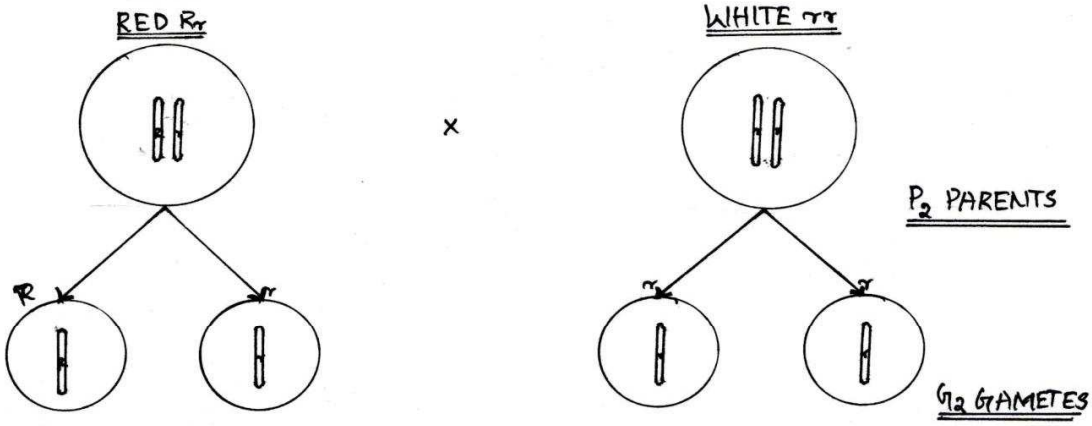
- In monohybrid cross contrasting varieties (**Tall** and **dwarf**) are crossed, a **hybrid (Tt)** is formed.
- The hybrid is crossed back with recessive parent.

Phenotypic ratio: 1 tall: 1 dwarf

Genotypic ratio: 1TT: 1tt



WHEN F_1 IS CROSSED WITH RECESSIVE PARENTS



PHENOTYPIC RATIO:

Sq.No: 1, 2 - 2 RED

Sq.No:-3, 4 - 2 WHITE

1 RED : 1 WHITE

F_2 HYBRID

♂ \ ♀	r	r
R	Rr	Rr
r	rr	rr

GENOTYPIC RATIO:

Sq.No:- 1, 2 - 2 HETEROZYGOUS RED [Rr]

Sq.No:- 3, 4 - 2 HOMOZYGOUS WHITE[rr]

1 Rr : 1 rr

DIHYBRID CROSS

- A cross between **two parents differing in two pairs of contrasting characters** is known as dihybrid cross.

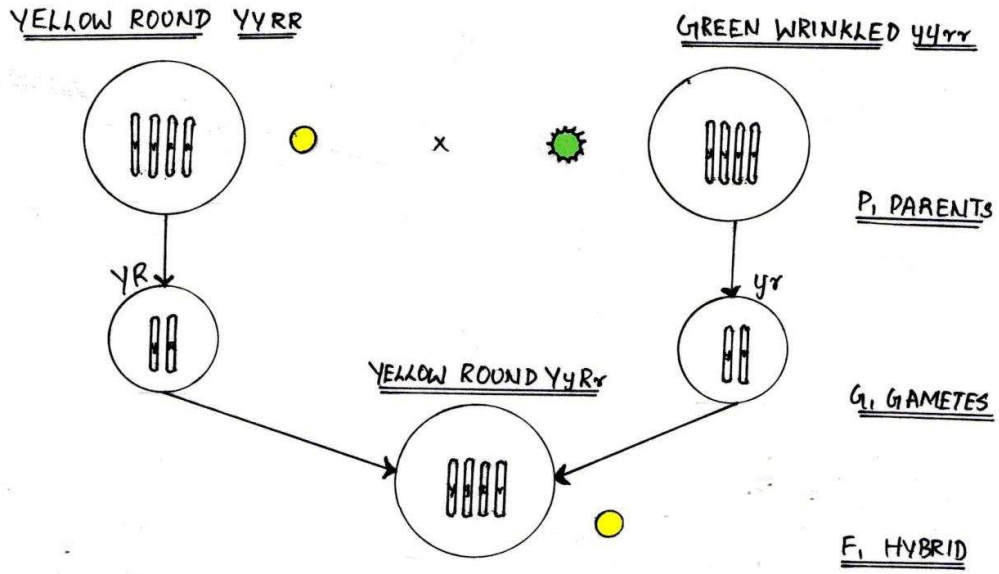
Example:

- A cross between a pure breeding **pea plant with yellow cotyledons with round seeds** and **pure breeding plants with green cotyledon** with **wrinkled seeds**.
- When F_1 hybrids were self fertilized, the F_2 ratios were as follows:

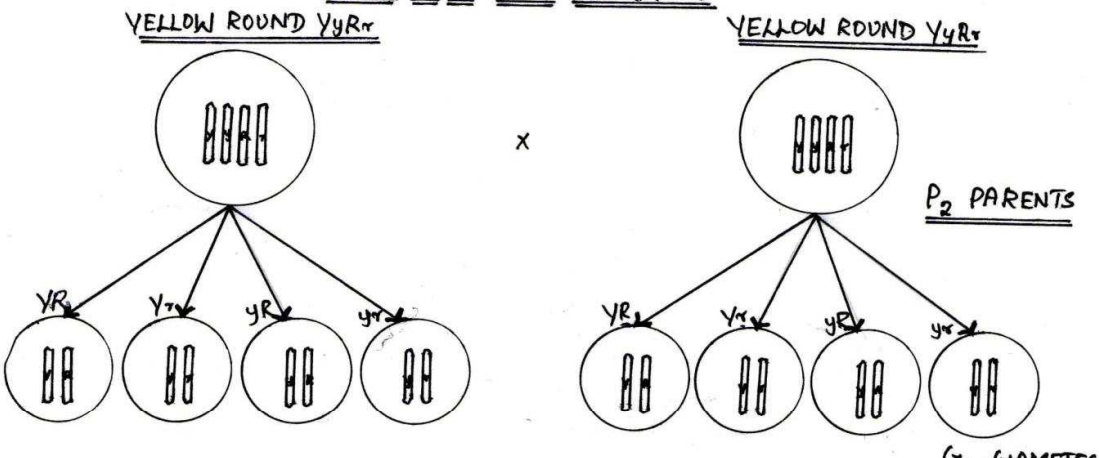
Phenotypic Ratio:

9 yellow round: 3 yellow wrinkled, 3 green round: 1 green wrinkled.

