MORPHOLOGY OF FLOWERING PLANTS

THE FLOWER

THE FRUIT

1. CHARACTERSTIC FEATURE

- Study of flowers is called Anthology.
- It is specialized modified shoot, which meant for carrying out the sexual reproduction.
- It is reproductive unit in the angiosperm.
- The shoot on which the flower is borne is called Mother axis.
- The side of the flower which is towards mother axis is posterior.

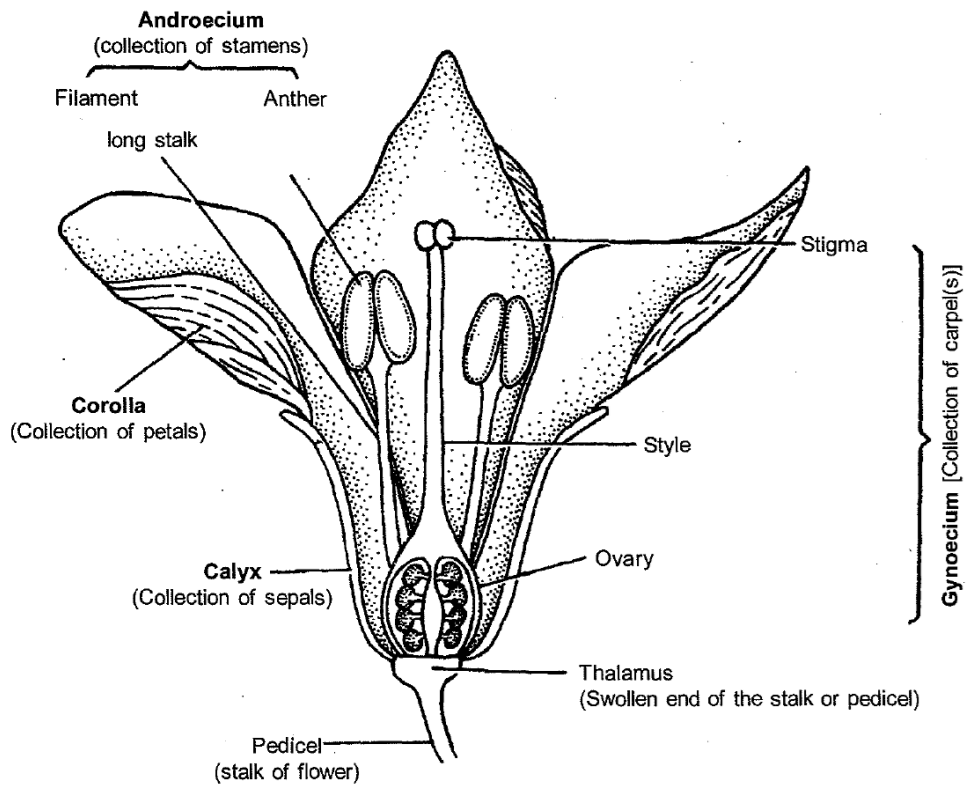
There are 4 types of floral leaves.

(1) Sepal (2) Petal (3) Stamen (4) Carpel

- A typical flower has four different kinds of whorls arranged successively on thalamus.

These are calyx, corolla, androecium and gynoecium.

- Calyx and corolla are accessory organs or accessory whorls while androecium and gynoecium 'are reproductive organs or reproductive .whorls or essential whorls.
- **Complete flower :** All four whorls are present.
- **Incomplete flower :** Any whorl is absent e.g. Unisexual flower
- **Bisexual flower :** Perfect flower
- **Unisexual flower :** Imperfect flower
- A flower may be timorous, tetramerous or pentamerous when the floral appendages are in multiple of 3,4 or 5, respectively. In divots flowers are usually pentamerous while in monocots flowers are timorous.



Parts of a flower

SYMMETRY OF FLOWER

1. **Actinomorphic/Radial/Regular -** When a flower can be divided into two equal radial halves by any vertical plane or radial plane passing through the centre, then it is said to be actinomorphic flower eg. Mustard. Datura. chilli.
2. **Zygomomhic/Bilateral -** When a flower can be divided into two equal (similar) halves only by on particular vertical plane, then it is said to be zygomorphic flower. eg. Pea. bean. gulmohur. Cassia.'
3. **Asymmetrical/Irregular -** When a flower cannot be divided into two equal (similar) halves from any vertical plane passing through the centre, then it is said to be asymmetrical flower. eg. Canna.

