POLLINATION AND FERTILIZATION

DSE-2
UNIT-5

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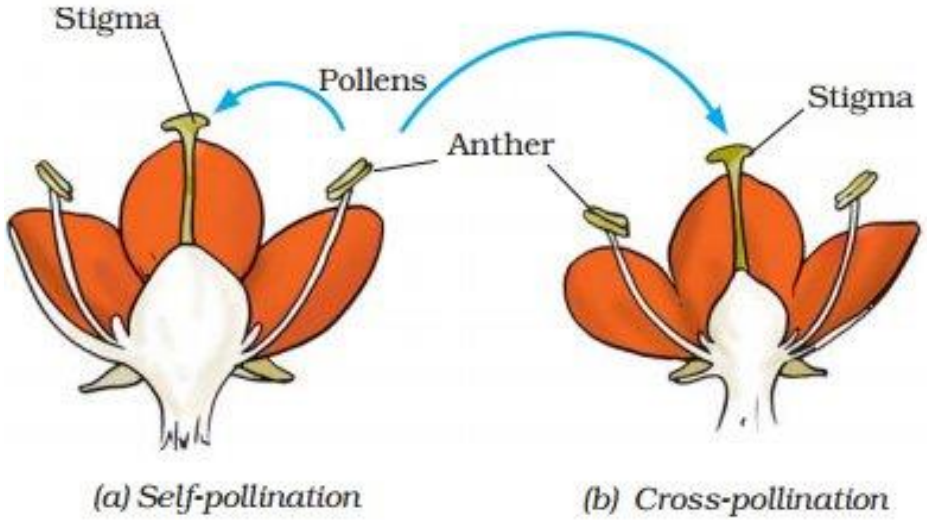
Unit 5: Pollination and fertilization:

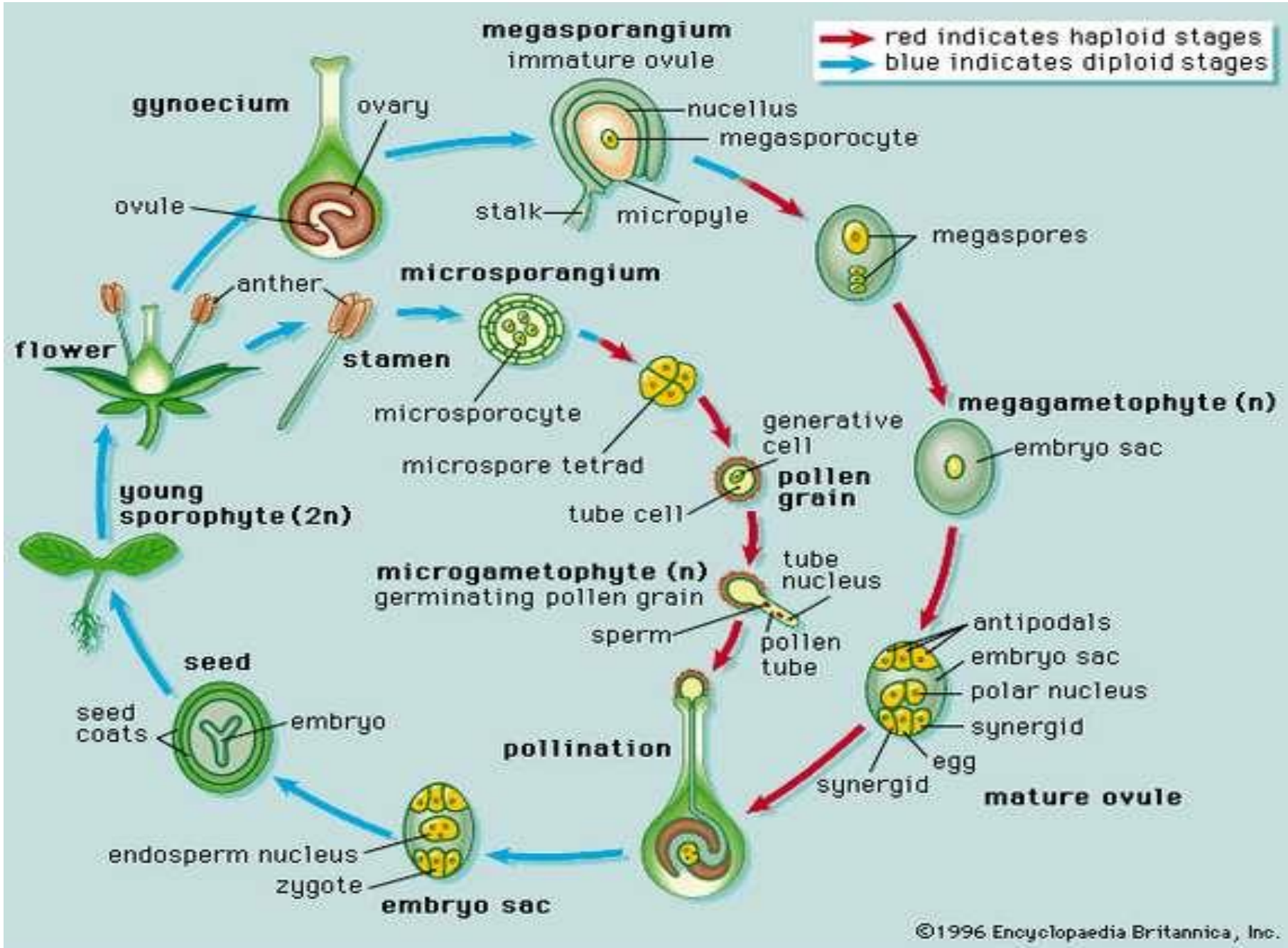
Pollination types and significance; adaptations.

