

- (1) Bud scales these are scaly stipules which enclose and protect the vegetative buds and fall off as soon as the leaves unfold e.g. *Ficus sp.*, *Mussanga sp.*
- (2) Spinous stipules are modified into two sharp pointed structures known as spines, one on each side of the leaf base. They protect the leaf against grazing by herbivorous animals e.g. *Mimosa sp.*, *Acacia sp.*

### Leaf Blade or lamina

This is the green, expanded portion of the leaf. It has a strong major vein known as the mid-rib which runs centrally through the leaf blade from its base to the apex. The mid-rib produces thinner lateral veins which in their turn give rise to still thinner veins or veinlets. The edge of the lamina is known as the leaf margin and the tip is called the leaf apex. The major function of the lamina is photosynthesis.

Leaf Apex is the tip of the leaf blade and it could be of various shapes. The various types are described below:

- (1) Obtuse or round apex is blunt or rounded e.g. *Terminalis catapa*, *Talinum triangulae* etc.
- (2) Acute Apex: the tip of the leaf is pointed and sharp in the form of an acute angle eg. *Sida acuta*
- (3) Acuminate apex: the leaf tip tapers to a long slender structure, which may be either acute or blunt, e.g. *Ficus religiosa*.
- (4) Cuspidate apex: the apex ends in a long rigid sharp point. It is similar to acuminate, but there is no abrupt constriction before tapering to a long slender structure e.g. Date palm, Pineapple.
- (5) Truncate apex: the apex ends abruptly as if cut off in a straight line e.g. Indian sago palm (*Caryota urens*).
- (6) Retuse apex: when the leaf apex is furnished with a shallowly notch i.e. The apex is shallowly depressed e.g. *Pistia* (water lettuce).

(Fig. 42: diagram)

- (1) Emerginate apex: this is similar to retuse apex, but the notch or depression is deeper and more pronounced than in retuse e.g. *Bauhinia sp.* *Oxalis sp.*

- (2) Mucronate apex is round but ends in a short point, looking as if the mid-rib is projected further above the apex e.g. *Ixora sp.*
- (3) Apiculate apex: the rounded apex is topped by a short point that is smaller than the one in mucronate.
- (4) Cirrhose apex: the leaf apex ends in a tendril-like structure or thread-like appendage e.g. *Gloriosa superba*, banana (*Musa sp.*)
- (5) Aristate apex: the apex is drawn into a straight and sharp pointed structure.
- (6) Caudate apex: the apex is shallowly depressed making the leaf to be hat-like.

#### Leaf Margins

The edge of the leaf blade could be of various patterns

- (1) Entire margin is smooth and even e.g. cashew (*Amarcadium occidentale*)
- (2) Repand or Sinuous margin – the leaf edge is shallowly wavy or undulating e.g. Mango (*Mangifera indica*).
- (3) Sinuate margin – the leaf margin is deeply undulating e.g. mast tree (*Polyalthia*), some garden crotons.
- (4) Serrate margin – the leaf edge is cut like the teeth of a saw and the teeth are directed upwards towards the apex e.g. *Azadirachta indica*, rose (*Rosa sp.*)
- (5) Serrulate margin when the serration is smaller than in serrate.
- (6) Bisserrate margin the leaf edge is doubly serrated i.e. there is a further serration of the primary serrate.
- (7) Dentate margin the teeth of the serration are directed outwards at right angles to the mid-rib of the leaf e.g. melon, water lily. The teeth may be round or pointed.
- (8) Denticulate margin the teeth are directed towards at right angles to the mid-rib of the leaf as in dentate, but the teeth are smaller than those of the dentate.
- (9) Runcinate margin is a serrated margin with the teeth directed downwards towards the leaf base.
- (10) Crenate margin the teeth are round and directed upwards i.e. the ascending notches are round as in *Bryophyllum sp.*, *Coleus sp.*

(11) Crenulate margin similar to crenate but the notches are smaller and more frequent than in crenate.

(12) Fimbriate margin the margin is fringed with fine segments.

(Fig. 43: diagram)

(13) Ciliate margin: the margin is fringed with hairs

(14) Spinous margin: the teeth are provided with spines

(15) Lobed margin is when the indentation or nothing of the leaf blade has gone more than half way into the leaf blade towards the mid-rib. The lobes may be pointed or round.