- The part of flower which lies near to the mother axis is posterior part while the part which is far from the mother axis is anterior part of flower. The position of the mother axis with respect to the flower is represented by a dot on the top of the floral diagram.

- In some flowers like lily, the calyx and corolla are not distinct and are termed as perianth. When a flower has both androecium and gynoecium, it is bisexual. A flower having either only stamens or only carpels is unisexual

Attachment of flower:

Sessile: When pedicel is absent. e.g. Morus, Adhatoda.

Pedicellate: When pedicel is present e.g. Dianthus.

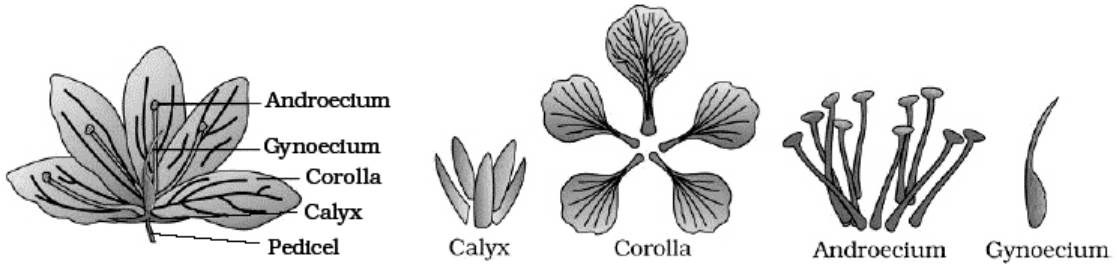


Figure: Parts of a flower

Symmetry:

(a) **Actinomorphic (Radial):** When a flower can be divided into two equal radial halves in any radial plane passing through the centre. It is said to be actinomorphic, e.g. Mustard, Datura, Chilli.

(b) **Zygomorphic (Bilateral):** A flower which can be divided into two equal vertical halves by one plane only is called zygomorphic flower. e.g. Pea, Gulmohur, Bean, Cassia.

(c) **Asymmetrical (irregular):** A flower which cannot be divided in to two equal parts by any vertical plane is known as acyclic or asymmetric flower. e.g. Opuntia, Canna.

TYPES OF FLOWERS ON THE BASIS OF INSERTION OF FLORAL LEAVES

The relative position of gynoecium changes with respect to floral parts. Based on the position of calyx, corolla and androecium in respect of the ovary on thalamus, the flowers are divided into three types.

1. **Hypogenous flower -** When gynoecium occupies the highest position while the other parts like petals, sepals and stamens are situated below the ovary, then the flower is called

hypogynous and in this condition ovary will be superior. eg. Mustard. china rose. brinjal, mango.

2. **Perigynous flower -** In it thalamus grows upwardly and form a cup shaped structure. On the margin or rim of thalamus floral parts are attached except gynoecium, which lies at-the basal part or in the centre. So in this condition gynoecium is situated below the other floral parts. But ovary in this condition is said to be half inferior. Eg. Rose. plum. peach.

3. **Epigenous flower -** When the margin of thalamus grows upward enclosing the ovary completely and getting fused with it and other parts of flower like petals, sepals & stamens are situated above the ovary, then the ovary is said to be inferior and rest of the floral parts superior. Eg. Guava, apple, cucumber and the rayflorets of sunflower.

BRACT

Bract is a reduced leaf found at the base of the pedicel of flower.

Bracteate flower - The flower with bract is called bracteate flower.

Ebracteate flower - Flower without bract is known as ebracteate flower.

Involucre - The whorl of bracts is called involucre.

Spathe - When large bract completely encloses whole inflorescence, then it is called spathe.

Eg. Banana, maize

Petaloid bract - When the size of bract is greater than the size of flower and it is of various coloured like petals, then it is called petaloid bract. Eg. Bougainvillea.

Glumes - Small, dry, scaly bracts are called glumes. Eg. Wheat, grass (Gramineae family).

