



MORPHOLOGY OF FLOWERING Plants

Morphology is studying external structures of an organisms like roots, stem, leaves in case of angiosperms.

THE ROOT SYSTEMS

IN DICOTS, DIRECT ELONGATION OF RADICLE LEADS TO FORMATION OF PRIMARY ROOT WHICH BEARS LATERAL ROOTS(SECONDARY & TERTIARY)

TYPES OF ROOT SYSTEMS

- **Tap root system**– primary root + it's branches Eg- mustard(dicot)
- **Fibrous root system**–in monocots (wheat, rice) primary root is short lived hence replaced by many several roots(arise from base of stem)
- **Adventitious root system**–in banyan tree, grass, *monstera* root arises from other than radicle.

FUNCTIONS OF ROOT

Absorb water & minerals, provides proper anchorage, storing reserve food, synthesis of plant growth regulators(auxin)

REGIONS OF ROOT

- **Root cap**– protect, root apex (meristematic cells), helps in deep anchoring
- **Region for meristematic activity**– cells divide without attaining maturity, responsible for growth of root
- **Region of elongation**– cells enlarge & increase length
- **Region of maturation**– contain roots hairs that absorb water & minerals from soil.

MODIFICATIONS OF ROOT

- **Storage**–tap roots of carrot & turnip, adventitious roots of sweet potato
- **Support**–prop roots(vertically downwards) of banayan tree, stilt roots (oblique downwards from lower nodes of stem) of sugarcane & maize
- **Respiration**–In some marshy plants develops vertically upward roots called pneumatophores. Eg-*Rhizophora*

THE STEM (SHOOT SYSTEM)

ASCENDING PART OF PLANT; BEARS NODES & INTERNODES; BEARS BUD(AXILLARY OR TERMINAL); GENERALLY GREEN IN EARLY STAGE & TOUGH WOODY LATER

Storage

eg-potato, ginger, turmeric, zaminkand, *Colocasia*.
Underground stems act as organs of perennation to tide over unfavourable condition.

Support–slendour & spirally coiled from axillary bud.
Eg- (watermelon, pumpkin, cucumber) gourds, grapevines

MODIFICATION OF STEM

Defense (against phytothagous)– axillary bud develops into thorns/spines in Citrus & *Bougainvillea*.

Photosynthesis–stem turns into flattened structure(*Opuntia*) or fleshy cylindrical (*Euphorbia*) which contain chlorophyll.

Vegetative propagation– **RUNNER**–underground stems of grass & strawberry spread to new niches & when older parts die new plants are formed. **STOLON**–slender lateral branch arises from the base of the main axis & after growing aerially for some time arch downwards to touch the ground. **OFFSET**–a lateral branch with short internodes & each node bearing a rosette of leaves & tuft of roots. Eg-*Pistia* & *Eichhornia* (water hyacinth/ terror of Bengal). **SUCKER**–lateral branches originate from the basal and underground portion of the main stem, grow horizontally beneath the soil and then come out obliquely upward giving rise to leafy shoots. Eg-Banana, Pineapple, *Crysanthemum*.



THE LEAF

INTRODUCTION

- It is lateral, flattened structure which develops exogenously at node & bears a bud in axil (axillary bud) which later develops into branch.
- Leaves originate from shoot apical meristem & arranged in acropetal order.

PARTS OF LEAF

- 1) Leaf base**—leaf is attached to stem by leaf base & it may bear 2 stipules. In monocot leaf base expands into sheath; (covers stem partially or wholly).
• In legumes it may become swollen pulvinus leaf base.
- 2) Petiole**—It holds leaf to stem, allow leaf to flutter in wind hence cooling leaf.
- 3) Lamina/leaf blade**—It expanded green part with veins & veinlets with a midrib.
• Veins provide rigidity to blade & transport water, minerals & food material.

TYPES OF LEAF

- 1. SIMPLE LEAF.** lamina is entire or when incised. Incisions do not touch midrib. Eg—Peepal
- 2. COMPOUND LEAF**—Incisions reaches midrib breaking it into leaflets. Bud is not found in axil or leaflet
- 3. Pinnately compound**—leaflets are present at Rachis (represents midrib). Eg—Neem.
- 4. Palmately compound**—Leaflets are attached at common point i.e. tip of petiole. Eg—Silk cotton.

