CHAPTER 13

Pollination in Plants

PERFORMANCE OBJECTIVES

At the end of this chapter, students should be able to:

- define pollination.
- name and describe the different types of pollination.
- list the features that aid self-pollination.
- state the characteristics of wind- and insect-pollinated flowers.
- state at least five agents of pollination

INTRODUCTION

Pollination is the process by which pollen is transferred in plants from the anther of a flower to the stigma of the same flower or another flower of the same species. The process enables fertilisation and sexual reproduction to occur.

TYPES OF POLLINATION

There are two types of pollination.

(i) Self-Pollination

(ii) Cross-pollination (Allogamy)

SELF-POLLINATION

This is the process by which mature pollen grains are transferred from the anthers of a flower to the stigma of the same flower (autogamy) or other flowers on the same plant (cleistogamy). It is common in short-lived annual species and plants that colonise new areas.

CROSS-POLLINATION

This is the transfer of mature pollen grains from the anther of a flower to the stigma of a differ- ent flower of the same or closely related species. Examples include Hibiscus and Sunflower. This produces genetically stronger plants.

AGENTS OF POLLINATION (POLLINATORS)

Pollination is mediated commonly by living and non-living agents called

pollinators.

BIOTIC POLLINATORS

Examples include insects (entomophily), such as bees, flies, moths, butterfly, wasps and ants and vertebrates (zoophily), such as bats and birds, especially sunbirds, humming birds and honey eaters.

ABIOTIC POLLINATORS

Examples include wind (anemophily) and water (hydrophily). Only 10% of flowering plants are pollinated without animal assistance. Many plants show various structural adaptations, which relate them to each agent of pollination.

POLLINATION BY WATER: This occurs in aquatic habitats. The flowers release their pollen directly into surrounding water. A very small percentage, roughly 2% pollination occurs by water.

POLLINATION BY WIND: About 8% pollination occurs by wind. This occurs mainly in grasses, most gymnosperms (conifers) and many deciduous trees.

FEATURES OF CROSS- POLLINATED FLOWERS

Many flowers exhibit various features, which assist in making cross-pollination possible and self-pollination impossible. These features include xenogamy, hybridisation, unisexuality, dichogamy and self-incompatibility.
(i) Xenogamy: It is the transfer of pollen grains of a flower to the stigma of another flower situated on different parts of the same species.
(ii) Hybridisation: It is the transfer of pollen grains of a flower of one species to the stigma of a flower of a different species.
(iii) Unisexuality: This is a situation where the male and female flowers are borne on separate plants. Such plants are called dioecious plants, and only cross-pollination can occur, e.g., pawpaw.
(iv) Dichogamy: This is a condition in which male and female reproductive organs of a flower mature at different times. This usually prevents self-pollination. They can be protandry (male reproductive flower matures before the female one, e.g., sun flower, okara and cotton) and protogyny (female reproductive flower matures before the male one, e.g., palm).
(v) Self-incompatibility: The bisexual flowers of some species may bear mature stamens and carpels at the same time. However, the pollen grains fall on the stigma of the same flower or of flowers on the same plant but fail to fertilise; it is an inherited condition described as self-incompatibility, e.g., passion flower and tea.

FEATURES OF SELF-POLLINATED FLOWERS

Self-pollination occurs in bisexual flowers whose stamens and carpels ripen at the same time. Its main advantage is that it ensures that pollination occurs in such flowers.

However, its major disadvantage is that repeated self-pollination leads to the production of weakened individuals. The individuals produced seem to be less adapted to their environments than those produced by cross-pollination. Some of the conditions that favour self-pollination include the following:

(i) Cleistogamy: This is a condition in which ripe pollen grains are deposited on the stigma, which ripen later. This occurs among closed flowers, i.e., bisexual flowers, which never open at all.

(ii) Homogamy: This is a condition in which both anthers and stigma ripen at the same time.

Self-pollination occurs in plants where the male flowers are borne above the female ones in the following ways:

(i) A slight wind may blow ripened pollen grains from a mature anther onto any ripened stig- mas below.

(ii) Ripened pollen grains may be transferred to ripened stigmas of the same flower by an insect searching for pollen or nectar.

(iii) When mature, the stigmas are pushed out of the corolla tube. They may be brushed against the anther and collect the pollen on the longest filaments.