(16) Parted margin: the indentation is deeper than in lobes margin, reaching or nearly reaching the mid-rib. This may lead to the evolution of compound leaves.

Leaf blade bases:

The base of the leaf blade could be of different shapes

(1) Acute base is when the leaf blade base ends sharply

(2) Alternuate base is when the leaf blade extends towards the petiole

(3) Obtuse base is when the leaf blade ends up roundly at the base

(4) Truncate base: the leaf blade base is drawn into a straight line e.g. Banana (*Musa* sp)

(5) Oblique or Irregular base is when the two sides of the leaf blade base do not end at the same point. It may be pointed or round.

(Fig. 44: diagram)

(1) Hastate base the lower part of the leaf draws outwards before ending at the leaf base

(2) Sagittate base the leaf blade is drawn in at the base e.g. cocoyam (*Xanthosoma sagittifolia*)

(3) Cordate base the leaf blade is drawn in at the base but not as pronounced as in sagittate, giving the leaf a hat-like shape.

## Sessile Leaves

These are leaves without petiole. They are also referred to as epetiolate or expetiolate. In sessile leaves, the leaf blade is directly attached to the stem or branch.

### Types of sessile leaves

- (1) Auriculate: the lobes at the leaf base partially enclose the stem e.g. *Calotropis procera*, basal leaves of *Emilia* sp., *Sonchus oleraceus*
- (2) Amplexicaul the lobing of the leaf blade base completely enclose the stem. The lobes are not fused or attached e.g. wheat, grass, cauline leaves of *Emilia* sp.

(Fig. 45: diagram)

- (1) Semi-amplexicaul: the lobing of the leaf blade base incompletely enclose the stem
- (2) Perfoliate: the lobes at the leaf blade base meet across the stem and fuse together, so that the stem seem to pass through the leaf blade e.g. *Aloe perfoliata*, *Conscora perfoliata*.
- (3) Connate: when two sessile opposite leaves meet each other across the stem and fuse together e.g. *Lonicera flava*, *Conscora diffusa*
- (4) Decurrent: the petiole and the leaf base become winged, and the wing extends down the stem, so that the stem also seems to be winged e.g. *Crotalaria alata*, *Laggera alata*, *Conscora decurrens* etc.

### Shape of Leaf:

Shape of leaf vary from plant to plant. There are plants with different type of leaves in different parts of the plants i.e. leaves at the lower part may be different from those at the upper part of the same plant. Such plants are said to be heterophyllous. Different shapes of leaf are described below.

- (1) Acicular leaf: The leaf is long, narrow and cylindrical i.e. the leaf is needle-like e.g. *Pinus*, onion (*Allium cepa*).

- (2) Linear leaf: the leaf is long, narrow and flat. All the main veins run parallel to one another e.g. grasses such as *Imperata cylindrical*, *Zea mays*, *Panicum maximum*.
- (3) Filiform leaf: The leaf is an extreme form of linear leaf. The leaf is very long, narrow and thin.
- (4) Subulate leaf: The leaf is linear, but the blade tapers from the base to the apex.
- (5) Lanceolate leaf: the leaf is lance-shaped, the broadest part of the leaf is about 1/3 of the leaf length to the base and the blade tapers towards the apex e.g. *Bambusa vulgaris*, *Oleander (Nerium sp.)*, *Polyalthia sp.* , *Mangifera indica*, *Lactuca capensis* etc.
- (6) Oblanceolate leaf: is an inverted form of lanceolate leaf. The leaf blade has its widest portion towards the apex e.g. *Alternanthera sessilis*.
- (7) Ovate leaf: the broadest part of the leaf-blade is below the middle point of the leaf and that margin curves symmetrically to produce an egg-shaped structure e.g. China rose, *Vigna unguiculata*.

