Chapter Outline

- Pollination
- Self-pollination
- Cross-pollination
- Agents of Cross-pollination
- Artificial Pollination
- Examples of Pollination

You are aware that flowers have stamens and carpels. Anthers of the stamens produce pollens which contain **male gametes**, while carpels have ovaries which contain **female gametes**. During the process of reproduction, these gametes have to come in contact with each other for fusion. Thus, for initiating the process of reproduction, the first step is that *pollen grains must come in contact with the stigma of the carpels.*

The pollen grains reach the stigma by a process called **pollination**.

POLLINATION

Pollination is the process of transfer of pollen grains from the anther to the stigma. It may take place in different ways, depending upon the parent plants involved:

Self-pollination

The process of transfer of pollen grains from an anther to the stigma of the same flower or another flower of the same plant is called **self-pollination**.

- The pollination between the same flower is called **autogamy**.

- The pollination between the two flowers borne on the same plant is known as **geitonogamy**.

Cross-pollination

The process of transfer of pollen grains from a flower to the stigma of the flower of another plant is called **cross-pollination** or **allogamy**.

Generally, cross-pollination occurs between the flowers of the same species and is called **xenogamy**. However, sometimes it may take place between the flowers of different species, which is known as **hybridism**. Hybridism is a very rare phenomenon and does not result in the viable offspring. This is due to the following reasons:

- Pollen grains either do not survive or do not germinate on the stigma of different species.
- If the pollen grains germinate, the male and female nuclei do not fuse to form the zygote.
- If the zygote is formed, it may not be viable.

SELF-POLLINATION

As we discussed earlier, *self-pollination is the process of transfer of pollen grains from an anther to the stigma of the same flower or another flower of the same plant*. The pollination between the two flowers present on the same plant is considered self-pollination because they have the **same genetic constitution**.

Self-pollination often occurs in the following circumstances:

Bisexuality

Self-pollination can take place in **bisexual flowers** as they have both male and female reproductive parts. However, it can also take place in unisexual flowers which are present on the same plant.

Homogamy

Self-pollination takes place only if the anther and stigma, of a flower or of two flowers present in a plant, *mature at the same time*. This condition is called **homogamy**.

Cleistogamy

A few bisexual flowers growing close to the ground **never open**. Their anthers and stigma lie close to each other and mature at the same time. On maturity, anthers liberate pollen grains inside the flower ensuring self-pollination. These are called **cleistogamous** or **closed flowers**. A few examples of cleistogamous flowers are *Commelina*, *Viola* (Pansy) and *Salvia* (Sage).

Advantages of Self-pollination

- Self-pollination **preserves the parental traits** and characters indefinitely.

- In a *bisexual flower, self-pollination is ensured* as both stamens and carpels mature at the same time.
- As pollen grains need not be transferred to the flower of another plant, there is *no wastage of pollen grains.*
- The flowers do not have to be **large, colourful** or **showy** to attract pollinating agents for pollination.
- The plant does not need to produce a large amount of pollen grains, nectar, scent and large colourful petals. It thus, *saves a lot of energy and material.*
- Self-pollination is the only means of pollination and thus **necessity in cleistogamous** flowers.

Disadvantages of Self-pollination

- If self-pollination continues generation after generation in a plant, it may *lead to loss in vigour, quality and vitality* of the species. As a result, the offspring produced *may be weak, susceptible to diseases and poor in quality.*
- The weak and abnormal character, if present in a breed (plant), continues to *appear in the next generation* and does not get eliminated.
- There is *no genetic variation in the next generation* due to lack of intermingling of different characters. The offspring produced are exactly the same as their parents. There is meagre chance of rejuvenation or betterment of the species.

CROSS-POLLINATION

Cross-pollination is the process of transfer of pollen grains from a flower to the stigma of the flower of another plant. Unisexual flowers present on two different plants have to undergo cross-pollination during reproduction, it may occur in bisexual flowers also.

The flowers which undergo cross-pollination possess the following features:

Unisexuality

Unisexual flowers have either stamens or carpels, *i.e.*, they have either male or female reproductive parts. As a result, cross-pollination is the only way of reproduction in these flowers, for example, papaya, cucumber, maize, etc.