PHYLLOTAXY

Pattern of arrangement of leaves on branch/stem

- 1. ALTERNATE**—one leaf at one node. Eg—China rose, Mustard, Sunflower
- 2. OPPOSITE**—a pair of leaf at one node eg.—*Calotropis*, Guava
- 3. WHORLED**—More than 2 leaves at one node. eg.—*Alstonia*

MODIFICATION

- 1. Support**—tendrils of peas
- 2. Defense**—spines of cacti
- 3. Storage**—fleshy leaves of onion & garlic
- 4. Photosynthesis**—(phylloids) petioles expand & become green colour leaves that are short lived. Eg—*Australian acacia*
- 5. Insectivorous**—Pitcher plant, Venus fly trap.

VENATION

Arrangement of veins & veinlets.

- **Reticulate venation**—veinlets form a network. Eg—dicots
- **Parallel venation**—when the veins run parallel to each other within a lamina. Eg—banana, monocots.

THE INFLORESCENCE

THE ARRANGEMENT OF FLOWERS ON THE FLORAL AXIS

Racemose inflorescence

- 1) The main axis continues to grow and does not terminate.
- 2) Flowers are arranged in acropetal order.
- 3) Main axis is monopodial.
- 4) Eg—Fabaceae family

Cymose inflorescence

- 1) The main axis terminate in a flower.
- 2) Flowers are arranged in basipetal order.
- 3) Main axis is sympodial.
- 4) Eg—Solanaceae, Liliaceae family.

THE FLOWER

Introduction: It is reproductive unit. A typical flower has 4 whorls on swollen end of the stalk/pedicel called thalamus which are Calyx, Corolla, androecium and gynoecium. Calyx & corolla are accessory while other two are reproductive whorls.
PERIANTH—in Lily the calyx & corolla are not distinct or differentiated and are termed as perianth.

Parts of flower

- 1) **Calyx**—green, protect flower in bud stage, photosynthetic, outermost whorl. Gamosepalous (sepals united), polysepalous (sepals free)
- 2) **Corolla**—to attract insects, may be tubular, bell shaped, funnel-shaped, wheel shaped. Gamopetalous (fused corolla), polypetalous (free petals)
- 3) **Androecium/stamen (stalk + filament + anther)**—anther → bilobed, each lobe having 2 pollen sacs. Sterile stamen is staminode. Stamens attached to petals → epipetalous eg—brinjal. Stamens attached to sepals → epiphyllous eg—lily
Polyandrous—free stamen. **Monoadolphous**—stamens in 1 bundle (china rose). **Diadelphous**—in 2 bundles (pea). Polyadelphous in more than 2 bundles (citrus) There may be variation in length of filaments
- 4) **Gynoecium/carpel/pistil (stigma + style + ovary)**—ovary as enlarged basal part, stigma is receptive surface. Each ovary bears one or more ovules attached to flattened cushion like placenta & one ovule have one embryo sac.
Monocarpellary—one carpel in flower. **Multicarpellary**—more than 1 carpel in a flower. **Apocarpous**—free carpel (lotus, rose). **Syncarpous**—fused carpel (mustard, tomato)



Types of flowers

On basis of symmetry

Actinomorphic (radial) – Mustard, *Datura*, Chilli
Zygomorphic (bilateral) – Pea, *Gulmohar*, Bean, *Cassia*
Asymmetric – *Canna*

On basis of floral appendages

Trimerous – floral appendages in multiple of 3
Tetramerous – multiple of 4
Pentamerous – multiple of 5

On basis of position of ovary

Hypogynous (superior ovary) – mustard, China rose, Brinjal, Mango, Coconut
Perigynous (half interior) – ovary in centre & other at rim of thalamus. Eg – Plum, Peach, Rose
Epigynous (inferior) – ovary enclosed in thalamus. Eg – guava, Cucumber, ray florets of Sunflower

On basis of presence of bract

Bracteate – flowers with bract
Ebracteate – flowers without bract

AESTIVATION

The mode of arrangement of sepals or petals in floral bud with respect to the other members of the same whorl