Genotypic ratio: 1:2:2:4:1:2:1:2:1



WHEN F_1 IS SELF FERTILIZED



PHENOTYPIC RATIO

SQ.NO:- 1, 2, 3, 4, 5, 7, 9, 10, 13 - 9 YELLOW ROUND

SQ.NO:- 6, 8, 14 - 3 YELLOW WRINKLED

SQ.NO:- 11, 12, 15 - 3 GREEN SMOOTH

SQ.NO:- 16 - 1 GREEN WRINKLED

9 : 3 : 3 : 1

F_2 GENERATION

♀ \ ♂	YR	Yr	yR	yr
YR	YYRR	YYRr	YyRR	YyRr
Yr	YYRr	YYrr	YyRr	Yyrr
yR	YyRR	YyRr	yyRR	yyRr
yr	YyRr	Yyrr	yyRr	yyrr

GENOTYPIC RATIO

SQ.NO:- 1 - 1 YYRR

SQ.NO:- 2, 5 - 2 YYRr

SQ.NO:- 3, 9 - 2 YyRR

SQ.NO:- 4, 7, 10, 13 - 4 YyRr

SQ.NO:- 6 - 1 YYrr

SQ.NO:- 8, 14 - 2 Yyrr

SQ.NO:- 11 - 1 yyRR

SQ.NO:- 12, 15 - 2 yyRr

SQ.NO:- 16 - 1 yyrr

1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1

ECOLOGY

SUBMERGED HYDROPHYTE

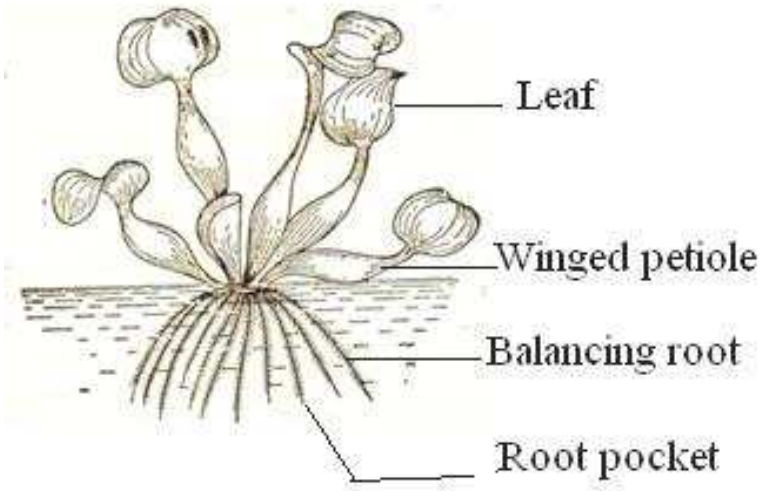
E.g. *Hydrilla*

- *Hydrilla* is a **rooted submerged** hydrophyte, branched and spongy.
- Roots **adventitious**.
- Leaves thin, small, **sessile** and linearly arranged in **whorls**.
- The plant body is completely covered with **mucilage**.

FREE FLOATING HYDROPHYTE

E.g. *Eichhornia*

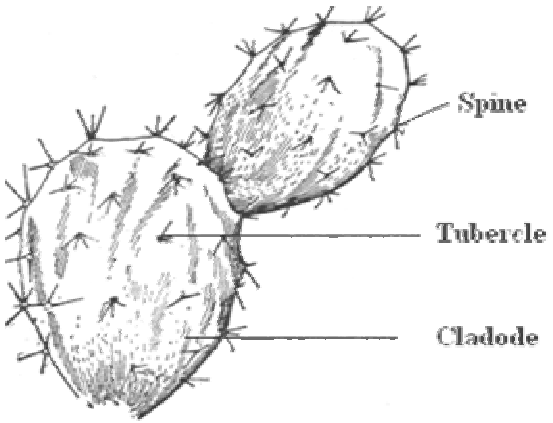
- It is a **free floating** hydrophyte.
- Presence of **fibrous root** with **pocket**.
- Leaves with **swollen petiole**.
- **Stored air** help in floating.
- Stem is **offset**.
- Leaves are coated with **wax**.



SUCCULENT XEROPHYTE

E.g. *Opuntia*

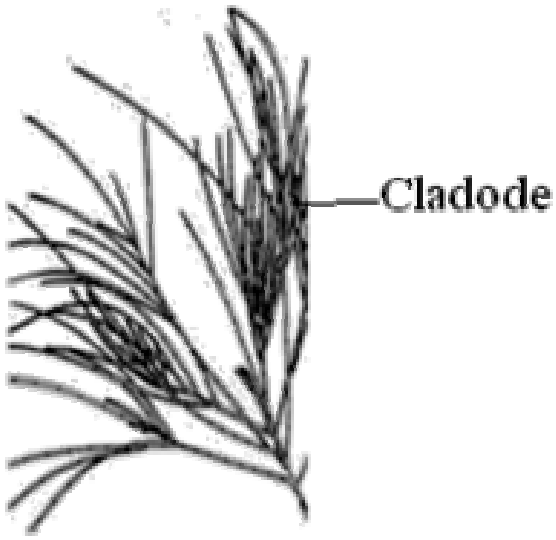
- *Opuntia* is a **succulent** xerophytic plant.
- Stem is **branched, jointed, fleshy, green** and leaf like **phylloclade**.
- Leaves are modified into **spines** which is present in the centre of the phylloclade.