(Fig. 46: Diagrams of leaf shapes)

- (1) Obovate leaf: The leaf shape is like an inverted egg i.e. inverted form of ovate leaf e.g. *Talinum triangular*, *Terminalia catapa*, *Artocarpus sp.*
- (2) Elliptic/oval leaf: The leaf margins are symmetrically curved with the broadest part at the mid-point of the leaf blade length e.g. Guava (*Psidium guajava*), Periwinkle (*Vinca sp.*), *Vernonia galamensis*
- (3) Oblong leaf: The leaf blade is wide and long, longer than broad with the widest part at the middle point, but unlike elliptic, the two margin run parallel to each other e.g. Banana (*Musa sp.*), *Ensete gilleti*.
- (4) Spathulate: The leaf blade is spoon-shaped i.e. like spatula. The leaf blade is broad and somewhat rounded at the top and narrower towards the base e.g. *Asteri sp.*, *Calendula sp.*

(Fig. 47: Diagrams of leaf shape contd.)

- (1) Rhombase leaf: the leaf blade is shaped like a geometric rhombus e.g. *Albizia zygia*, *Sida rhombifolia*.
- (2) Deltoid or Triangular leaf: the leaf blade is triangularly shaped e.g. *Amaranthus sp.*, *Ficus sp.*
- (3) Orgiular/Rotund leaf: the leaf blade has rounded or circular outline e.g. *Trianthema portulacastrum*.
- (4) Reniform leaf: the leaf blade is shaped like the kidney e.g. *Aristolochia sp.*
- (5) Cordotale leaf: the leaf blade is heart-shaped e.g. *Sida venonicifolia*, *Peperomia pellucid*, *Piper betle*.
- (6) Obcordate leaf: the leaf blade is inversely heart-shaped e.g. *Oxalis sp.*
- (7) Hastate leaf: the leaf blade has the shape of an arrow-head, but the basal lobes are pointed or narrow, more or less at right angle to the base e.g. *Caladium sp.*, *Ipomoea sp.*, *Typhonium sp.*
- (8) Sagittate leaf: the leaf blade is shaped like an arrow with the basal lobes blunt and are not at right angle to the base e.g. *Sagittaria*, *Xanthosoma sagittifolia* (cocoyam)
- (9) Peltate leaf: this is when the leaf stalk (petiole) is attached to the leaf blade inside the lamina.
- (10) Oblique leaf: the two halves of the leaf are unequal or irregularly or obliquely shaped e.g. *Azadirachta indica*, *Begonia sp.*
- (11) Cuneate leaf: the leaf blade is wedge-shaped e.g. water lettuce (*Pistia*).
- (12) Falcate leaf: The leaf blade is sickle-shaped as in *Albizia sp.*, *Encalyptus globules*, *Arundinaria falcate* (a kind of bamboo).
- (13) Lyrate leaf: the leaf blade shape is like that of a lyre i.e. with a large terminal lobe and some smaller lateral lobes e.g. Mustard, radish etc.
- (14) Pedate leaf: this is when the leaf blade is like the claw of a bird with the lobes spreading outwards e.g. *Vitis pedata*.

VENATION OF LEAF:

Veins are rigid linear structures which arise from the petiole and the mid-rib and traverse the leaf lamina in different directions. They are composed of vascular tissues and they perform mechanical and conduction functions. Venation is the arrangement of the veins and the veinlets on the leaf on the leaf blade. Venation should not be confused with vernation, which is the arrangement of leaves when in buds.

### Types of Venation

There are two types of venation which are reticulated and parallel venations.

(1) Reticulate venation: the major vein gives rise to lateral branches which further branch and rebranch to produce veinlets which may join together to form a network pattern. This type of venation is typical of the dicotyledons.

(Fig. 48: and Fig. 49 diagrams)

(2) Parallel venation: the main veins are many and run parallel to each other and they are approximately of equal size. This type is found in the monocotyledons.

### Types of Reticulate Venation

(1) Pinnate reticulate venation: The mid-rib gives off lateral veins which proceed towards the margin or apex of the leaf. The lateral veins are then connected by smaller veins which pass in all directions, forming a network e.g. *Ficus sp.*, Mango (*Mangifera indica*).

(Fig. 50 diagram)

(2) Palmate reticulate venation: there are a number of more or less equally strong veins which arise from the tip of the petiole and proceed outwards or upwards.