Valvate:

Sepals/petals in a whorl just touch one another at margin without overlapping.
Eg – *Calotropis*

Twisted:

One margin of appendage overlaps that of next one.
Eg – China rose, Lady finger, Cotton

Imbricate:

Margins of appendage overlap one another in any direction
Eg – *Cassia*, *Gulmohur*

Vaxillary:

Largest petal (standard) overlaps 2 lateral (wings) which in turn overlaps 2 smallest (keels).
Eg – Pea, Bean. It is also called Papilionaceous aestivation.

PLACENTATION

Arrangement of ovules within ovary



Marginal: Placenta forms a ridge along ventral ovary & suture of the ovule are formed on it forming 2 rows Eg – Pea

Axile: Placenta is axial, ovules attached to multilocular ovary Eg – China rose, Tomato, Lemon



Parietal: Ovules develop on inner wall of ovary or periphery. Ovary becomes 2 chambered due to the formation of false septum called Replum.

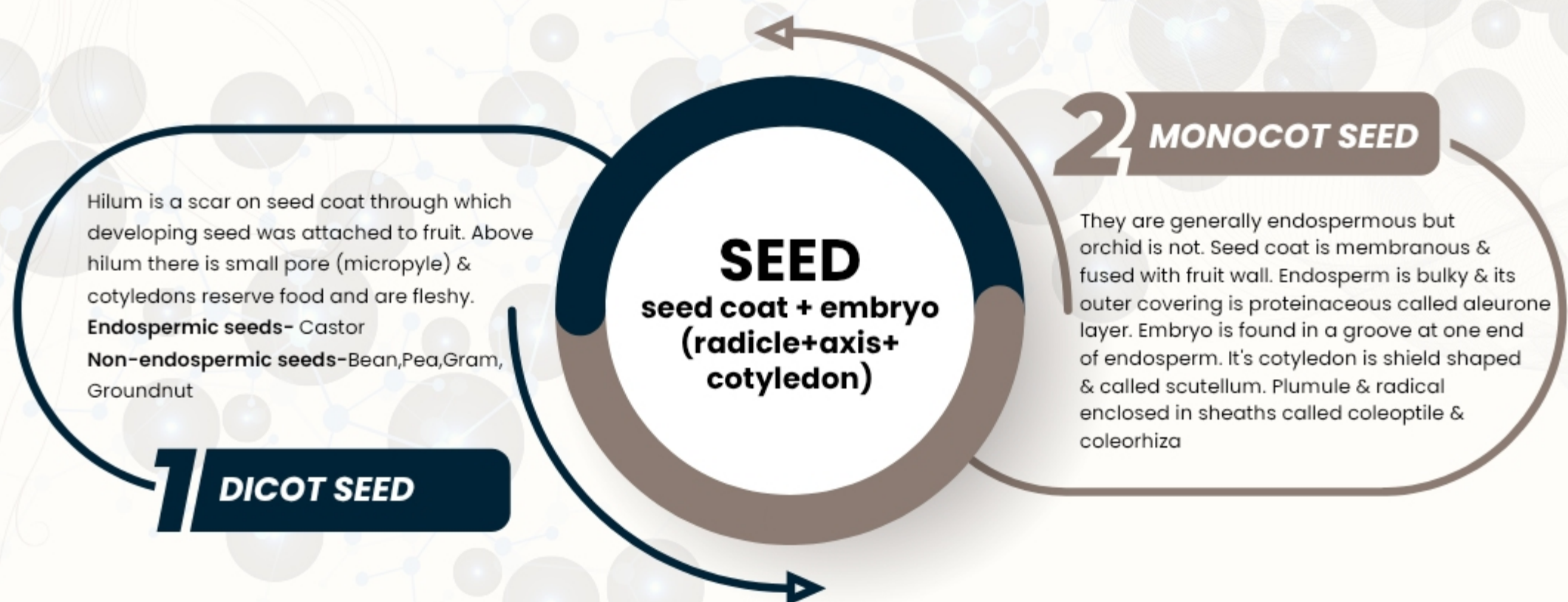
Free central: Ovules are born on central axis & septum are absent. Eg – *Dianthus*, *Primrose*



Basal: Placenta develops from base of ovary & single ovule is attached. Eg – Sunflower, Marigold

Fruit (matured ovary) = pericarp(wall) + seed

After fertilisation ovary → fruit, ovule → seed. If pericarp is thick & fleshy it gets differentiated into epicarp, mesocarp & endocarps. Mango and coconut are drupe fruits as they are developed from monocarpellary superior ovary. In mango mesocarp is edible & in coconut mesocarp is fibrous but in both endocarp is stony.