Structure of stigma and style; path of pollen tube in pistil; double fertilization.



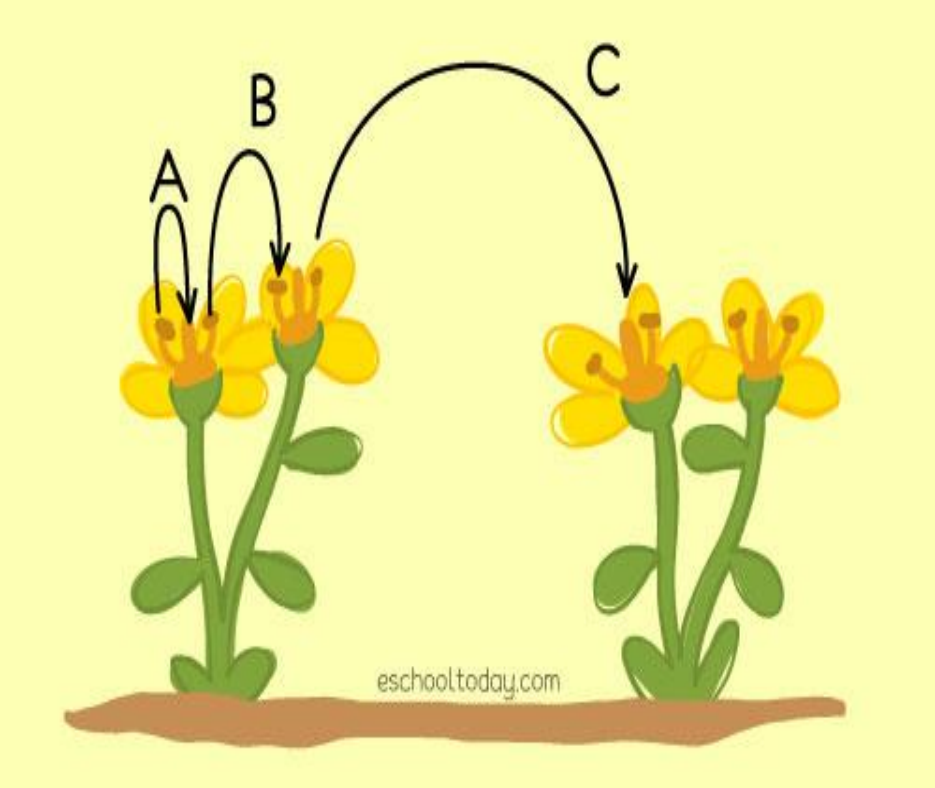
Pollination in flower

life cycle of Angiospermic plants



Pllination

- The transfer of pollen grains from the opened anther of the stamen to the receptive stigma of the carpel/pistil is called pollination.
- Effective pollination involves the transfer of pollen from the anthers to a stigma of the same species and subsequent germination and growth of the pollen tube to the micropyle of the ovule.



Types:

1. Autogamy
2. Geitonogamy
3. Xenogamy

Types of Pollination

Depending upon the source of pollen grain, pollination is of three types:

1. Autogamy (Self-pollination):

It is the kind of pollination in which the pollen from the anthers of a flower is transferred to the stigma of the same flower, e.g., wheat, rice, pea, etc.

Autogamy is further classified as:

(i) Cleistogamy In some plants, flowers never open up and the anthers dehisce inside these closed flowers to ensure pollination. Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross-pollination. e.g., Oxalis, Viola, etc.

(ii) Homogamy In this method, both the anthers and the stigma mature at the same time, e.g., Mirabilis.

Types of Pollination

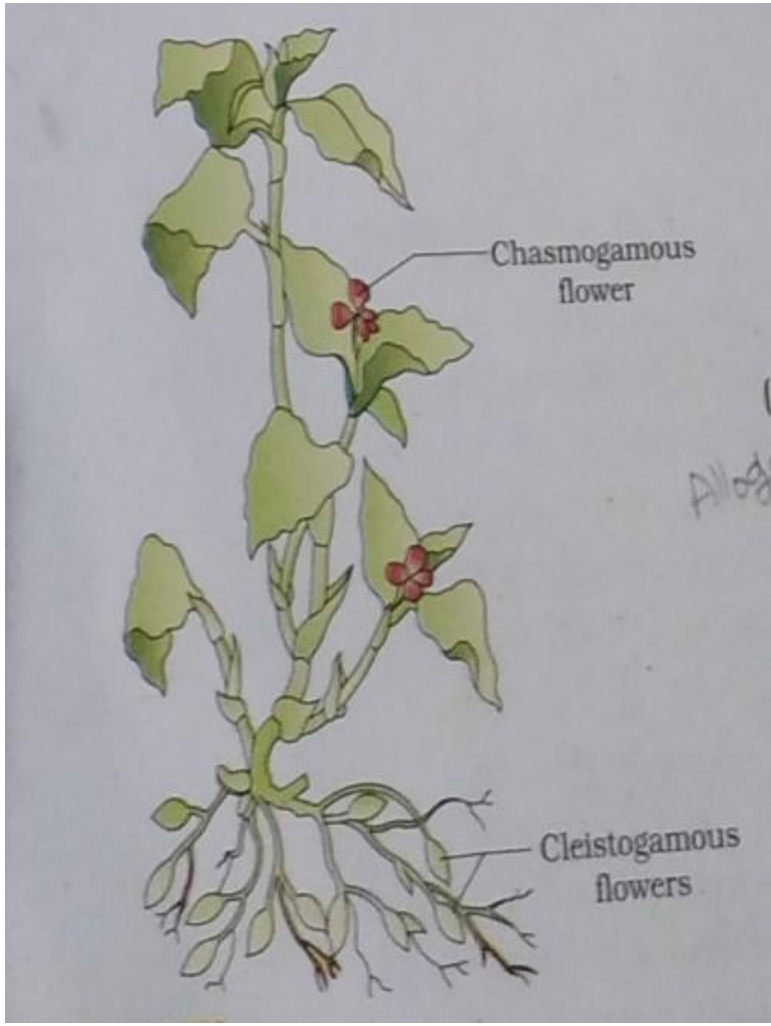
Cleistogamy is of two types:

a. Obligate or Habitual Cleistogamy:

The flowers are typically cleistogamous and never open, e.g., small underground flowers of *Commelina benghalensis* of Commelinaceae etc.

b. Facultative or Pseudo-Cleistogamy:

The flowers remain open for a short period of time and then they become closed permanently, e.g., sundew, *Drosera burmanii* of Droseraceae, *Oxalis corniculata* of Oxalidaceae, *Portulaca oleracea* of Portulacaceae etc.



Types of Pollination

2. Geitonogamy:

It is a kind of pollination where the pollen grains from the anther of the flower are transferred to the stigma of another flower borne on the same plant but at different branches.

It usually occurs in plants, which show monoecious condition, e.g., Cucurbita.

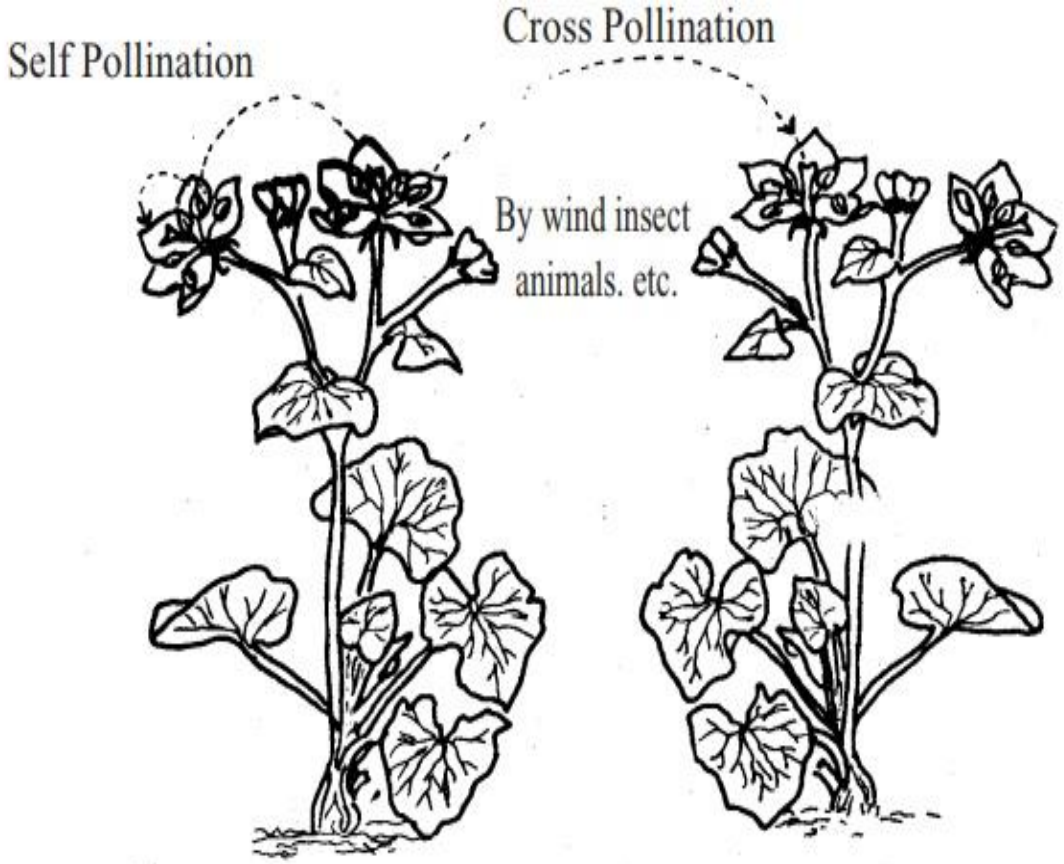
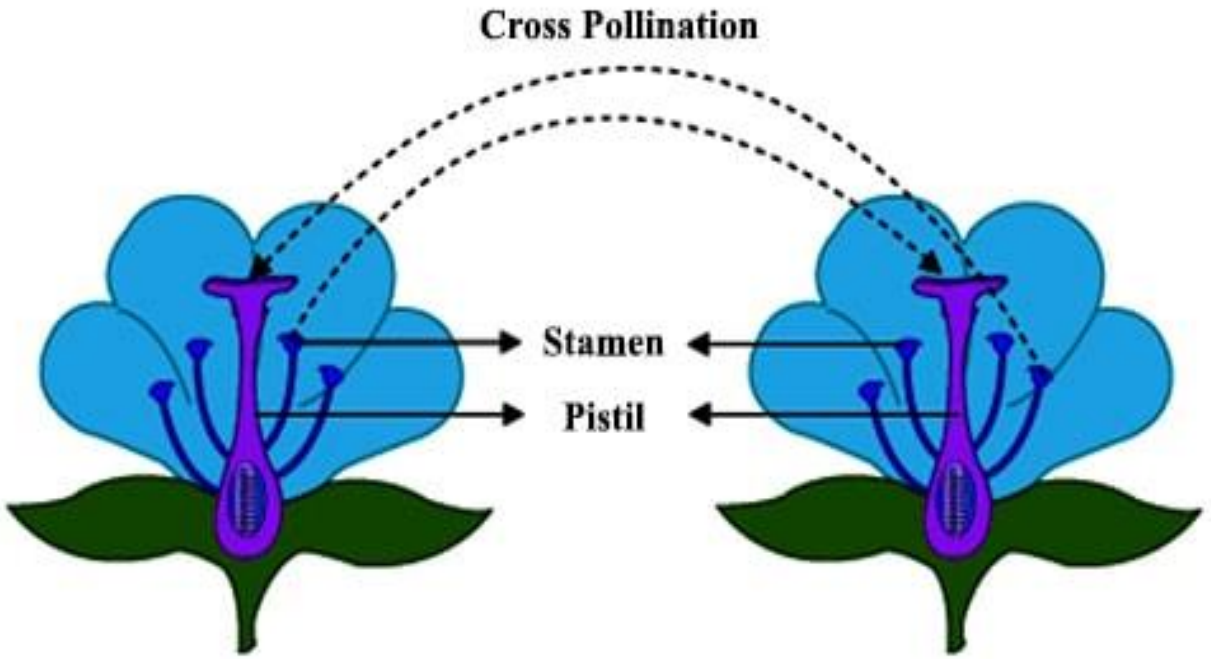