There are two types

(a) Palmate divergent: The main veins arise from the same base and diverge outwards towards the margin of the leaf e.g. pawpaw (*Carica papaya*), castor oil (*Ricinus communis*).

- (b) Palmate convergent: The veins converge to the apex of the leaf blade e.g. *dioscorea sp.*

#### Types of parallel venation

- (1) Pinnate parallel venation: There is a prominent mid-rib which gives off lateral veins which run parallel to each other towards the margin or apex of the leaf blade e.g. Banana (*Musa sp.*), alligator pepper (*Aframomum melegueta*), ginger (*Zingiber officinarum*), *Canna indica*.
- (2) Palmate parallel venation: The veins arise from the tip of the petiole and proceed outwards towards the margin or upwards towards the apex. There are two types:
- (a) Palmate divergent: the veins arise from a point and diverge towards the margin of the leaf blade running parallel to each other e.g. fan palms.

(Fig. 51: diagram)

- (b) Palmate convergent: the veins arise from the base of the leaf blade and proceed towards the apex, running parallel to each other e.g. Bamboo, rice (*Oryza sativa*).

#### INCISION OF THE LEAF BLADE

This refers to the pattern of cutting into the leaf blade. Depending on the venation pattern, there could be two types

- (1) Pinnate incision type: in the pinnately-veined leaf, the incision or cutting of the leaf blade proceeds from the margin towards the mid-rib.
- (2) Palmate incision type: in palmately-veined leaf, the cutting of the leaf blade proceeds from the margin towards the base of the leaf blade.

#### Incision of the pinnate series

- (1) Pinnatifid: this is when the incision of the margin is half-way or nearly half-way down towards the mini-rib e.g. *Launea taraxacifolia*.



(2) Pinnatipartite: this is when the incision is more than half-way down towards the mid-rib e.g. Radish, mustard.

(Fig. 52: Incision of leafblade (Pinnate Series)

(3) Pinnatisect: the incision of the leaf blade is carried down to near the mid-rib i.e. the cutting has gone more than  $\frac{3}{4}$  of the leaf blade towards the mid-rib e.g. Ferns.

#### Incisions in the Palmate series

(1) Palmatifid: the incision has not gone more than half way towards the leaf base or petiole e.g. *Passiflora edulis*, cotton (*Gossypium sp.*)

(2) Palmatipartite: the incision has gone more than half-way towards the base or petiole e.g. castor oil (*Ricinus communis*), pawpaw (*Carica papaya*).

(Fig. 53: diagram)

(3) Palmatisect: the incision is more or about  $\frac{3}{4}$  of the leaf blade towards the leaf base or petiole e.g. cassava (*Manihot esculenta*), hemp plant (*Cannabis sativa*).

#### TYPES OF LEAF

A leaf can be simple or compound.

Simple leaf consists of a single blade which maybe entire or incised (lobed) to any depth, but not down to the mid-rib or the petiole i.e. the leaf blade remains intact.

In Compound leaf, the incision of the leaf blade goes down to the mid-rib or petiole, so that the leaf is broken up into a number of segments, called leaflets, which are free from one another and more or less distinctly jointed at their base.

(Diagram)

A bud (axillary bud) is always present in the axil of a simple or a compound leaf, but it is absent in the axil of the leaflets of a compound leaf.

Each leaflet has its own stalks known as the Petiolule. The main vein of the compound leaf is called the rachis while the mid-vein of the leaflet is called rachilla. The lateral leaf-like appendages borne at the base of the leaflets are called stipels.

There are two types of compound leaves, which are pinnate compound leaf and palmate compound leaf.

Pinnately compound leaf is one in which the mid-rib (rachis) bears laterally a number of leaflets, which are arranged alternately or in an opposite manner e.g. *Acacia sp.*, *Mimosa sp.*, *Cassia sp.*, etc.

(Fig. 55 Diagram)

Pinnately compound leaves may be of the following types

- (1) Unipinnate compound leaf: the mid-rib (rachis) bears the leaflets directly. When the leaflets are even in number, the leaf is said to be Paripinnate e.g. *Acacia sp.*, *Cassia obtusifolia*, *Sesbania sp.*

(Fig. 56: Diagram)

When the leaflets are odd in number and the leaf is terminated by one leaflet, the leaf is said to be Imparipinnate e.g. *Rose*, *Azadirachta indica*, *Murraya sp.* etc.