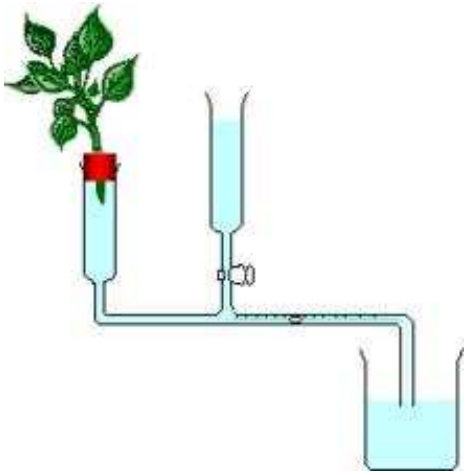


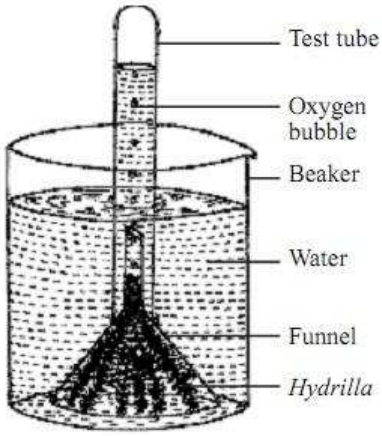
NON-SUCCULENT XEROPHYTE

E.g. *Casuarina*

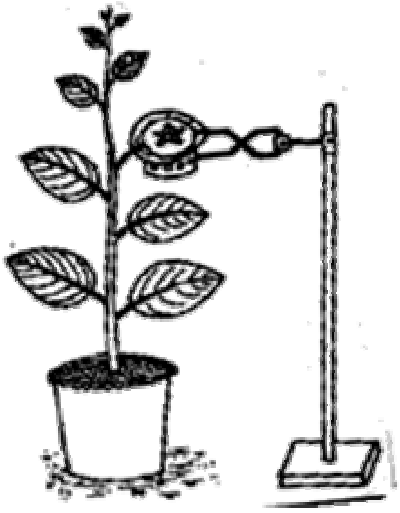
- *Casuarina* is a **non-succulent** xerophytic plant.
- Stem is **branched** differentiated into **nodes**.
- Leaves reduced into **scale leaves**.







PHYSIOLOGY



GANONG'S POTOMETER

Aim:

To measure the rate of transpiration by using Ganong's potometer under two different environmental conditions, such as direct and diffused sunlight.

Requisites:

Ganong's potometer apparatus, leafy twig, one-holed rubber cork, beaker with water, vaseline, vial and stand.

Apparatus Description:

It consists of a graduated capillary tube dilated from the shoot chamber in which a leafy twig is introduced into the one-holed rubber cork and the end is bent with small hole through which the air bubble is introduced. The reservoir is connected to the capillary tube with a stop cork.

Procedure:

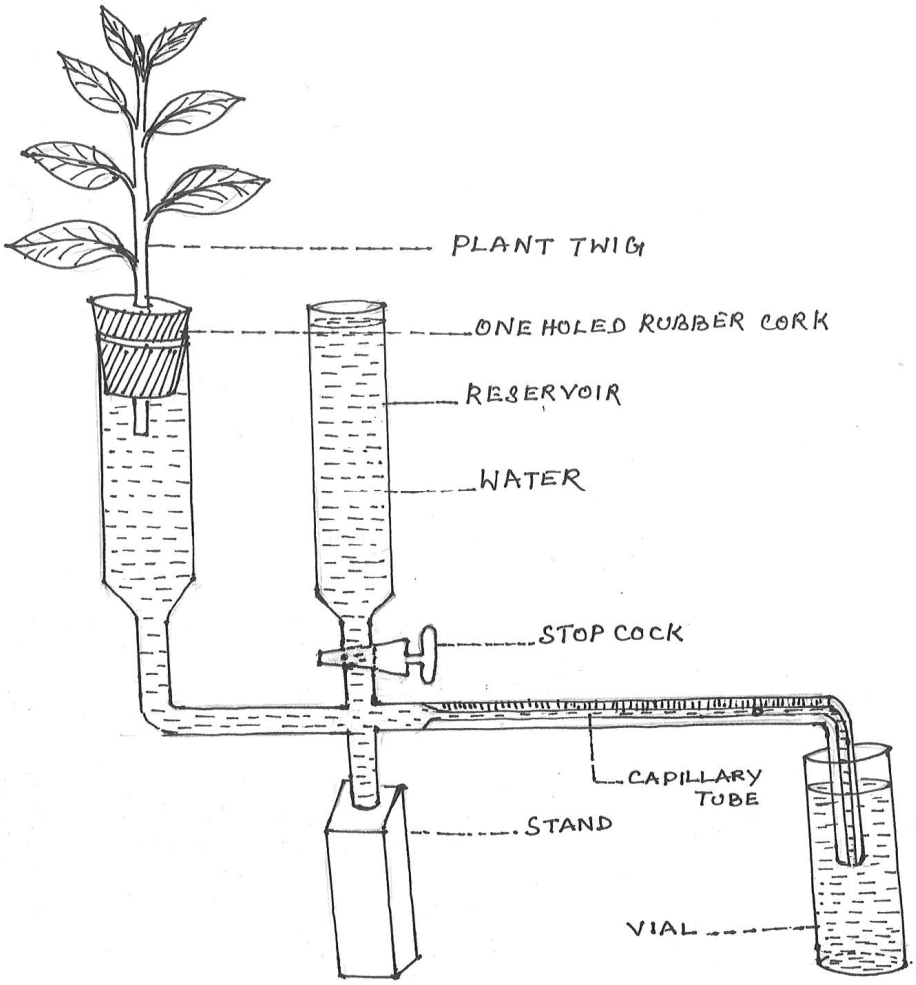
The apparatus is filled without any air bubble. The leafy twig is introduced into the one-holed rubber cork and is filled with the shoot chamber. An air bubble is introduced into the capillary tube through the hole and the initial level is marked. The bent tube is immersed in small beaker [vial] containing water. The apparatus is made airtight by applying vaseline. The set up is kept in the direct sunlight as well as in the diffused sunlight.

Observation:

The air bubble moves in the capillary tube.

Inference:

Due to transpiration a vacuum and suction pressure is developed in the leafy twig. In order to fill this, water moves in the capillary tube along with air bubble. It clearly indicates that the rate of transpiration was found to be greater in direct sunlight than in diffused sunlight.