Semitechnical descriptions of a typical flowering plant

Br → Bractate
 K → Calyx
 C → Corolla
 P → Perianth
 A → Androecium
 G → Gynoecium
G → Superior ovary

\overline{G} → Inferior ovary
 σ^7 → Male
 ϕ → Female
 $\sigma^7\phi$ → Bisexual
 \odot → Actinomorphic
 $\%$ → Zygomorphic

DESCRIPTION OF SOME IMPORTANT FAMILIES

FABACEAE

Earlier called Papilionoideae, a sub family of Leguminosae & is distributed all over world.

Vegetative characters- trees, herbs, shrubs, roots with nodules.
 Stem-erect/climber.

Leaves-alternate, pinnately compound or simple; pulvinate base; stipulate; reticulate venation.

Floral character- Racemose; bisexual; zygomorphic.
 • **Calyx**-5; gamosepalous(valvate/ imbricate aestivation).
 • **Corolla**-5; polypetalous;papilionaceous.
 • **Androecium**-10; diadelphous (9+1); ditheous anther.
 • **Gynoecium**- superior ovary, monocarpellary; unilocular with many ovules; single style.
 • **Fruit**- Legume seed; one to many,non endospermic.

Economic importance-sources of pulses (Gram,arhar, Moong, Soyabean), edible oil (Soyabean, Groundnut); dye (*Indigofera*); fibres (Sunhemp); fodder (*Sesbania*, *Trifolium*); ornamentals (*Lupin*, Sweet pea); medicine (*Muliathi*)

SOLANACEAE

Also called potato family, distributed in tropics, subtropics, & event temperate zones.

Vegetative characters-mostly herbs, shrubs, rarely small trees. **Stem**- herbaceous, rarely woody, aerial; erect, cylindrical branched, solid/hollow, hairy or glabrous, underground in *Solanum tuberosum*.

Leaves-Alternate, simple; rarely pinnately compound; exstipulate; reticulate.

Floral characters-
INFLORESCENCE- solitary, axillary cymose in *Solanum*.
FLOWER-actinomorphic, bisexual.
CALYX-5; (united sepals); valvate; persistant.
COROLLA-5; (united & valvate).
ANDROECIUM-5; (epipetalous).
GYNOECIUM-bicarpellary; obligately placed, syncarpus, superior, bilocular; placenta swollen with many ovules, axile placentation.
FRUIT-berry, capsule.
SEEDS-many; endospermous.

Economic importance.: Food (Tomato, Brinjal, Potato), spice(Chilli), medicine (*Belladonna*, *Ashwagandha*); fumigatory(Tobacco); ornamentals(*Petunia*)

LILIACEAE

Also called Lily family, representative of monocots, distributed world wide.

Vegetative characters-Perennial herbs with underground bulb/ corms/rhizomes. **LEAVES**- mostly basal, alternate, linear, exstipulate, parallel venation.

Floral characters- **INFLORESCENCE**. solitary/cymose; often umbellate clusters. **FLOWER** bisexual, actinomorphic. **PERIANTH**-tepals six (3 + 3); (often united into tube), valvate. **ANDROECIUM**-6, 3 + 3, epitepalous. **GYNOECIUM**- tricarpeallary, syncarpous, superior, trilocular with many ovules; axile placentation.
FRUIT-capsule; rarely berry.
SEED-endospermous.

Economic importance-good ornamentals (*Tulip*, *Gloriosa*), medicine(*Aloe*), vegetables (*Asparagus*), colchicine(*Colchicum Autumnale*).