Pinnate compound leaves can be described based on the number of leaflets on them.

The following types are known:

Unifoliate are those having only one leaflet e.g. *Desmodium*, *Bauhinia sp.*

Bifoliate are those having two leaflets e.g. *Balanites sp.*

Trifoliate compound leaves possess three leaflets e.g. *Vigna sp.*, *Etythrina sp.*, *Vitis trifolia*, *Calapogonium sp.*, etc.

Quadrifoliate, pentafoliate or multifoliate possess four, five or many leaflets respectively. It should be noted that leaflets may vary in number in the compound leaves of the same plant.

- (2) Bipinnate compound leaf this is when the pinnation is of the second order i.e. when the leaflets on the unipinnate compound leaf is further divided into smaller

leaflets (double pinnation) e.g. *Caesalpinia pulcherima*, *Mimosa pudica*, *Delonix regia* etc.

(Fig. 57: diagram)

(3) Tripinnate compound leaf this is when the leaf is thrice pinnate i.e. pinnate of the third order whereby the leaflets are borne on the tertiary axes e.g. *Moringa sp.*, *Oroxylum sp.*, etc.

(4) Decompounds leaf: this is when the leaf is more than thrice pinnate i.e. the pinnation is beyond the third order e.g. Carrot (*Daucus carota*), *Cosmos sp.*, *Coriandrum sp.*

Palmately compound leaf is the one in which the petiole bears terminally a number of leaflets which radiate from a common point like fingers of the palm e.g. *Bombax sp.*, *Polinisia sp.*, *Lupinus sp.*, etc. Palmately compound leaves are also described based on the number of leaflets borne on them. Examples are

Unifoliate (those with one leaflet) e.g. Citrus sp. (this is very rare)

Bifoliate (those with two leaflets)

Trifoliate (those with three leaflets) e.g. *Aegle*, *Oxalis*, *Dioscorea dumetorum*

Quadrifoliate (those with four leaflets) e.g. *Marsilea quadrifolia*

Digitate or multifoliate (those with five or more leaflets) e.g. *Bombax*, *Polinisia*

(Fig. 58: diagram)

Trifoliate palmate leaf can be distinguished from trifoliate pinnate in the sense that the three leaflets of the palmate trifoliate leaf are attached to the apex of the petiole, whereas, in trifoliate pinnate leaf, it is only the terminal leaflet that is attached to the tip of the petiole.

## LEAF ARRANGEMENT

The arrangement of leaves on the stem is termed phyllotaxy. There are different kinds of leaf arrangement, depending on the number of leaves developing from a node.

(1) Single leaf at a node: the arrangement could be either alternate or spiral

- (a) Alternate: the single leaves are arranged alternately along the length of the stem in a single plane e.g. Mango (*Mangifera indica*)
- (b) Spiral: the single leaves are arranged spirally along the length of the stem e.g. *Hibiscus rosasinensis*.

(Fig. 59: diagram)

- (2) Two leaves at a node: this could be opposite or decussate
  - (a) Opposite (superposed): the two leaves at the node are arranged opposite each other on each side of the stem in a single plane, with all the pairs of leaves on the stem occurring in the same plane e.g. Cassia sp.
  - (b) Opposite (Decussate): the pair of opposite leaves at one node are arranged at a right angle to the pair of opposite leaves at the next upper and lower nodes e.g. *Calotropis procera*, *Ixora sp.*, *Ocimum gratissimum*, *Psidium guajava*.