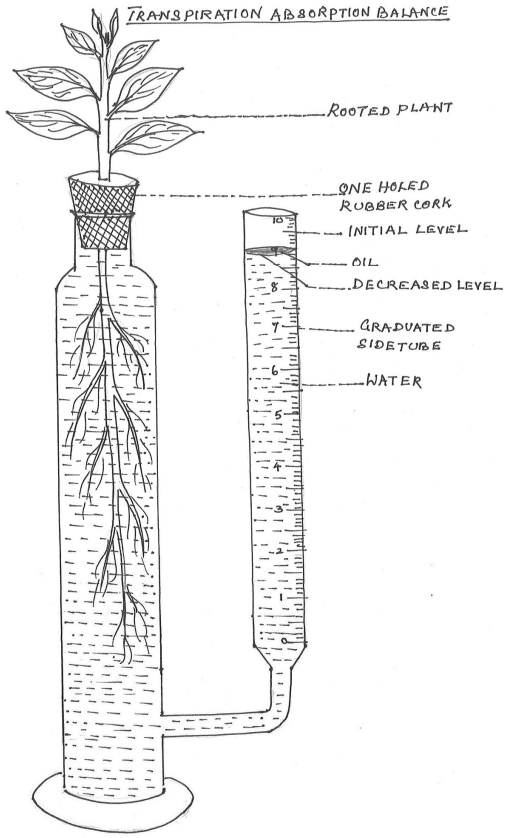
TRANSPIRATION ABSORPTION BALANCE

Aim:

To show that the amount of water transpired is equal to the amount of water absorbed.

Requisites:

Transpiration absorption apparatus, a rooted plant, water and oil. The apparatus consists of a wide mouthed bottle which is connected to a graduated narrow side tube.



Procedure:

The apparatus is filled with water. The rooted plant is introduced into the glass jar through one-holed rubber cork. The initial level of water in the graduated side tube prevents the evaporation of water. The apparatus is kept in the sunlight for half an hour.

Observation:

The water level in the graduated side tube falls down.

Inference:

The decrease in the water level is due to the absorption of water. It clearly indicates the amount of water transpired is equal to the amount of water absorbed.

TEST TUBE FUNNEL EXPERIMENT

Aim:

To show the effect of carbon di oxide concentration on the rate of photosynthesis by using test tube funnel experiment.

Requisites:

Beaker, funnel, test tube, water, *Hydrilla* twigs and different concentrations of sodium bi carbonate (100, 200 and 300 mg).

Procedure:

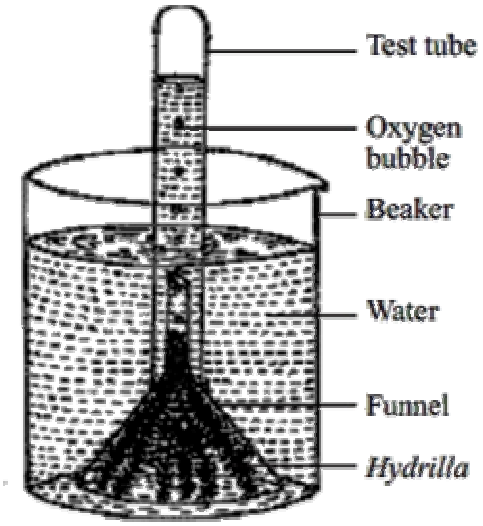
Hydrilla twigs are introduced into the mouth of the funnel and the funnel is inverted into the beaker containing water. The graduated test tube is filled with water and it is inverted over the stem of funnel. In the same way the other setups are made .The set up without sodium bicarbonate is used as control. In the other set ups, different concentration of sodium bi carbonate such as 100, 200 and 300 mg are added. All of them are kept in the direct sunlight.

Observation:

Water level in all the setups decreases in the graduated test tube. It is due to the accumulation of oxygen which is evolved during photosynthesis.

Inference:

The decrease level of water in test tube indicates the rate of photosynthesis. The rate of photosynthesis was found to be greater in 200 mg than in 100 mg and 300 mg.



GANONG'S LIGHT SCREEN EXPERIMENT

Aim:

To prove that light is necessary for photosynthesis.

Apparatus Required:

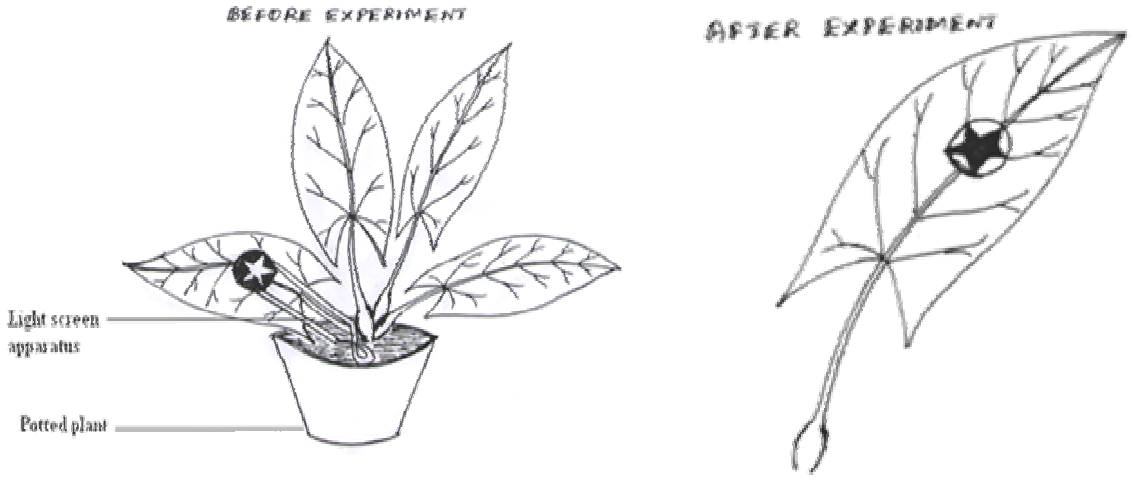
Ganong's light screen, iodine solution, alcohol, water and potted plant.