Number of floral parts:

(a) **Bimerous or Dimerous:** Two or multiple of two parts in each type of floral organs. **e.g. Poppy.**

(b) **Trimerous:** Three or multiple of three parts in each type of floral organs. **e.g. Onion, Argemone.**

(c) **Tetramerous:** Four or multiple of four parts in each type of floral organs. **e.g. Mustard.**

(d) **Pentamerous:** Five or multiple of five parts in each type of floral organs. **e.g. Solanum nigrum.**

PARTS OF THE FLOWER

CALYX -

The outermost whorl of flower is called calyx. Each member of this whorl is called sepal, when all the sepals are free from each other, then it is called polysepalous condition eg. Mustard, radish. When the sepals are fused (united) with each other then this condition is called gamosepalous condition. Eg. Cotton, Datura, brinjal.

- Sepals are green leaf like and protect the flower in the bud stage.
- In calyx of Mussaenda, one of the sepal enlarges and forms a leaf like structure. It may be brightly coloured. It attracts the insects and thus acts as advertisement flag/advertising flag.
- In Trapa, Calyx is modified into spines and helps in protection of fruits.
- In the family of sunflower (compositae) sepals are modified into hairy structure which is known as pappus. The pappus is modified calyx and helps in dispersal of fruit by parachute mechanism.
- If sepals do not fall and remain attached to fruit, then they are called persistent sepals.
  Eg. Tomato, chilli, brinjal, cotton, Datura

COROLLA:

- Corolla is composed of petals. Petals are usually brightly coloured to attract insects for pollination. Like calyx, corolla may also be gamopetalous (petals united) or polypetalous (petals free)
- The shape and colour of corolla vary greatly in plants. Corolla may be tubular, bellshaped, funnel-shaped or wheel-shaped.

Aestivation:

The mode of arrangement of sepals or petals in floral bud with respect to the other members of the same whorl is known as aestivation. It is of following types.

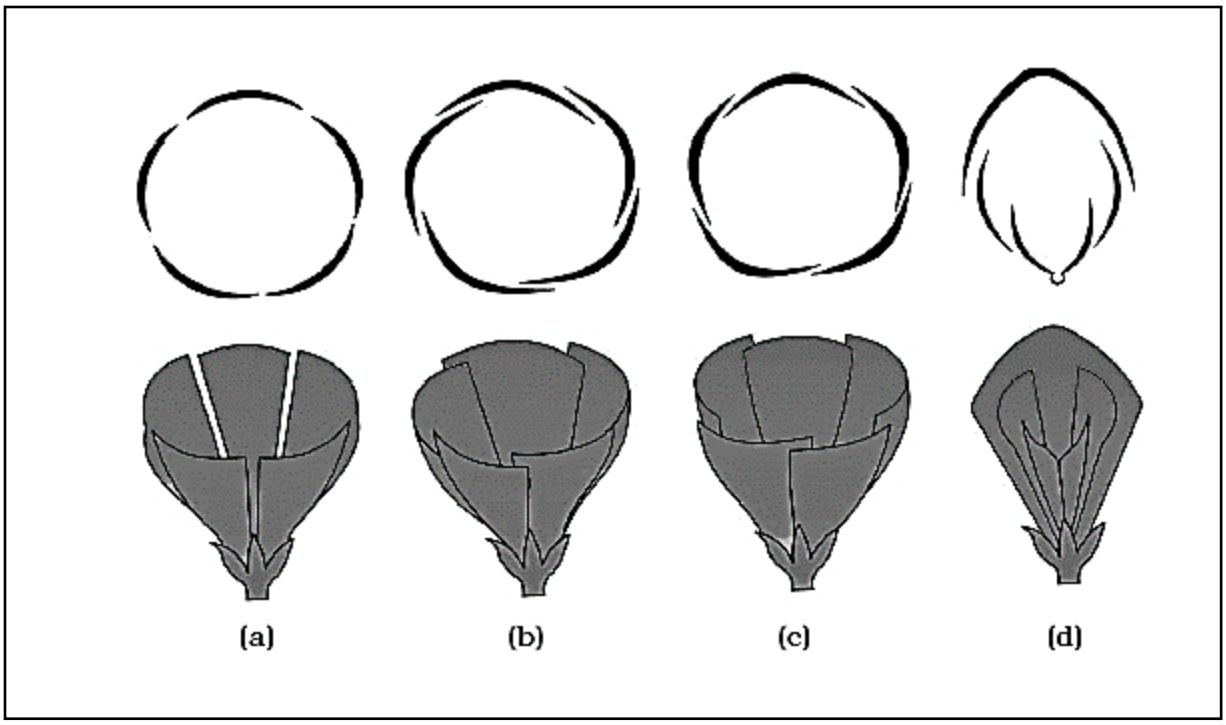


Fig.: Types of aestivation in corolla : (a) Valvate (b) Twisted (c) Imbricate (d) Vexillary