Fig. 11.1 Self-Pollination and Cross-Pollination

Types of Pollination

3. Xenogamy (Cross-Pollination):

It involves the transfer of pollen grains from the flower of one plant to the stigma of the flower of another plant. This is the only type of pollination which brings genetically different types of pollen grains to the stigma during pollination, e.g., papaya, maize, etc.



Advantages and Disadvantages of Self Pollination

Advantages:

1. The purity of the race is maintained through self-pollination.
2. The wastage of pollen grain is negligible.
3. Chances of failure of pollination are very less.

Disadvantages:

1. The production of new species and varieties is inhibited.
2. Due to continued self-pollination for several generations, the progeny becomes weak.

Advantages and Disadvantages of Cross-Pollination

Advantages:

1. Cross-pollination is useful in improving the crop and also for production of new varieties of different crops like fruits, vegetables etc.
2. The offsprings become more healthy and strong.
3. The production of more viable seeds is increased.
4. The plants are better adapted in the nature.

Disadvantages:

1. Pollination is uncertain, because it depends on external agencies like wind, insects, water etc.
2. The wastage of pollen is much more as it depends on external agents. Wastage of pollen is more in anemophily (wind pollination) than other types.
3. The wastage of energy is much more.

Contrivances for Cross-Pollination

Contrivances for Cross-Pollination

There are several devices which ensure cross-pollination:

1. Dicliny or Unisexuality:

When unisexual (diclinous) flowers i.e., staminate or male flowers and pistillate or female flowers are borne on the different plants of the same species (dioecious plant), then the cross- pollination is a must.

e.g., *Bryonia dioica* and *Trichosanthes dioica* of Cucurbitaceae; *Carica papaya* of Caricaceae; *Borassus flabellifer* of Arecaceae etc.

Contrivances for Cross-Pollination

2. Dichogamy:

In some bisexual flowers, the stamens and carpels do not mature at the same time, thereby the self-pollination becomes hindered.

It is of two types:

a. Protandry or Proterandry:

The anthers of a flower mature earlier than the carpels, e.g., Leonurus sp. of Lamiaceae (Labiatae), Helianthus annuus of Asteraceae (Compositae), Hibiscus sp. of Malvaceae etc.

b. Protogyny or Proterogyny:

The carpels of a flower mature earlier than the anthers, e.g., Magnolia grandriflora and Michelia champaca of Magnoliaceae, Pedilanthus tithymaloides and Poinsettia pulcherrima of Euphorbiaceae etc.

Contrivances for Cross-Pollination

3. Self-sterility or incompatibility:

In this condition, the pollen grains are not able to fertilise the ovule of the same flower as they failed to germinate on the stigma, e.g., Reseda odorata of Resedaceae, a few fruit trees of Rosaceae, Solanum tuberosum of Solanaceae, Passiflora sp. of Passifloraceae etc.

Contrivances for Cross-Pollination

4. Herkogamy:

In some flowers, due to some physical barriers between anther and style, the pollination becomes impossible. In orchids and members of Asclepiadaceae like Calotropis procera, where the pollens are aggregated in pollinia, the pollination is completely depends on the mercy of the insects. Due to the extrorse anthers in Gloriosa superba of Liliaceae, the pollens become out of reach of its own stigma.

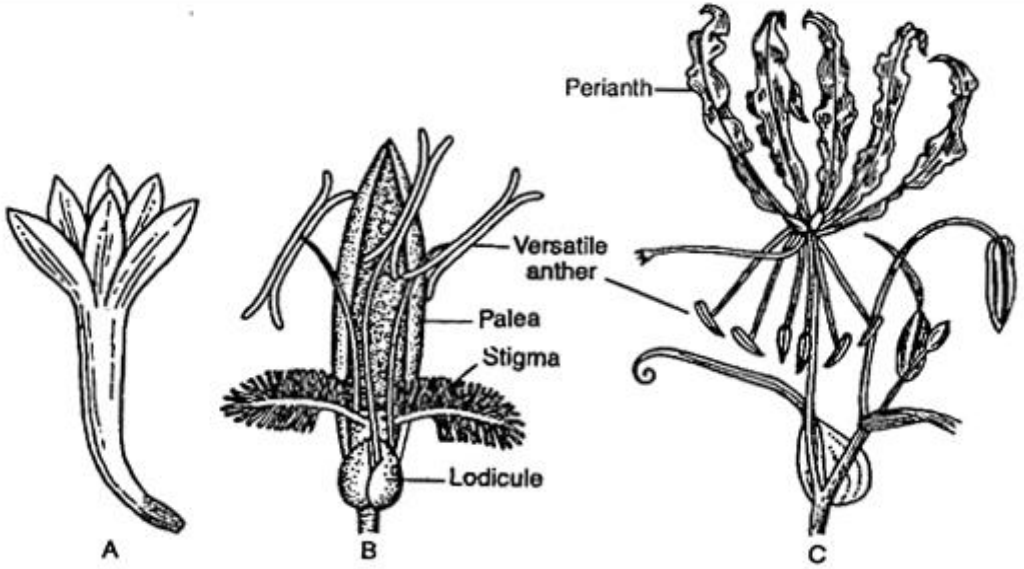


Fig. 2.120 : Perianths of different kinds : A. Petaloid perianth of tuberose, *Polyanthes tuberosa*, B. Flower of *Festuca pratensis* showing lodicules on removal of lemma, and C. Flower of *Gloriosa superba* showing petaloid polyphyllous perianth