Procedure:

The leaves in the potted plants are destarched in dark for about 48 hours. The leaf is fixed with light screen. Destarched plant is kept in light for few hours. The leaf is plucked and tested for starch with iodine solution. Iodine test is performed after killing the leaf in boiling water and decolorized with alcohol.

Inference:

Starch is present in the portion exposed to light. The portion covered with light screen receives no light, does not show the presence of starch. This proves that light is necessary for photosynthesis.



GANONG'S RESPIROSCOPE

Aim:

To prove that carbon-di-oxide is released during respiration using Ganong's respiroscope.

Apparatus required:

Ganong's respiroscope, potassium hydroxide solution, flower buds, water, stands, beakers and cotton.

Procedure:

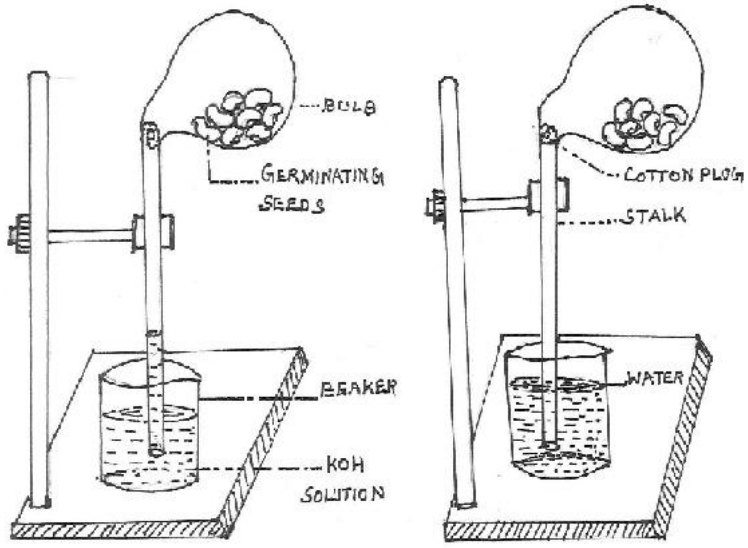
Equal amount of flower buds are taken in the bulb of respiroscope. A piece of cotton is introduced in the bulb to prevent the flow of buds into the beaker. The open ends of the bulb are kept immersed in a beaker containing water and potassium hydroxide solution respectively.

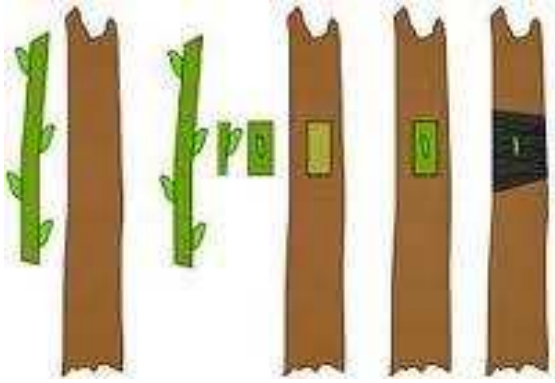
Observation:

There is no increase of water in the respiroscope. But KOH solution rises up in the corresponding respiroscope.

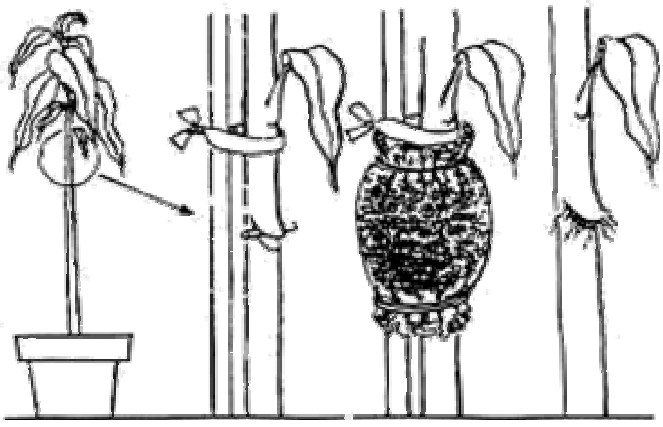
Inference:

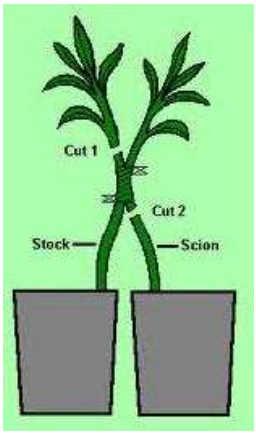
In the first setup, the potassium hydroxide solution rises in the respiroscope. It is because of the respiration of flower buds. During respiration, carbon-di-oxide is released which is absorbed by the KOH solution. As a result, the level of KOH rises in the respiroscope.