(i) **Valvate:** Margins of adjacent petals touch each other without overlapping.
e.g. Mustard, Calotropis

(ii) **Twisted or contorted:** One margin of a petal overlaps regularly the margin of an adjacent petal and vice versa. **e.g. China rose, Lady's finger and Cotton (Malvaceae family).**

(iii) **Imbricate:** One petal External one internal and in the remain three petals; one margin external while their other margin is internal or margins of sepals or petals overlap one another but not in any particular direction. **e.g. Cassia, Gulmohur.**

(iv) **Vexillary/Descending imbricate/Papilionaceous:** In which posterior petal **(standard)** overlapping the two lateral petals **(wings)** the latter overlapping the two anterior petals **(keel)**. **e.g. Pea, Beans.**

ANDROECIUM:

It is composed of stamens. When the stamens of an androecium are free from one another, then it is called polyandrous condition,

COHESION OF STAMENS:-

When the floral parts of similar whorl are fused, then it is called cohesion.

(1) When stamens are united by their filaments only, then it is called Adelphi. It is of following types-

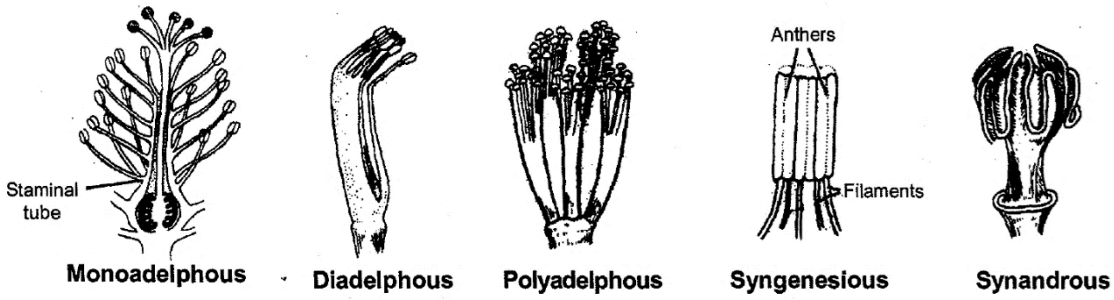
(a) **Monoadelphous -** In this type of cohesion all the filaments are united into a single bundle or one bunch but anthers remain free. In this type of cohesion a tube is formed around the gynoecium which is called stamina tube Eg. China rose (Malvaceae family).

(b) **Diadelphous -** In this type of cohesion filaments are united into two bundles but the anthers remain free Eg. Pea (Papilionatae). In these plants out of 10 stamens, 9 stamens are united into a bundle while 1 stamen remains free.

(c) **Polyadelphous -** Filaments are united into more than two bundles. Eg. Citrus.

(2) **Syngenesious -** Only anthers are united in bundle, but filaments remain free eg. Compositae family.

(3) **Synandrous -** Anthers as well as filaments of stamens are united through their whole length. Eg. Colocasia, Alocasia, Cucurbitaceae family.



ADHESION OF STAMENS -

When the stamens are attached to other parts of flower, then it is called adhesion of stamens. I

(1) **Epipetalous -** Stamens are attached to the petals. Eg. Brinjal. (Solanaceae)

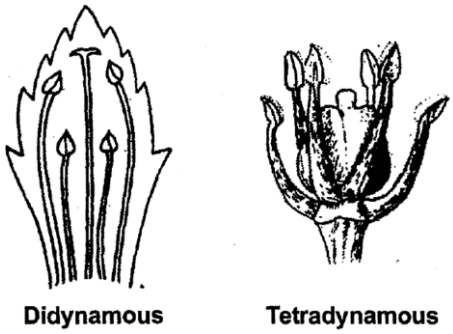
(2) **Epiphyllous or Epitepalous -** Stamens are attached to the tepals (perianth) . Eg. Lily. (Liliaceae)

(3) **Gynandrous -** Complete stamens or only anthers are attached to the gynoecium. Eg. Calotropis, Aristolochia

LENGTH OF STAMENS –

There may be a variation in the length of filaments within a flower. as in Salvia and mustard.