(Fig. 60: diagram)

- (3) More than two leaves at a node: this is termed whorled leaf arrangement. There may be variation in the number of leaves developing from a node, ranging from three to five or six e.g. *Alstonia boonei*, *Oleander (Nerium sp.)*, *Allamanda sp.*

(Fig. 61 diagram)

## THE FLOWER

The flower is a specialized shoot of limited growth bearing reproductive organs. The flowers are the main reproductive organs of flowering plant. They are the most attractive due to the colouring of the petals. Flowers are the most constant character or organ of flowering plants, hence they are very important in the classification of flowering plants. Flowers that develop from leaf axils are termed axillary flowers, while terminal flowers are formed at the apex of stems or branches. Cauliflorous flowers develop directly on the stem of trees. Some flowers may occur singly or solitary flowers are in Hibiscus sp. or as cluster of flowers known as inflorescence e.g. *Aspilia sp.*, *Emilia*

*sp.*, etc. The flower stalk of a solitary flower is called Pedicel while the stalk of an inflorescence is termed peduncle. Flowers with pedicel are called pedicellate flowers while those without pedicel are sessile flowers.

(Fig. 62: diagram)

A flower is composed of our floral parts that are attached to the flower base known as the receptacle or thalamus. The floral parts which are arranged in four different whorls on the receptacle are Calyx, corolla, androecium and gynoecium. Flowers having all the four floral parts are called Complete flowers, while incomplete flowers lack one or more of the floral parts.

The calyx is the outermost whorl of the floral parts on the receptacle. It is made up of two to five small leaf-like structures known as the sepals. Sepals could be numerous in some Cactus species. Sepals are usually green in colour, but when coloured as in *Caesalpinia sp.*, they are said to be Petaloid. The sepals may be completely free from one another or fused together to form a cup-like structure as in *Hibiscus sp.*, *Crotalaria sp.* When the sepals are free, they are said to be polysepalous, and when fused, they are gamosepalous.

The sepals function is protection of the inner floral parts during the bud stage. They could also serve for insect attraction when coloured and served as means of dispersal where they occur in the form of hairs known as pappus as in *Tridax procumbens*, *Picris humilis* etc.

Some flowers may possess another whorl of green floral parts outside the calyx known as the epicalyx which is made up of episepals e.g. *Hibiscus rosa-sinensis*.

The Corolla is the second floral whorl next and inner to the calyx which is usually composed of five coloured petals. The petals are very conspicuous (due to their large size and bright colour) and serve to attract insects to the flower for pollination. They could also produce scent for insect attraction e.g. 'queen of the night'. When the petals are free from one another, they are said to be polypetalous e.g. *Hibiscus* and when fused gamopetalous e.g. *Thevetia neriiifolia*. When the petals are fused, they form

corolla tube which protects the androecium and the gynoecium e.g. *Allamanda*. When the petals are green, they are said to be sepaloid.

In some flowers, the sepals and petals may be indistinguishable or be found to fused to form the perianth e.g. *Gloriosa*. Each unit of the perianth is called a tepal. There could be an additional whorl of lobes, scales or hairs at the base of the corolla of some flowers. This is known as the corona e.g. Oleander, *Passiflora sp.*

Flowers without calyx and corolla are said to be naked or achlamydeous. Flowers with either of the two whorls are monochlamydeous, while those with the two are dichlamydeous.

The Androecium: the third whorl, inner to the corolla is the androecium which is the male reproductive organ of the plant. The androecium is made up of stamens which vary in number in different species e.g. the stamens are three in grass flowers, five in most dicots, ten in Clitoria and numerous in the Cactus flowers. Each stamen comprised a long stalk known as the filament which carries a bean-shaped or elongated yellow body known as the anther. The stamens are said to be epipetalous when the filaments are attached to the petals. The filaments of the stamens may be free or fused into one, two or more bundles. When a single bundle is formed, it gives rise to a tube-like structure known as the staminal tube as in Hibiscus. The anthers are usually free from one another, but they could be joined together in some cases e.g. sunflower (*Helianthus sp.*). The anther is comprised of two lobes with each lobe containing two pollen sacs, thus, each anther contains four pollen sacs. The anther lobes are connected by a connective tissue. The pollen sacs contain the powdery pollen grains which are the male gametes.

(Fig. 63 diagram)

The Gynoecium or Pistil: this is the female reproductive organ and it is the innermost floral whorl. It may comprise of one, few or many carpels. The pistil is monocarpous if it comprises a single carpel e.g. Clitoria, and it is polycarpous when it comprises two or more carpels e.g. Hibiscus. The pistil is apocarpous when the carpels are free e.g. rose and it is syncarpous when the carpels are fused e.g. lilies.