Contrivances for Cross-Pollination

5. Heteromorphism:

In some plants, the flowers are of two (dimorphic) or three (trimorphic) different forms having anthers and stigmas developed at different levels.

The di- or trimorphism usually involves heteroanthy (i.e., anthers of different types) and heterostyly (i.e., styles of different lengths). Thus, the cross-pollination takes place between stamens and stigmas of same length.

Contrivances for Cross-Pollination

a. Dimorphism:

The dimorphism is found in Primula sinensis of Primulaceae, where one type having long stamen and a short style and the other having short stamen and a long style. It is also found in *Polygonum orientale* and *Fagopyrum esculentum* of Polygonaceae, *Biophytum sensitivum* of Oxalidaceae etc.

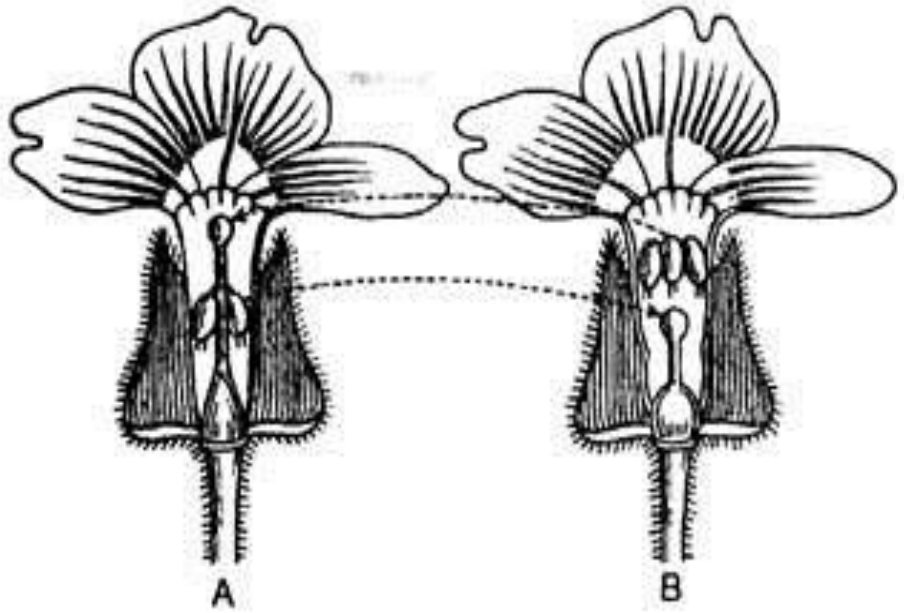


Fig. 2.147 : Dimorphic flowers of *Primula sinensis*

Contrivances for Cross-Pollination

b. Trimorphism:

The trimorphism is found in *Lythrum salicaria* of Lythraceae, where three different forms of flowers having short, long and medium sized stamens and styles. It is also found in *Oxalis corniculata* and *Averrhoa carambola* of Oxalidaceae, *Woodfordia Moribunda* of Lythraceae etc.