(iv) Where the filaments are longer than the stigmas, the filaments may recoil to touch the mature stigmas.

(v) Where the styles are longer than the filaments, the styles may bend to make the stigmas touch the anther.

FEATURES OF WIND- POLLINATED FLOWERS

Examples of wind-pollinated flowers include maize, rice, millet, grasses and sugarcane. Wind-pollinated flowers are also regarded as anemophilous flowers. They have the following features in common:

(i) The flowers are dull in colour. The perianth (i.e., calyx and corolla) is usually tiny, pale green and inconspicuous.

(ii) The sizes of the flowers are usually small and inconspicuous but they are often borne in large inflorescences, e.g., cereals, sugar- cane and coconut.

(iii) They have neither scent nor nectar.

(iv) They are not bilaterally symmetrical but are radically symmetrical.

(v) The stamens have pendulous and long filaments with loosely attached or versatile anthers, which can swing easily in the wind. Each explosive anther contains smooth pollen grains. Most of the pollens are liable to wastage, whereas only a small proportion may reach a receptive stigma.

(vi) The stigmas are usually large, branched and feathery. This feature provides a wide surface on which floating pollen grains may be caught. Styles are long and they project out of the flower. These assist in trapping any floating pollen in the air.

FEATURES OF INSECT-POLLINATED FLOWERS

Insect-pollinated flowers are also called ento- mophilous flowers. Many of them have the following characteristics:

- The petals of the flowers are usually brightly coloured. Other parts of the flower may be brightly coloured in some other plants, e.g., bract in Bougainvillea and poinsettia, or sepals as in Caesalpinia pulcherrima and Mussaenda or spathes as in bananas.
- The flowers are usually large and conspicuous. They may consist of small florets, which are grouped into a head as in the composites, e.g., sunflower. They may also be enclosed in a large and conspicuous inflorescence, e.g., Ixora and Salvia.
- Many have sweet smell or scents. Those that are pollinated at night tend to be more strongly scented to attract the nocturnal insects, e.g., moths.
- Insect-pollinated flowers, e.g., Hibiscus and flamboyant, have nectar – a sweet juice, which is the liquid food for many of the insect pollinators, e.g., honey bee, moth and butterfly.
- Each flower has a peculiar shape or complicated arrangement, as floral parts have mechanisms for moving the essential parts against the visiting insects, e.g., Crotalaria and Salvia. The arrangement in each flower ensures that pollen grains are released and made to rub off on the body of the insect, which in turn rubs the pollen on receptive stigmas on its visits, in many cases in search of nectar. Such insects include the bees and butterflies. Some flowers have long, narrow corolla tubes, e.g., moonflower and Jacaranda. Insects with long proboscis, e.g., moth and butterflies can only reach the nectar. Through the process, they spread the pollen grains on the stigma.
- The stamens are conspicuous. They occur in definite numbers. The anthers are relatively small, compact and firmly attached to the filaments. Mature anthers produce small quantities of pollen grains. The pollen grains are usually heavy, rough edged and spiky or sticky. These features ensure that wastage is greatly reduced. These also ensure that they are attached to a visiting insect.
- The stigmas are often flat, broad, lobed or rounded with sticky surfaces. The gummy nature helps pollen to be trapped easily on the stigmas.

The differences between wind-pollinated and insect-pollinated flowers are

listed below.

WIND-POLLINATED FLOWER	INSECT-POLLINATED FLOWER
Flowers are usually small and inconspicuous	Flowers are large and conspicuous
Petals are dull	Petals are brightly coloured
They have no scent and no nectar	Scent and nectar are usually present
Pollen is dry, light and smooth	Pollen is sticky, heavy and rough edged
Stigma is usually large and feathery	Surface of stigma is sticky, broad or rounded
Flowers have no special shape	Flowers have peculiar shapes, e.g., *Crotalaria* and *Salvia*