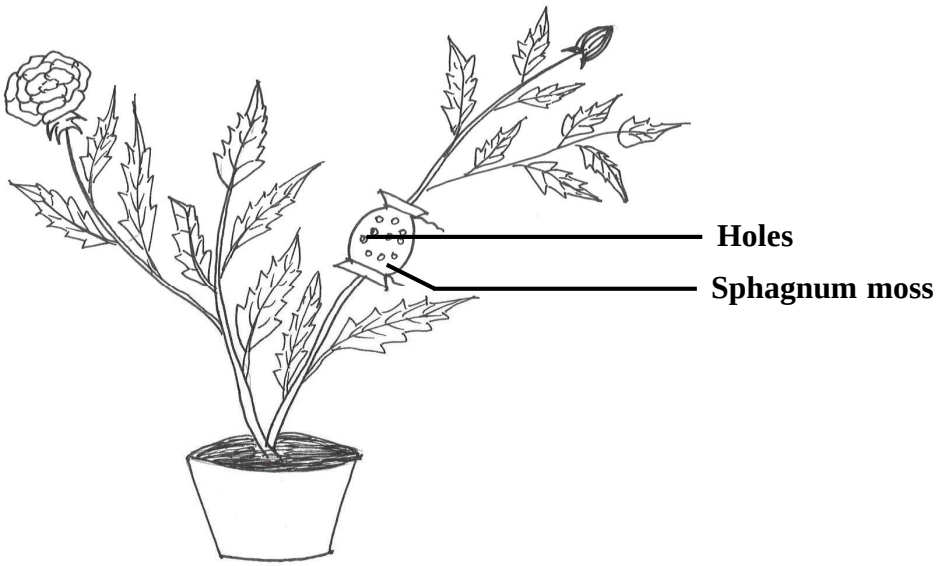
PLANT PROPAGATION





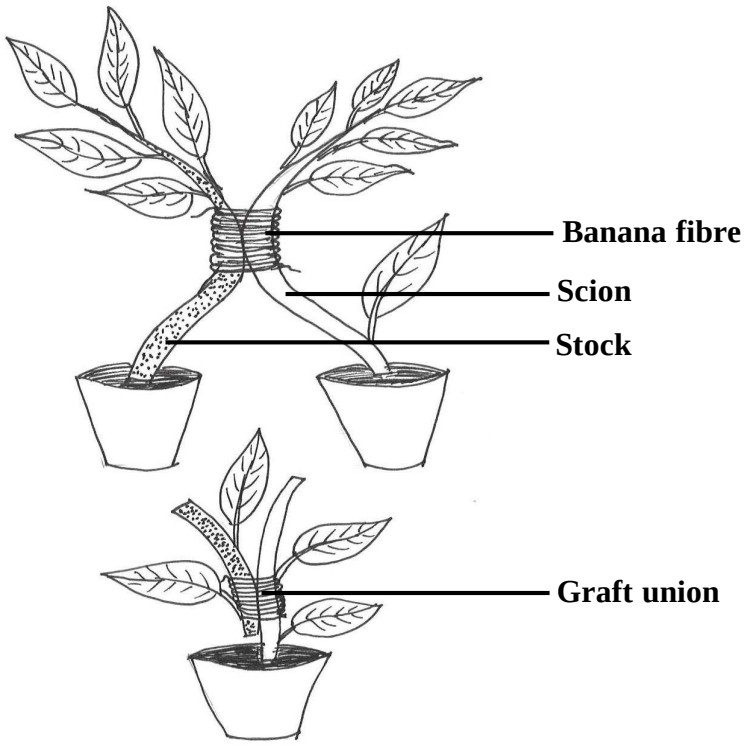
AIR LAYERING

- It is a vegetative propagation; where rooting takes place in the **aerial part** of the plant, when covered with any rooting medium other than soil.
- The stem is **injured** first by **slicing**.
- The injured portion is enclosed with **rooting medium** which maintains moisture.
- **Sphagnum moss** is used as the rooting medium.
- Rooting takes place above the **girdle** or on the upper portion of the cut end of a ring.
- Ex: *Croton, Ixora* and *Ficus*.



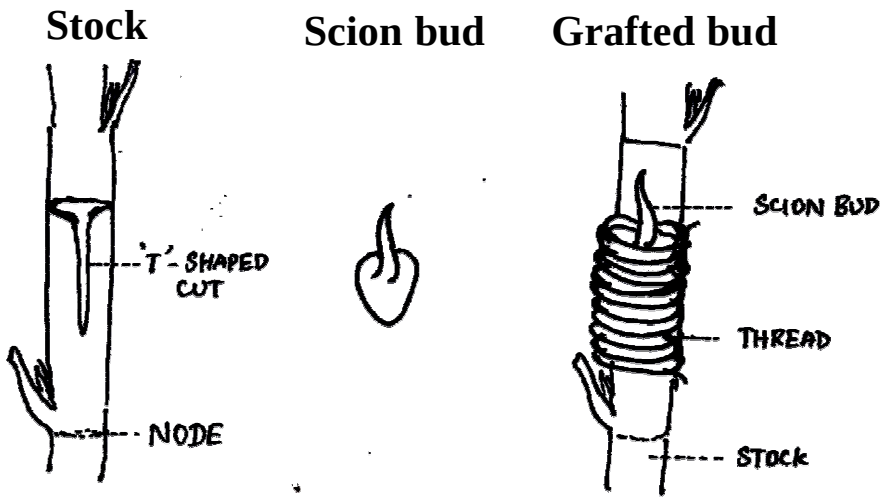
APPROACH GRAFTING

- It is a method of vegetative propagation, where **two potted plants** are **grafted**.
- It is also known as **inarching**. Ex: Mango and Sapota.
- In the stem of stock about 5 to 8 cm **long slice** of bark and wood is removed to a height of 22cm above the **ground level**.
- Cut is made on the **scion**, so that the two cuts fit in perfectly.
- The cuts are placed face to face and tied firmly with **banana fibre**.
- After union is established, the apex of the **stock** plant above the graft is **cut off**.
- The base of the **scion** plant is cut off **below** the **graft point**.



T-Budding

- T-shape incision is made on the **stock stem** and the scion bud is inserted into the "**T**" cut surface. It is also known as **shield budding.**
- In the stock stem a T- shaped cut of 1.5 cm length is made and the **bark is lifted** with a sharp knife.
- The **scion bud** is removed in the form of a **shield.**
- The **bark** is **raised** and the **scion bud** is inserted into the **T cut** surface of the stock and given **bandage.**
- The scion bud is allowed to grow. E.g. **Oranges, Plums, Peaches.**

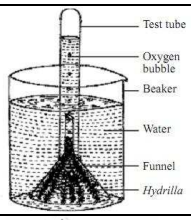


WORK SHEET

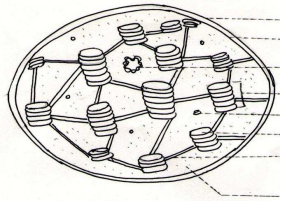
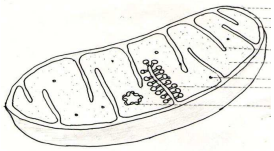
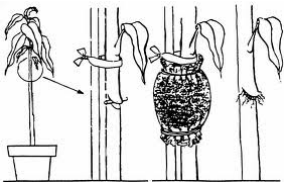
Identify the family, construct the floral diagram and write down its floral formula.