The carpel is made up of an ovary, a style and a stigma. The style connects the ovary to the stigma. The ovary contains the ovules (egg cells) which are attached to the placenta by a short stalk called funicle. The arrangement of the ovules in the ovary is termed placentation. The ovary could be superior ovary when it is positioned above other floral parts e.g. Hibiscus, Cassia etc. and the flower is said to be hypogynous. The ovary is inferior ovary when other floral parts are positioned above the ovary and the flower is said to be epigynous e.g. guava (*Psidium guajava*), *Canna sp.* The ovary is described half-inferior in perigynous flowers when the receptacle did not enclose the ovary completely as in inferior ovary and the other floral parts appear to be positioned slightly above the ovary e.g. Rose.

(Fig. 64: diagram)

The stigma is the sticky surface that receives the pollen grains. The stigma surface may be smooth, hairy or feathery. It may branch as in Hibiscus.

At the base of the corolla or pistil or within the receptacle is the nectar which contains glandular cells that secrete a sugary solution called nectar. The nectar plays an important role in pollination by attracting insects which feed on it to the flowers.

In the dicotyledons, the number of each type of floral part is usually four or five or multiples of these numbers. In the monocotyledons, the number of each type of floral part is three or multiple of three.

A flower having only one of the reproductive organs is known as a unisexual flower while those with both reproductive organs are known as a bisexual or hermaphrodite flower.

A unisexual flower could be either pistillate (female) or staminate (male). When both male and female flowers are borne on the same plant, but at different portions of the plant is known as a monoecious plant e.g. *Zea mays* (maize), *Elaeis guineensis* (oil palm).

A plant is described as dioecious when the male and female organs or flowers are borne on different plants of the same species e.g. *Carica papaya* (pawpaw). In such cases, male and female plants are identified.

Androecium and gynoecium are regarded as the essential parts of a flower because reproduction can occur without them. Actinomorphic or regular flowers are those that

are radially symmetrical i.e. they can be divided into two equal halves by any vertical section passing through the centre e.g. *Hibiscus rosa-sinensis*. Zygomorphic or irregular flowers are those that are bilaterally symmetrical i.e. can only be divided into two equal halves in only one particular plane e.g. *Crotalaria sp.*, *Vigna sp.*

## FRUITS AND SEEDS

After pollination and fertilization in the flowers, fruits and seeds are formed. The fruits develop from fertilized ovaries and the ovules in the ovaries become the seeds. In some plants, fruits are formed without fertilization, such fruits are known as parthenocarpic fruits and they are usually seedless e.g. banana, pineapple, etc.

The fruit wall known as the pericarp is made up of three layers comprising of an outer layer called epicarp, a middle layer called mesocarp and an inner layer called endocarp. The pericarp encloses the seeds.

Fruits are described as true fruits and false fruits based on the floral parts that form the fruit. Fruits formed solely from the ovary are known as true fruits e.g. cowpea (*Vigna unguiculata*), while fruits formed not only from the ovary but also from floral parts such as calyx, corolla and receptacle are known as false fruits e.g. cashew, apple. The fruit has two scars, one is the point of attachment to the receptacle and the other is the remain of style. A seed on the other hand has only one scar which is the point of attachment to the placenta.

### Classification of Fruits

Fruits are broadly divided into two classes namely fleshy/succulent and dry fruits on the basis of the nature of the pericarp.

Fleshy/succulent fruits have fleshy fruit walls while dry fruits have hard, dry, fibrous or woody fruit walls. Fleshy fruits are usually juicy, they store water and carbohydrate in their tissues and they are indehiscent i.e. they do not split open to release their seeds. While the dry fruits may be dehiscent or indehiscent.



Fruits are also classified on the basis of the number of flowers involved in the fruit formation. The fruit types under this criteria are simple, aggregate and compound (or multiple) fruits.

Simple fruit are formed from a single flower with a monocarpous or syncarpous pistils e.g. cowpea. Aggregate fruits are formed from a single flower with an apocarpous pistil with each carpel forming a fruitlet e.g. strawberry.

Compound/multiple fruit are formed from whole inflorescence or from many flowers that are positioned very close to one another forming fruitlets that fuse together to form a single large fruit e.g. pineapple, fig, etc.