POLLINATION IN INSECT- POLLINATED FLOWER

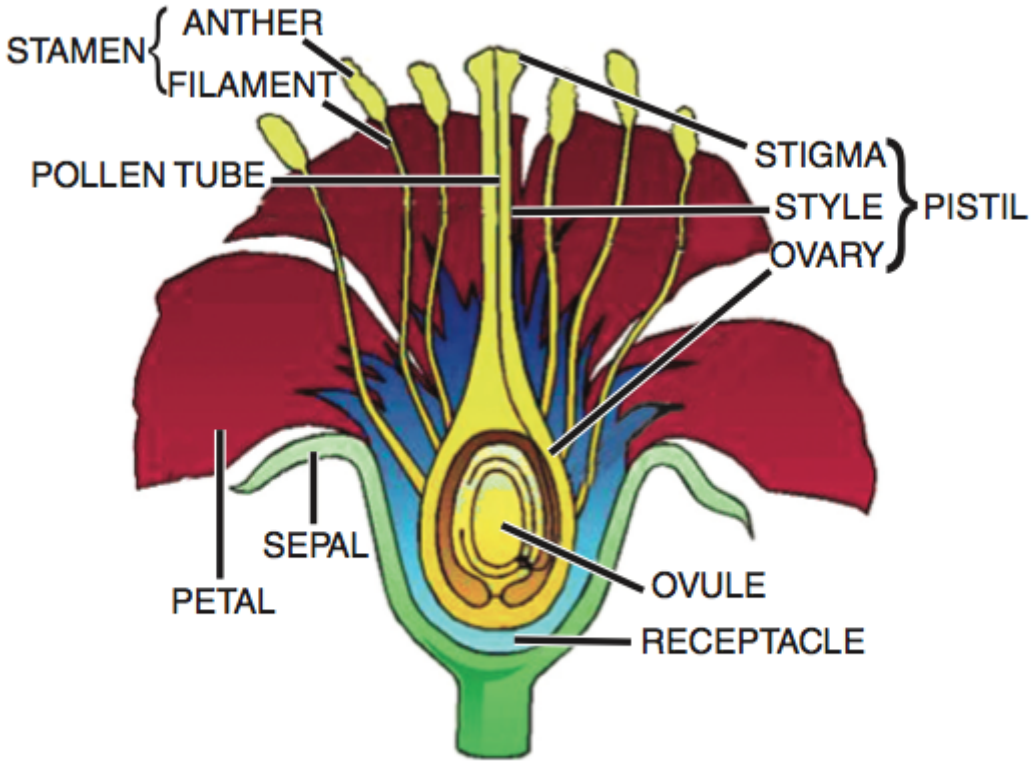
- POLLINATION IN FLAMBOYANT (DELONIX REGIA)

Its agent of pollination is a large butterfly with a long proboscis. The flower has a number of adaptive mechanisms for attracting the pollina- tor to it.

The flower has sweet smell and bright red coloured petals and sepals. The insectâ€™s atten- tion is further directed by a special petal or honey guide, the labellum. This stands upright from others, and it is more brilliantly coloured. The flower also has a nectar. In an attempt to reach this petal, to search for nectar, the insect lands on the stigma, which is sticky. The head or body, which is likely to be dusted with sticky pollen grains from the last flowers, rubs on the sticky protandrous stigma and thus pollination occurs.

As the butterfly tries to suck the nectar at the base of the petal with its proboscis, the body also gathers pollen grains from the flower. The insect

flies to another flower and deposits some pollen to affect cross-pollination. After this, the yellow petal curls over and so prevents further pollination.



▲ FIGURE 13.1 An insect-pollinated flower

POLLINATION IN CROTALARIA

Crotalaria is an insect-pollinated flower. It is a complete and irregular flower. It has a complicated structure. It consists of five brightly coloured pet- als, a standard petal, two side petals called wings and two anterior pairs of petals called keel.

The insect pollinator is the bee. It is attracted to the flower by its scent, presence of nectar as well as the bright colour of the petals. The flower is protandrous and cross-pollination occurs in it. The bee is initially attracted to the flower by the bright standard yellow petal. The insect lands on the wing petals.

The honey guidelines present in the standard petal direct it to the nectar. The keel becomes depressed by the weight of the bee on the wing. Through a narrow opening, the ripe sticky pollen grains are released from the stamens onto the hair on the under surface of the bee.

When the bee tries to reach the nectar below in another mature Crotalaria flower, the pollen grains on the hairy body of the bee gets rubbed off on the sticky stigma, which relatively pro- trudes longer than the stamens, thus

pollinating it. This usually occurs in an older related flower with mature stigma. After obtaining the nectar, the bee leaves the flower and the keel closes up to enclose the stigma.