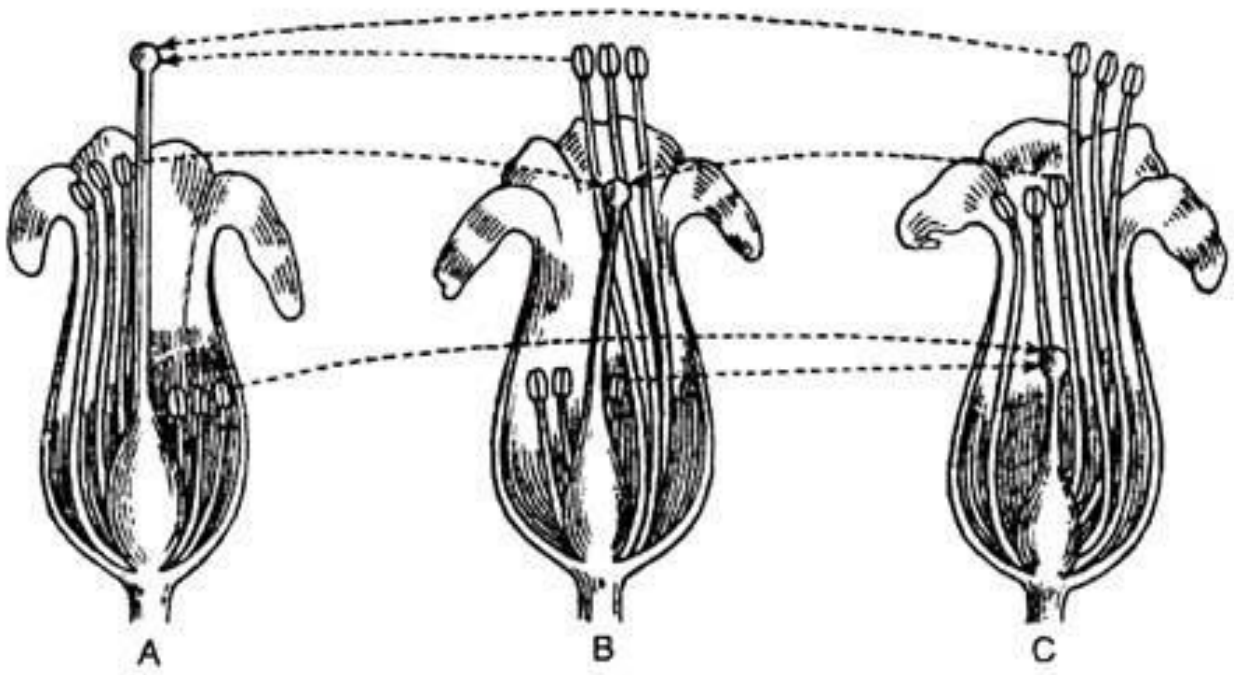
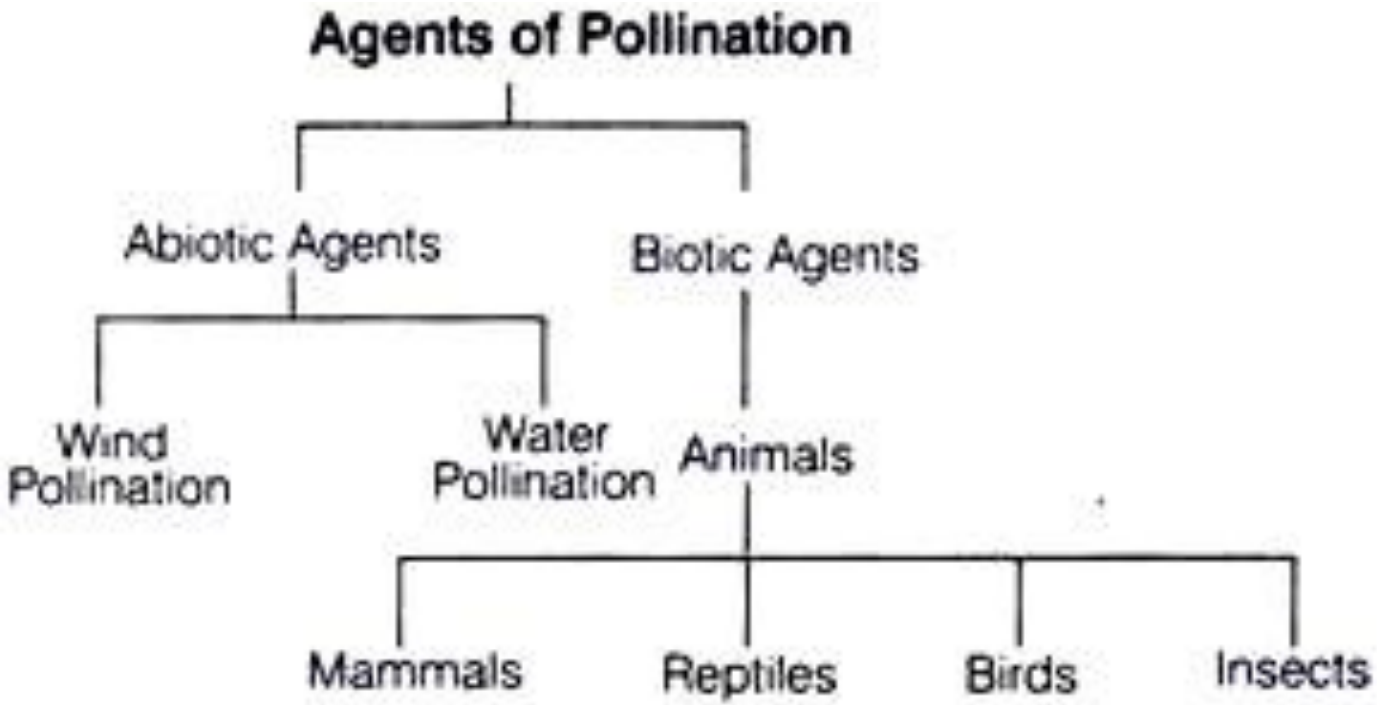


Fig. 2.148 : Trimorphic flowers of *Lythrum salicaria*

Agents of Pollination

- **The agents responsible for pollination in angiosperms have been grouped into two main categories.**



Pollination by Wind

Wind pollination is also termed as anemophily and takes place through the wind.

Adaptations for Wind Pollination

i. Flowers are small, colourless, inconspicuous, nectar less and become arranged as inflorescence.

ii. The anthers are well exposed for the easy dispersal of pollen grains.

iii. Pollen grains are small, light, dry, dusty, non-sticky and sometimes even winged.

iv. The stigmas are large, hairy and feathery or branched to catch the air borne pollen grains.

v. Common examples of wind pollinated flowers are grass, sugarcane, bamboo and coconut, etc.

Pollination by Water

The pollination with the help of water is called hydrophily or hydrogamy. It is of two types: a. Hypohydrogamy and b. Epihydrogamy.It is quite rare in flowering plants and is limited to about 30 genera, mostly monocotyledons.

a. Hypohydrogamy:

When the pollination takes place inside the water, it is called hypohydrogamy, e.g., *Najas sp*., *Ceratophyllum* sp. etc.

b. Epihydrogamy:

When pollination takes place on the water surface, it is called Epihydrogamy, e.g., *Vallisneria spiralis* (ribbon weed). In *Vallisneria*, the flowers are borne under water. After maturation, the pistillate flowers are brought to the surface by their long stalk and form a cup-like depression.

The male flowers get detached from the parent plant and float on the surface of water. If male flower gets lodged into the depression, pollination occurs. After pollination, the elongated stalk of the pistillate flower undergoes spiral coiling, thereby it again comes under the water.