#### Types of fleshy fruits

- (1) Drupe is a true, simple fruit with well-developed pericarp. The pericarp consists of three layers of which one is fleshy or fibrous. The layers are epicarp which is the thin outer skin, the mesocarp which is the fleshy or fibrous middle layer and the endocarp which is the hard and stony inner layer that encloses the seed. Drupes are usually one-seeded e.g. mango, coconut, etc.
- (2) Berry is a true, simple fruit with well-developed pericarp but the endocarp is fleshy and it is usually many-seeded e.g. tomato, guava. The mesocarp and endocarp are more or less fused to form a fleshy mass in which the seeds are embedded. It is formed from a syncarpous pistil.
- (3) Hesperidium is a true simple fruit with distinct chambers that are separated by sheets of endocarp. The epicarp and mesocarp are fused to form the skin or rind. The chambers are filled with succulent and juicy pulps that are attached to the endocarp. The seeds are formed in the chambers e.g. orange, lime, lemon, etc.
- (4) Pome is a simple false fruit that develops from an inferior ovary. The fleshy and edible outer layer is formed by the swollen receptacle, while the inner core that contains the seeds is formed from the ovary e.g. pear, apple.

(Fig. 65: diagram)

- (5) Sorosis is a fleshy, multiple false fruit formed from a closely packed inflorescence. The peduncle swells to become the fruit core, while every part of each flower forms part of the fruit e.g. pineapple. In pineapple, the fleshy peduncle extends beyond the fruit to form the fruit crown.
- (6) Synconus is a fleshy multiple false fruit formed from a closely packed inflorescence with a swollen, fleshy and cup-like peduncle which encloses small fruitlets. The peduncle cavity opens to the outside as a small hole that are surrounded by scaly bracts e.g. Fig.

### Types of Dry Fruit

Dry fruits could be either dehiscent i.e. those whose pericarp splits open to release their seeds or indehiscent i.e. those whose pericarp do not split.

### Dry Dehiscent fruits

- (1) Follicle is a simple dry fruit formed from a superior monocarpous pistil and splits longitudinally along one suture only e.g. periwinkle.
- (2) Legume is a simple dry fruit formed from a superior monocarpous pistil. It is usually long and flat with two sutures to release the seeds inside it e.g. *Delonix regia*, *Vigna sp.*, *Crotalaria*, *Caesalpinia sp.* etc.
- (3) Capsule is a simple dry fruit formed from a superior syncarpous pistil. It is usually capsular with more than two sutures. The pericarp splits at more than two sutures e.g. okro, cotton.
- (4) Schizocarp is a many-seeded simple dry dehiscent fruit formed from a superior ovary. The fruit breaks up into a number of small one-seeded parts when ripe e.g. castor oil, *Desmodium*.
- (5) Siliqua is a long, narrow, two-chambered capsule-like fruit formed from a bicarpellary ovary. The two chambers are separated by a false calyx and the fruit splits at the two sutures e.g. *Tecoma stan*.

(Fig. 66: diagram)

Dry Indehiscent Fruits they are usually small size, but are produced in large number.

- (1) Achene is a small, one-chambered and one-seeded fruit formed from a monocarpous pistil, with superior ovary. The pericarp is dry and is free from the seed coat e.g. sunflower, *Aspilia sp.*, *Tithonia diversifolia* etc.
- (2) Cypsela is similar to achene, but it is formed from bicarpellary ovary. Many of them bear persistent calyx as tuft of hairs, known as pappus e.g. *Tridax*, *Procumbens sp.*, *Lactuca*, *Sonchus sp.*, *Picris humilis* etc.
- (3) Nut is similar to an achene but the pericarp is tough, stony or woody e.g. cashew nut, almond, walnut, etc.

(Fig. 67: diagram)

- (4) Caryopsis is a small one-seeded fruit formed from a superior monocarpous pistil. The pericarp and seed coat fuse to form a thin cover over the seed e.g. maize or cereals in general and fruits of grasses.
- (5) Samara is one or two-seeded achene-like fruit with the pericarp extended to form wings e.g. *Combretum*, *Dipterocarpus* etc.