Flowering twig	Family	Floral diagram/ floral formula
		
		
		
		

Comment on the physiological setup giving reasons

Physiological setup	Name of the apparatus	Reasons
		
		

Identify the given spotter giving reasons.

Spotter	Identification	Reasons
		
		
		
		
		
		

SEETHALAKSHMI RAMASWAMI COLLEGE (AUTONOMOUS)

AFFILIATED TO BHARATHIDASAN UNIVERSITY
NATIONALLY REACCREDITED BY NAAC WITH A GRADE
TIRUCHIRAPPALLI – 2

DEPARTMENT OF BOTANY

II B.Sc., ALLIED – BOTANY

PRACTICAL PAPER

11 IV BO AP2 **Max. Marks: 60**

Time: 3 Hrs.

1. Refer **A** and **B** to their respective families giving reasons. Draw the **L.S.** of flower of **A** and construct the **F.D.** of flower of **B** and write down its floral formula.
(Identification-1, Figure-1, Reason-2.) **(2 × 4 = 8)**

2. Make suitable micro preparation of **C, D** and **E.** Stain and mount in glycerin. Draw diagram and identify giving reasons. Submit the slides for valuation.
(Slide-2, Identification-1, Diagram-1, Notes-2.) **(3 × 6 = 18)**

3. Comment on the set up **F.**
(Diagram-1, Notes-2, Identification-1). **(1 × 4 = 4)**

4. Identify, draw diagram and write notes on **G, H, I, J** and **K.**
(Identification-1, Diagram-1, Notes-2.) **(5 × 4 = 20)**

Record = 10
Total = 60

ALLIED – PRACTICAL

KEY

A: Annonaceae, Rutaceae.

B: Rubiaceae, Apocynaceae.

C: *Marchantia* thallus-T.S., *Cycas* microsporophyll-V.S.

D: *Albugo* infected leaf-T.S., *Cycas* leaflet-T.S.

E: Monocot stem-T.S., Orchid root-T.S.

F: Ganong's light screen experiment, Test tube funnel experiment.

G: *Nephrolepis* sorus-V.S., *Marchantia* sporophyte L.S.

H: Chloroplast, Mitochondria

I: Test cross, back cross.

J: *Opuntia, Eichhornia*.

K: T-Budding, Air layering.

A. Annonaceae:

- Alternate, exstipulate, distichous leaves.
- Leaf opposed fascicle.
- Bisexual, trimerous, hemicyclic, hypogynous flower.
- Sepaloid spathulate petals.
- Numerous free stamens, carpels arranged spirally – conical torus.
- Dithecous, hooded anthers.
- Numerous carpels, apocarpous, superior ovary.
- Each carpel unilocular- one ovule- basal placentation.
- Aggregate fruit.

A. Rutaceae:

- Exstipulate, aromatic gland dotted compound leaves.
- Cymose clusters.
- Bisexual, regular, pentamerous, hypogynous flower.
- Ten stamens, obdiplostemony.
- Anthers dithecous, introrse.
- Bicarpellary, syncarpous, bilocular, superior ovary- axile placentation.
- Hypogynous disc present.

B. Rubiaceae:

- Opposite, decussate, stipulate leaves.
- Head inflorescence.

- Bisexual, actinomorphic, epigynous flower.
- Calyx reduced to a ring.
- Gamopetalous corolla.
- Epipetalous stamens.
- Anthers dithecous, introrse.
- Bicarpellary, syncarpous, bilocular, inferior ovary.
- Two ovules- each locule- axile placentation.
- Multiple fruit.

B. Apocynaceae:

- Presence of milky latex.
- Simple opposite decussate, exstipulate leaves.
- Axillary paired cyme.
- Bisexual, regular, actinomorphic, pentamerous, hypogynous flower.
- 5 sepals, united, quincuncial.
- 5 petals, united, salver shaped, twisted.
- Coralline corona present.
- 5 epipetalous stamens, filaments inserted- corolla tube.
- Anthers dithecous, introrse, sagittate.
- Bicarpellary, apocarpous, superior ovary.
- Carpel unilocular- ovules- marginal placentation.
- 2 styles united ending in hour glass shaped stigma.
- Double follicle fruit.

C. Marchantia Thallus- T.S.

Thallus T.S. shows:

- Two epidermal layers: upper- photosynthetic region; lower- storage region.
- Airpores – upper epidermis.
- Photosynthetic region: partition wall, assimilatory filaments with chloroplast.
- Storage region: thin walled parenchyma cells.
- Lower epidermis: scale, smooth walled and tuberculate rhizoids.

C. Albugo Infected Leaf – T.S.

T.S. of infected portion shows:

- Branched, aseptate, unicellular mycelium with haustoria.
- Mycelial mat below lower epidermis.
- Club shaped conidiophores – parallel from mycelial mat.
- Chain of conidia- basipetal arrangement with mucilage pad.
- Each conidium multinucleate, small, smooth and spherical.

D. Cycas Leaflet T.S.

- Leaflet- swollen midrib, flat wings
- The outermost layer- cuticularised epidermis
- Sclerenchymatous hypodermis- both sides
- The vascular bundle- conjoint, collateral open.
- Xylem- diploxylic: V-shaped centripetal xylem, two groups of centrifugal xylem.
- Mesophyll- Palisade and spongy tissue.
- Presence of transfusion cells- lateral conduction.

D. Cycas Microsporophyll T.S.

- Outline- triangular.
- Mucilaginous ducts- in the ground tissue.
- Sporangia- occur in sori- attached on the lower surface.
- Sporangia- oval, sac like with a short stalk.
- Sporangia enclose a large number of micropores.
- Unicellular soral hairs- intermixed with sporangia.

E. Orchid Root T.S.

- T.S. of root- circular in outline: outer epidermis, middle cortex, inner stele.
- Epidermis- uniseriate, thin walled with numerous unicellular hairs.
- Presence of velamen tissue- assimilatory function.
- Velamen- hypodermal chlorenchymatous tissue.
- A single layer- exodermis- delimits cortex and velamen.
- Large parenchymatous cortex with starch grains and raphides.
- Endodermis with passage cells.
- Vascular Bundle- Polyarch, radial, closed with exarch xylem.
- Conjunctive tissue sclerenchymatous.
- Parenchymatous pith with starch grains.