(1) **Didynamous -** If four stamens are present and out of them two are long and two are short, then it is called didynamous condition. Eg. Lamiaceae/Labiatae family (Salvia)



(2) **Tetradynamous -** When there are six stamens and they are arranged in two whorls. In outer whorl, there are two short stamens while in inner whorl, there are four long stamens, this condition is called tetradynamous.

Eg. Cruciferae family (Mustard, radish, turnip) .

ATTACHMENT OF FILAMENT TO THE ANTHER:

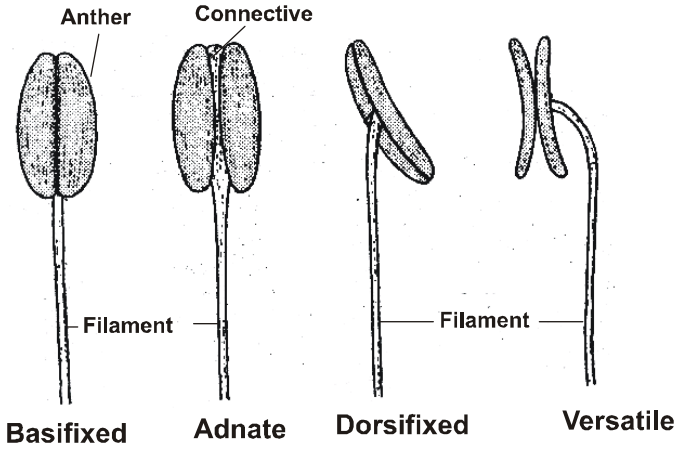


Fig :- Types of Attachment of filament to the anther

(1) **Dorsifixed:** The filament is firmly fixed to the back of the Anther. **e.g. Bauhinia variegata.**

(2) **Basifixed:** The filament is fixed to the base of the Anther. **e.g. Mustard.**

(3) **Adnate:** The filament Joints throughout the length of the Anther. **e.g. Ranunculus, Magnolia, Nymphaea.**

(4) **Versatile:** The filament is attached to the back of the anther and the anther can swing freely. **e.g. Grasses (Graminae family).**

GYNOECIUM:

- It is female reproductive organ of flower and is made up of one or more carpels.

CARPEL:

- It is a structural unit of **gynoecium**. It consists of **swollen ovary, a stalk like style and terminal receptive part stigma.**
- Sterile & undeveloped pistil is known as **pistillode.**
- When **gynoecium** bears **only one carpel**, it is called **Monocarpellary (Papilionaceae), two- bicarpellary (Solanaceae), three- tricarpellary (Liliaceae), many-polycarpellary.**

COHESION OF CARPELS:

(i) **Apocarpous:** Carpels free. **e.g. Ranunculus, Rose, Lotus, Michelia (AIPMT-2012).**

(ii) **Syncarpous:** Carpels more than two and fused. **e.g. Most of the plants - mustard, tomato, Poppy**

NUMBER OF LOCULES:

- Ovary has locules and may be unilocular, bilocular, trilocular, tetralocular, pentalocular or Multilocular.

PLACENTATION:

- **Each ovary bears one or more ovules attached to a flattened, cushion-like placenta.**
- **The arrangement of ovules** on placenta **with in the ovary is called placentation.**

IT IS OF FOLLOWING TYPES.

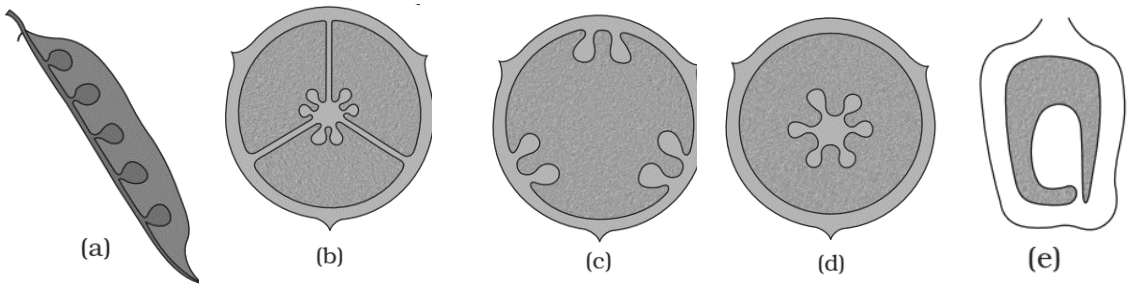


Fig. Types of placentation : (a) Marginal (b) Axile (c) Parietal (d) Free central (e) Basal

1. **Marginal:**

   In marginal placentation the placenta forms a ridge along the ventral suture of the ovary and the ovules are borne on this ridge forming two rows e.g. Pea, Cassia, Acacia.