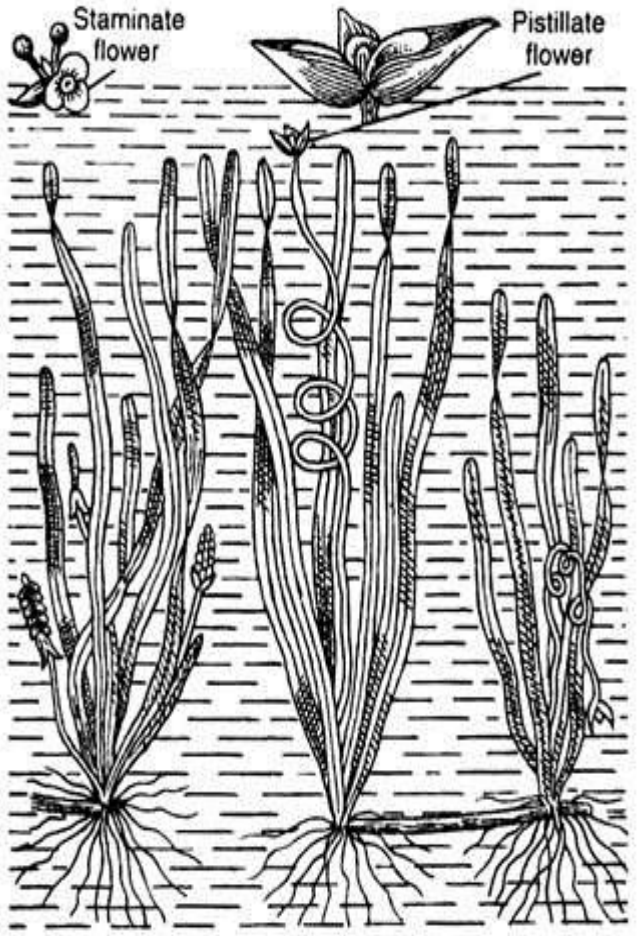


Fig. 2.149 : Pollination (epihydrogamy) in *Vallisneria spiralis*

Pollination by Water

Adaptations for Water Pollination:

i. Flowers are small, colourless, inconspicuous, odourless and nectar-less and pollen grains and stigmas are generally unwettable.

ii. The stigmas are long and sticky, e.g., Vallisneria, Hydrilla and Zostera.

iii. In most of the water pollinated species, pollen grains are protected by mucilaginous covering.

iv. In Vallisneria, the female flower reach the surface of water by the long stalk and pollen grains are released on to the surface of water. They are then carried by the passive water currents.

v. In a majority of aquatic plants, the flowers emerge above the level of water and are pollinated by insects or winds as in land plants, e.g., water hyacinth and lily.

Zoophily or Zoogamy or Zoidiophily

When pollination takes place with the help of animals, it is called Zoophily.

It is of the following types:

a. Entomophily or Entomogamy:

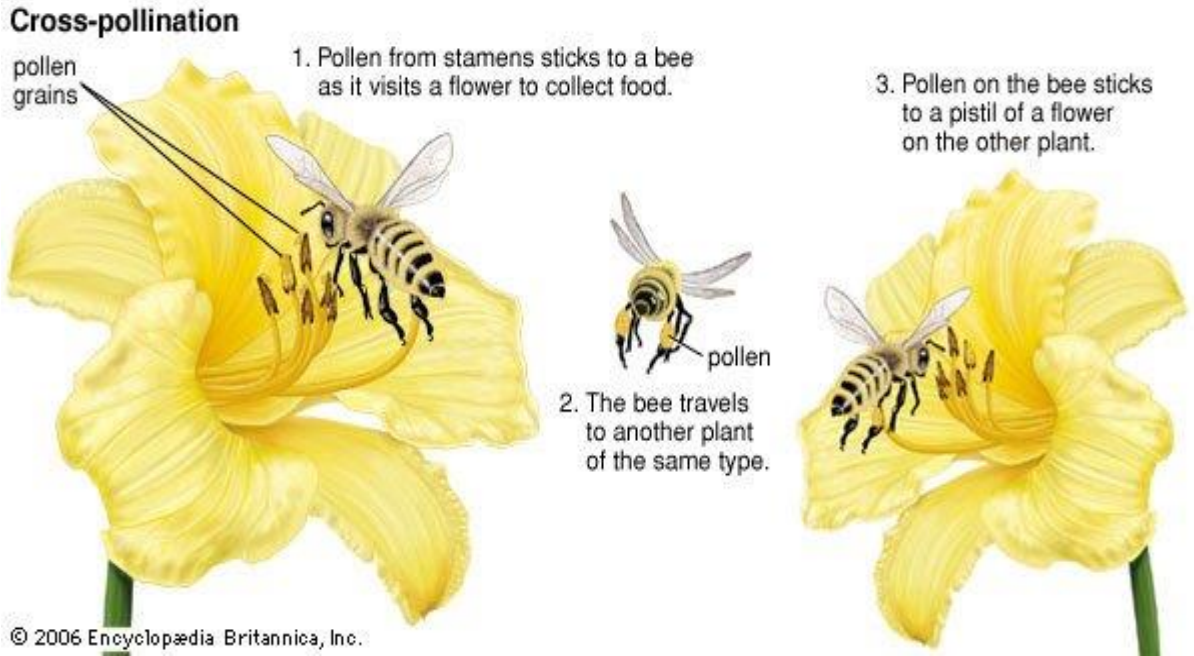
b. Malacophily or Malacogamy:

c. Ornithophily or Ornithogamy:

d. Chiropteriphily or Chiropterigamy:

Entomophily or Entomogamy

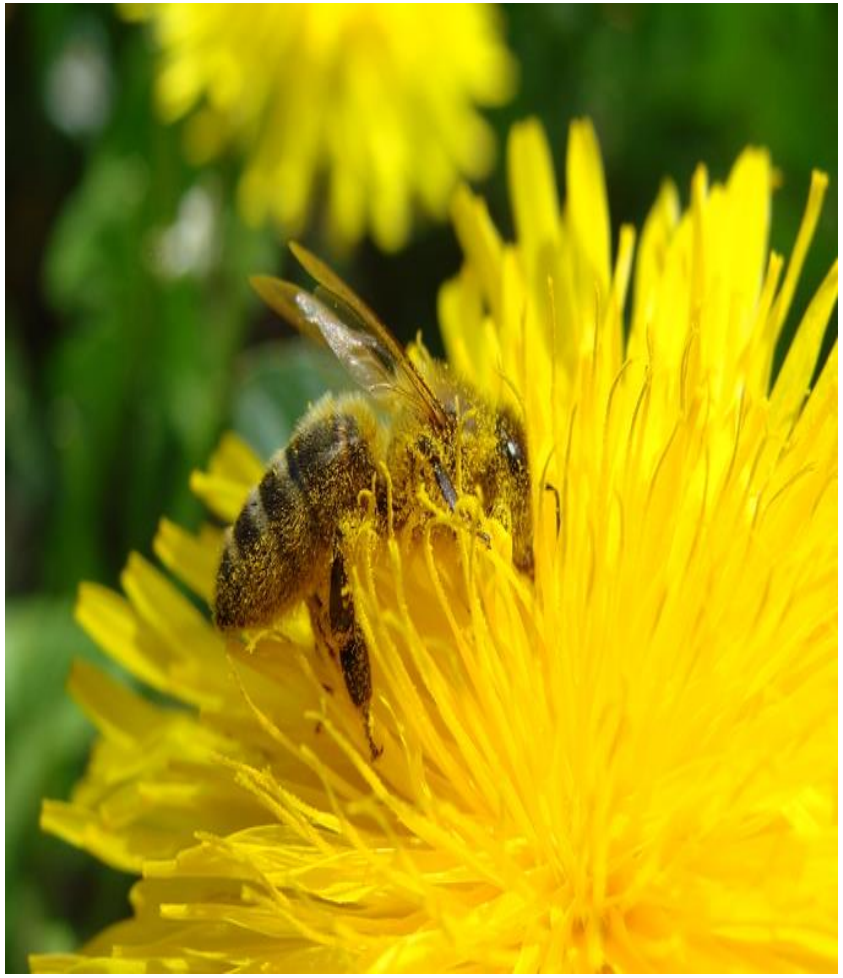
- When pollination takes place with the help of insects, it is called entomophily. The insects those help in pollination are bees, flies, beetles etc.
- The flowers which open during sunrise are generally brightly coloured, acting as flag apparatus for attracting insects. But the flowers those open after sunset are white in colour, thus become visible in night.
- Approximately, 80% of the pollination done by the insects is carried by bees.



Entomophily or Entomogamy

Adaptations for Insect Pollination:

1) Insect-pollinated flowers are large, colourful, fragrant and rich in nectar.
2) A number of flowers are clustered into an inflorescence to make them conspicuous.
3) Flowers have nectar glands and are highly fragrant to attract insects.
4) The surface of pollen grains is sticky due to exine layer and stigma is sticky due to mucilaginous layer.
5) Nectar and pollen grains are floral rewards for the insect pollinators.
6) In some species, floral rewards are to provide safe place to lay eggs, e.g., for the tallest flower of *Amorphophallus sp* (about 6 feet in height).



Malacophily or Malacogamy

When pollination takes place with the help of other animals like slugs, snails, squirrels etc., it is called malacophily.

During their visit from one tree to other, the slugs help in pollination.

Like wise, snails and squirrels also pollinate some aroid flowers.

Ornithophily or Ornithogamy

When pollination takes place with the help of birds, it is called ornithophily.

- **The ornithophilous flowers are very large and showy, those secrete profuse nectar within them, thereby some birds get attracted.**
- **The flower typically has a curved, tubular shape, which allows access for the bird's beak.**
- **The flowers are Brightly-colored, odorless that are open during the day.**

Ornithophily is visible in some flowers like *Bignonia capreolata* of Bignoniaceae, *Strelitzia reginae* of Musaceae, *Butea monosperma* of Fabaceae, *Bombax ceiba* of Bombacaceae etc

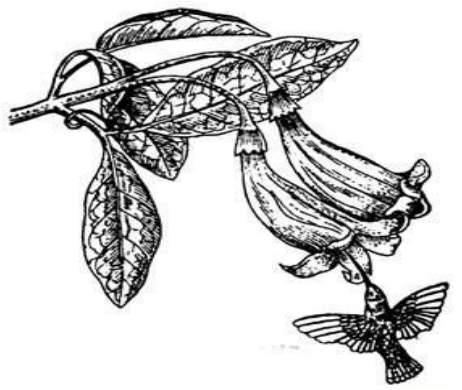


Fig. 2.150 : Pollination by humming bud during collection of nectar from *Bignonia capreolata* (After Bates)

Chiropteriphily or Chiropterigamy

When pollination takes place with the help of bats, it is called chiropteriphily.

- The flowers are usually large and white or pale-colored so that they can be distinguished from their dark surroundings at night.
- The flowers have a strong, fruity, or musky fragrance and produce large amounts of nectar.
- They are naturally-large and wide-mouthed to accommodate the head of the bat.
- As the bats seek the nectar, their faces and heads become covered with pollen, which is then transferred to the next flower.

The flowers of Bombax ceiba of Bombacaceae, Anthocephalous cadamba of Rubiaceae etc., are pollinated by bat.