POLLINATION IN WIND-POLLINATED

POLLINATION IN ANEMOPHILOUS FLOWERS

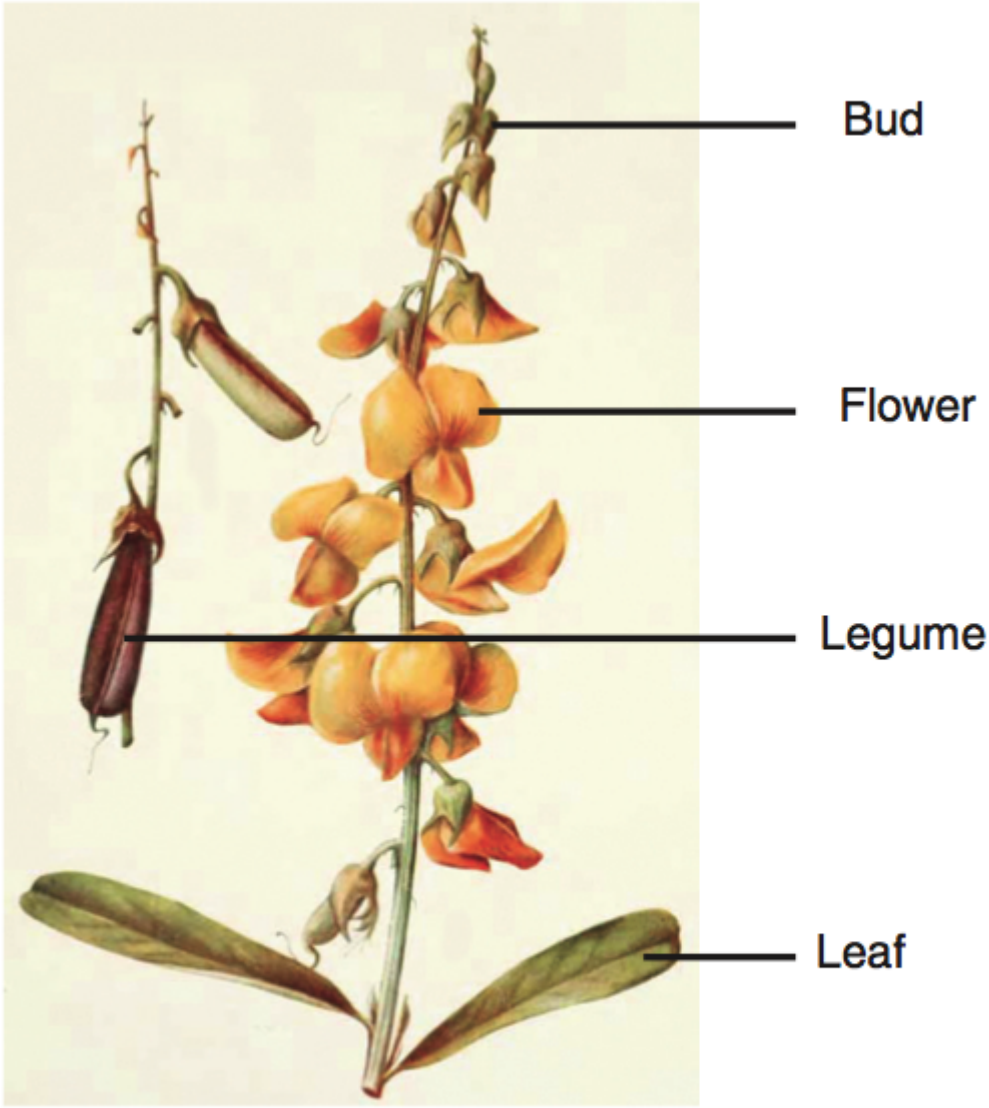
Maize (Zea mays) is an example of a wind-pollinated flower. It is dull and scentless and so it does not attract insect pollinators.

Maize plant bears both male and female flowers, i.e., it is monoecious. The male flower is terminal and it is borne above the female flow- ers, which are below it. The male flower exists in the much branched inflorescence called tassel. Female flowers are borne below the male flowers. They are found in the leaf axils. The female inflo- rescence is the cob, but it appears on the outside as a long, silky thread (the style). Neither the male nor the female flowers have petals or sepals. Both occur in pairs of one fertile and one sterile.