2. **Parietal:**

In parietal placentation, the ovules develop on the inner wall of the ovary or on peripheral part. Ovary is one-chambered but it becomes two chambered due to the formation of the false septum, e.g., mustard and Argemone.

3. **Axile placentation:**

- It is found in syncarpous pistils.
- The ovary is partitioned into two or more chambers.
- **When the placenta is axial and the ovules are attached to it in a multilocular ovary, the placentaion is said to be axile. e.g. Potato, Tomato, China rose, Lemon.**
- **Free central:** The pistil is polycarpellary and syncarpous but the ovary is unilocular.
- **When the ovules are borne on central axis and septa are absent e.g. Dianthus, Primrose.**

4. **Basal:**

Ovary is unilocular and **the placenta develops at the base of ovary and a single ovule is attached to it. e.g. Sunflower, Marigold.**

Thalamus:

- It is the swollen and broaden part of flower, which lies at the tip of pedicel and bears floral organs.
- Thalamus is similar to a dwarf shoot in which growth is definite and the internodes are very short.Rarely internodes become elongated as –

(i) **Anthophore :** Internode between calyx and corolla is elongated. **e.g. Silene.**

(ii) **Androphore :** Between corolla and Androecium. **e.g. Passiflora.**

(iii) **Gynophore :** Between androecium and Gynoecium. **e.g. Capparis.** Sometimes the thalamus is prolonged into gynoecium to form central axis called **Carpophore. e.g. Coriander.**

(iv) **Androgynophore or Gynandrophore :** When gynophore associate with androphore eg. Cleome gynandra (Gynandropsis).

IMPORTANT POINT

ARRANGEMENT OF FLORAL ORGANS:

- Aestivation is also considered in calyx and Perianth.
- **Quincuncial :** Two petals external, Two internal, and fifth with one margin external while its other margin is internal. **e.g. Duranta**. (It is considered as a type of imbricate aestivation).

- **Epicalyx :** It is a whorl of 5-8 bracteoles outside to the calyx, which are green sepals like floral organs. They provide protection to the other floral organs. **e.g. Malvaceae and Rosaceae.**
- **Perianth :** When there is no distinction of sepals and petals then they are collectively called perianth. Each part of perianth is called tepal. **e.g. Lily.**
- **Seploid :** When perianth is green and as sepal like. **e.g. Asphodelus.**
- **Petaloid :** When perianth is coloured as petals. **e.g. Date palm.**
- **Monocarpic plant** : The plant which produces flowers and fruits only once in life. **e.g. Annual plants, Bamboo.**
- **Polycarpic plant :** The plant which produces flowers and fruits many times in life. **e.g. Mango, pear.**

STYLE:

On the basis of origin, style is of three types.

(1) **Terminal :** It originates from tip of ovary. **e.g. Petunia.**

(2) **Lateral :** Arising from side of ovary. **e.g. Mango.**

(3) **Gynobasic -** Arising from mid basal part of ovary. **e.g. Salvia, Ocimum.**

STIGMA:

It is a part of Gynoecium, which receives pollen grains. It is of following types

(i) Capitate	**(ii) Discoid**	**(iii) Plumose**
(iv) Bifid	**(v) Knob like**	**(vi) Drum-shaped**
(vii) Dumbell shaped	**(viii) Dome shaped**	**(ix) Sticky**
(x) Linear	**(xi) Radiate hood like.**	

- When the different parts of each series of a flower are similar in size, shape, colour and origin then the flower is known as Regular flower.
- When a flower shows any irregularity in any types of its floral organs, whether in size, shape, colour or origin is termed as irregular flower.
- Lotus or Nelumbo nucifera is National flower of India.
- Longest style is present in Maize or Zea mays.
- Obdiplostemonous: - Stamens occur in two whorls out of them outer whorl is opposite to petals while inner whorl is alternating with petals. e.g. Spergula, Stellaria.
- Diplostemonous: Stamens occurs double the number of petals and present in two whorls. The outer whorl is alternating with petals while inner whorl is opposite to petals eg. Cassia.