E. Monocot Stem T.S.

- T.S. of stem- circular in outline.
- Epidermis, hypodermis, ground tissue- scattered vascular bundle.

- Epidermis- single layered, cuticularised.
- Vascular Bundle- collateral, closed with endarch xylem.
- Xylem- Y shaped – two metaxylem, one protoxylem with lacuna.
- Sclerenchymatous bundle sheath.
- Pith is hollow.

F. Test Tube Funnel Experiment

Aim:

- Experiment- proves oxygen released during photosynthesis.

Materials Required:

- Beaker, test tube, funnel, hydrilla twigs, water

Procedure:

- Hydrilla twigs- inverted in the mouth of the funnel
- Kept inverted in a beaker with
- A test tube is filled with water
- Kept inverted on the funnel
- The setup is kept in direct sunlight.

Observation:

- The level of water in the test tube- decreased- air bubbles collected at the top

Inference:

- Oxygen gets collected in the test tube
- Proves oxygen is liberated during photosynthesis.

F. Ganong's Light Screen Experiment

Aim:

- To prove that light is necessary for photosynthesis.

Apparatus Required:

- Ganong's light screen, iodine solution, alcohol, water, potted plant with wide leaves

Procedure:

- The leaves- potted plants- destarched- in dark- for about 48 hours
- Leaf is fixed with light screen.
- Destarch plant- kept in light for few hours
- The leaf- plucked- tested for starch with iodine solution.
- Iodine test- performed after killing the leaf in boiling water
- Decolourised with alcohol

Observation:

- Portion of the leaf not covered with light screen- receives the light turns blue with iodine.

Inference:

- Starch is present in the portion exposed to light
- The portion covered with light screen receives no light- does not show the presence of starch.
- This proves- light- necessary for photosynthesis

G. Marchantia- Sporophyte L.S.

- Sporophyte: three parts: foot, seta, capsule
- Foot- bulbous- anchorage, nutritive function.
- Seta- short, elongates at maturity
- Capsule- oval, encloses spore and elaters
- Sporogonium- enclosed by calyptra, two layers: inner- perigynium, outer- perichaetium
- Elaters- hygroscopic, meant for dispersal of spores.

G. Nephrolepis- Sorus V.S.

- Fertile leaflets- sporophyll- sori (group of sporangia) on lower surface.
- Sorus- multi cellular stalked.
- Sporangium attached to placenta covered by indusium.
- Sporangial wall- thick walled annulus, thin walled stomium, enclosing spores.

H. Choloroplast

- Cytoplasmic organelle of plant cell.
- Bounded by two lipo proteinaceous membranes.
- Inner space filled with colloidal substance- stroma.
- Closed flat sacs- thylakoids arranged one above the other- granum.
- Grana found in stroma interconnected by frets.
- Quantasome pigment present on the thylakoid membrane.
- Function- photosynthesis.

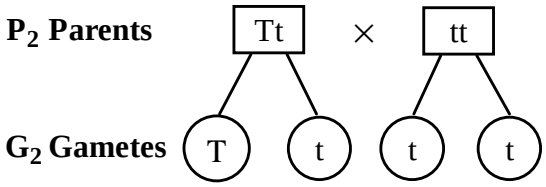
H. Mitochondria

- Granular or rodlike cytoplasmic organelle- power house of the cell.
- Covered by two unit membranes separated by a space.
- Inner membrane- finger like projection- cristae.
- Inner region- the matrix.
- Inner and outer membrane contains ETP or F_1 particles.
- Functions: Respiration and energy supply.

I. Test Cross

Tt × tt

- F_1 progeny is crossed back with its recessive parent- test cross
- Helps to test- the individual is homozygous or heterozygous



F_2:

	T	t
t	Tt (1)	Tt (2)
t	tt (3)	tt (4)

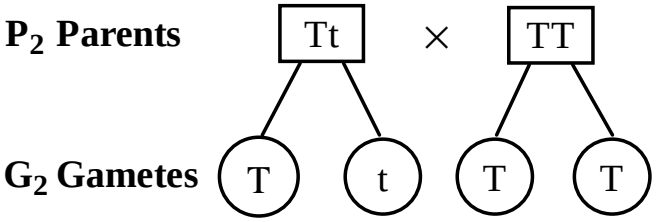
Phenotypic Ratio: 1 Tall : 1 Dwarf

Genotypic Ratio : 1 Tt : 1 tt

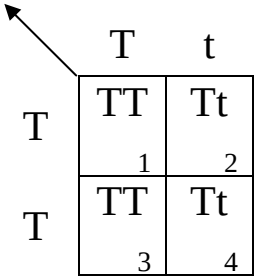
I. Back Cross

Tt × TT

- F_1 progeny is crossed with dominant parent, the cross is back cross.



F_2:



Phenotypic Ratio: All the plants are tall

Genotypic Ratio : 1 TT : 1 Tt

J. Opuntia

- Succulent xerophyte.
- Flat fleshy jointed stem- cladode.
- Leaves reduced to spines- occur in groups on the raised tubercles on the stem.
- Cladode- stem- performs the function of leaf blade- photosynthesis.

J. Eichhornia

- Free floating hydrophyte
- Stem- offset- cluster of leaves above, roots below
- Leaves with swollen petiole
- Roots- balancing roots- many hairy rootlets
- Tip of each root covered by root pockets

K. Air Layering

- It is a method of vegetative propagation.
- Layering is made in the aerial branch.
- Stem- injured by slicing
- Injured portion enclosed with rooting medium
- Rooting takes place on the upper portion of the cut end of a ring.
- Practiced in ornamental and flowering plants.

K. T-Budding:

- It is a method of vegetative propagation.
- ‘T’ shaped incision made on the stock stem.
- Scion bud inserted into the ‘T’ cut surface, given bandage.
- Scion bud is allowed to grow.
- Practiced in fruit trees.