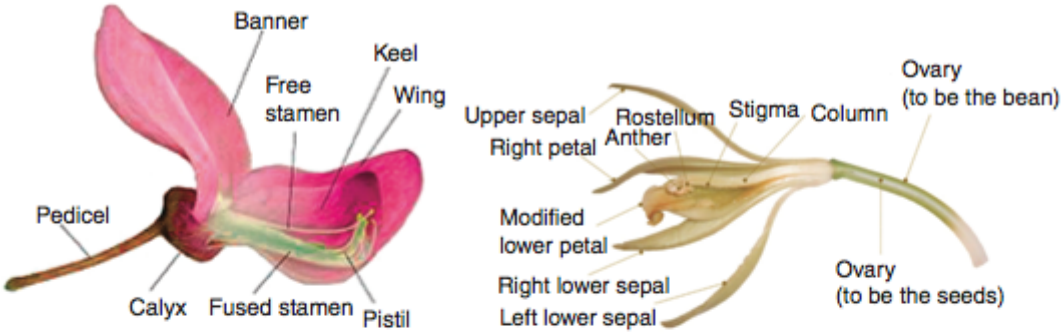
The male floret consists of two bracts (petals), three stamens with long, slender filaments and large anthers. These hang out of a pair of leaf- like glumes as the stamens ripen. Each anther is versatile and can reproduce large quantities of light pollen grains. In a maize plant, pollens are shed before the stigmas mature. Hence, cross- pollination is always occurring.

The female floret is enclosed by a pair of glumes. In addition, the fertile ones are further covered by a pair of pales. It consists of one car- pel that is made up of an ovary, a long silky style and a feathery stigma. It also has a pair of lodi- cules per female floret.

Lodicules swell to open the covering bracts (glumes and pales). The cloud of powdery pollen grains are shed and blown out of the anthers as they sway in the wind. These float and drop onto the long, massed silky stigmas of the cob of the same or other plants. This way, wind and cross- pollinations are achieved.

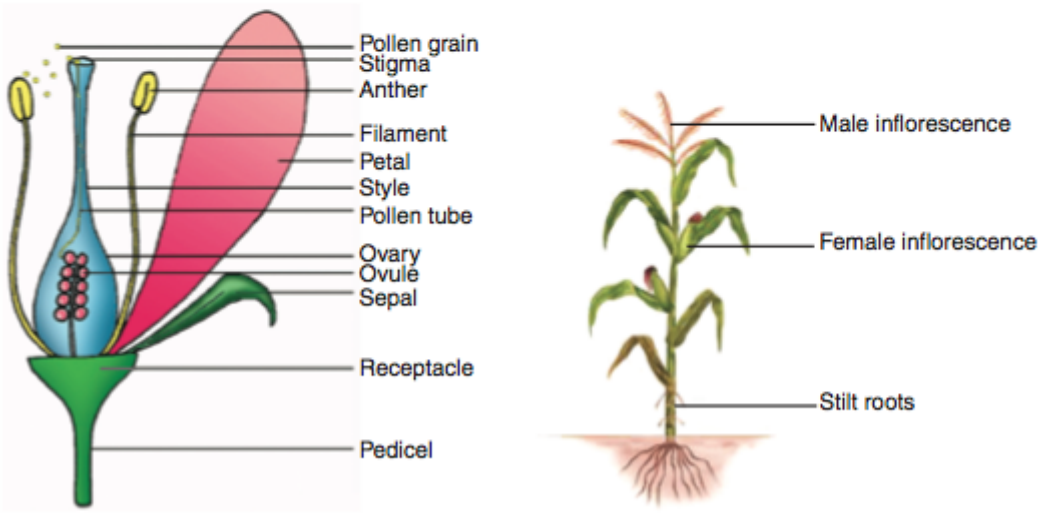


▲ **FIGURE 13.2** Pollination in wind-pollinated flowers



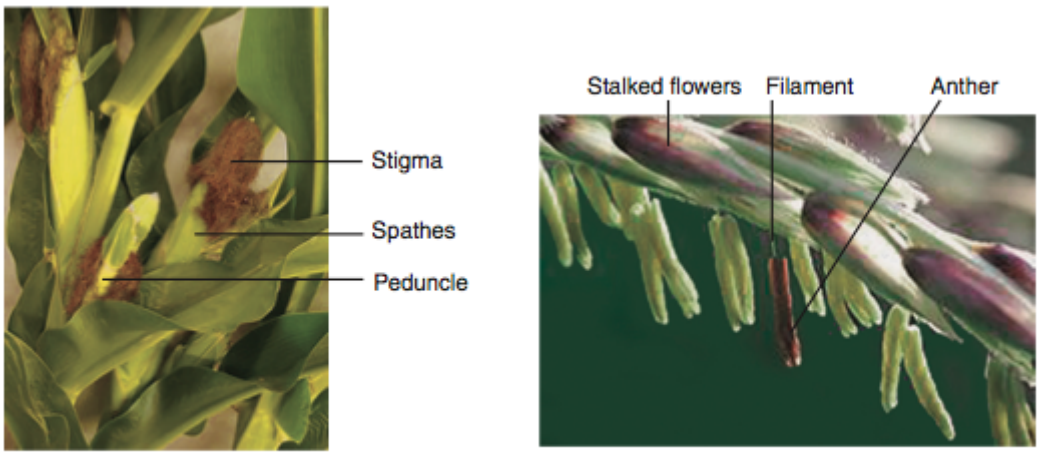
(b) *Flower with one wing removed*

(c) *Longitudinal section of flower*



(d) *Flower with petals and sepals removed*

(e) *Male and female inflorescence*



(f) *Female florets of maize*

(g) *Male florets of maize*

▲ FIG. 13.2 Pollination in wind-pollinated flowers

SUGGESTED PRACTICALS

Observation of flowers and modes of pollination.
Bring various flowers to class. Study the flowers all over again.

(a) Relate the position of the stigma and stamens to the type of pollination.

(b) Note the nature of the corolla and their relationship with the stamens and stigmas.

(c) Suggest the type of pollination, which occurs in each flower: maize, hibiscus and crotalaria, with reasons

CHAPTER SUMMARY

â– Pollination is the transfer of pollen grains from the anther to the stigma in flowers. It is the first phase of sexual reproduction in flowering plants.

â– There are two types of pollination in flowering plants: self- and cross-pollinations.

â– Some of the common external agents of pollination are wind, water, insects as well as other animals such as snails, birds and bats.

â– Flowers exhibit various features, which ensure cross-pollination. These include self-sterility, unisexuality and dichogamy.

â– Some flowers exhibit features that ensure self-pollination. These include the following:

- âœ¦ Simultaneous ripening of both the pollen and stigma
- âœ¦ Transfer of pollen to stigma by insects at a single visit
- âœ¦ When styles are longer than stamens, the former coil back to reach the stamens.

â– Wind-pollinated flowers have no scent and nectar. They have numerous, light and dry pollen grains. The flowers are very tiny but the stigmas are relatively large and feathery.

â– Insect-pollinated flowers are usually brightly coloured, scented, large and conspicuous

REVISION QUESTIONS

OBJECTIVE QUESTIONS

Choose the correct options to the following questions.

1. Pollination that involves two separate flowers located on the same plant is called

a. Hybridisation b. Xenogamy c. Autogamy d. Geitonogamy

2. All the following features ensure cross-fertilisation expect
a. Homogamy b. Protandry c. Protogyny d. Unisexuality

3. **Which of the following statements is not true of self pollination?**

a. There is cleistogamy in certain closed flowers

b. Some plants bear only male or female flowers.
c. In some flowers, the styles are longer than the filaments making them coil back.

d. Filaments are longer than styles.

4. Which of the following statements is not shown by wind-pollinated flowers?

a. There are no scent and nectar.

b. Flowers are usually small and inconspicuous.
c. Flowers are borne on large inflorescence.

d. Pollen grains are heavy, rough edged and sticky.

5. Pollination can occur through the following except

a. wind. b. air. c. water. d. insects

ESSAY QUESTIONS

1. (a) Define pollination.
(b) List the features that aid self-pollination.

(c) List five features of cross-pollinated flowers.

2. Tabulate the major differences in the characteristics of wind- and insect-pollinated flowers.

3. Describe the mechanism of pollination in a named insect-pollinated flower.

4. Describe pollination in a named wind-pollinated flower.