Unisexual flowers may be borne on the same plant or on two separate plants.

Based on this, plants are of **two** types:

- **Monoecious** (**Gr.** *mono* = single; *oikos* = a house): When the male and female flowers are **borne on the same plant**, as in gourd, cucumber, castor and maize.
- **Dioecious** (**Gr.** *di* = two; oikos = a house): When the male and female flowers are **borne on different plants**, as in papaya and mulberry.

Self-sterility

In a few bisexual flowers, even if *pollen grains reach the stigma of the same flower, they either do not germinate* or have an injurious effect on the stigma. In these flowers, cross-pollination is the only method, by which reproduction takes place. A few examples of such plants are tea, orchids, potato and ray florets of sunflower.

Dichogamy

In many bisexual flowers, the *anther and stigma of the same flower often mature at different times* and thus, they cannot self-pollinate. This condition is known as **dichogamy**. Dichogamy can be of two types:

Protogyny

(**Gr.** *protos* = first; *gyne* = female)

In protogyny, the *stigma of the flower matures earlier than the anthers*, as observed in the flowers of fig, peepal and custard apple plants.

Protandry

(**Gr.** *protos* = first; *andros* = male)

In this condition, the *anthers mature earlier*

than the stigma. Protandry is exhibited in the flowers of china rose, cotton, okra, sunflower and sweet pea.

Heterostyly

(**Gr.** *heteros* = different)

Some plants bear flowers of two different types with respect to the *length of stamens and styles*.

In one type of flowers, the stamens are long while the style is short. In the second type of flowers, the stamens are short and the style is long.

This condition is unfavourable for self-pollination and therefore, such flowers undergo cross-pollination. This condition is exhibited in the flowers of evening primrose, linseed and *Oxalis*.

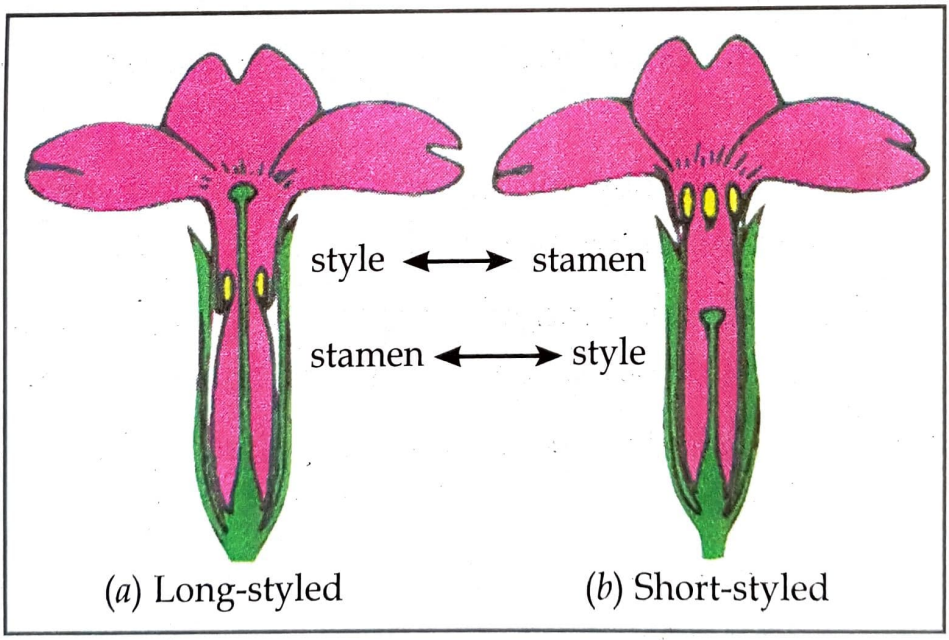

Fig. 4.2: Heterostyly in flowers of primrose

Herkogamy

(**Gr.** *herkos* = a barrier; *gamos* = marriage)

In a few flowers like *Calotropis*, certain *features act as a barrier to self-pollination* resulting in

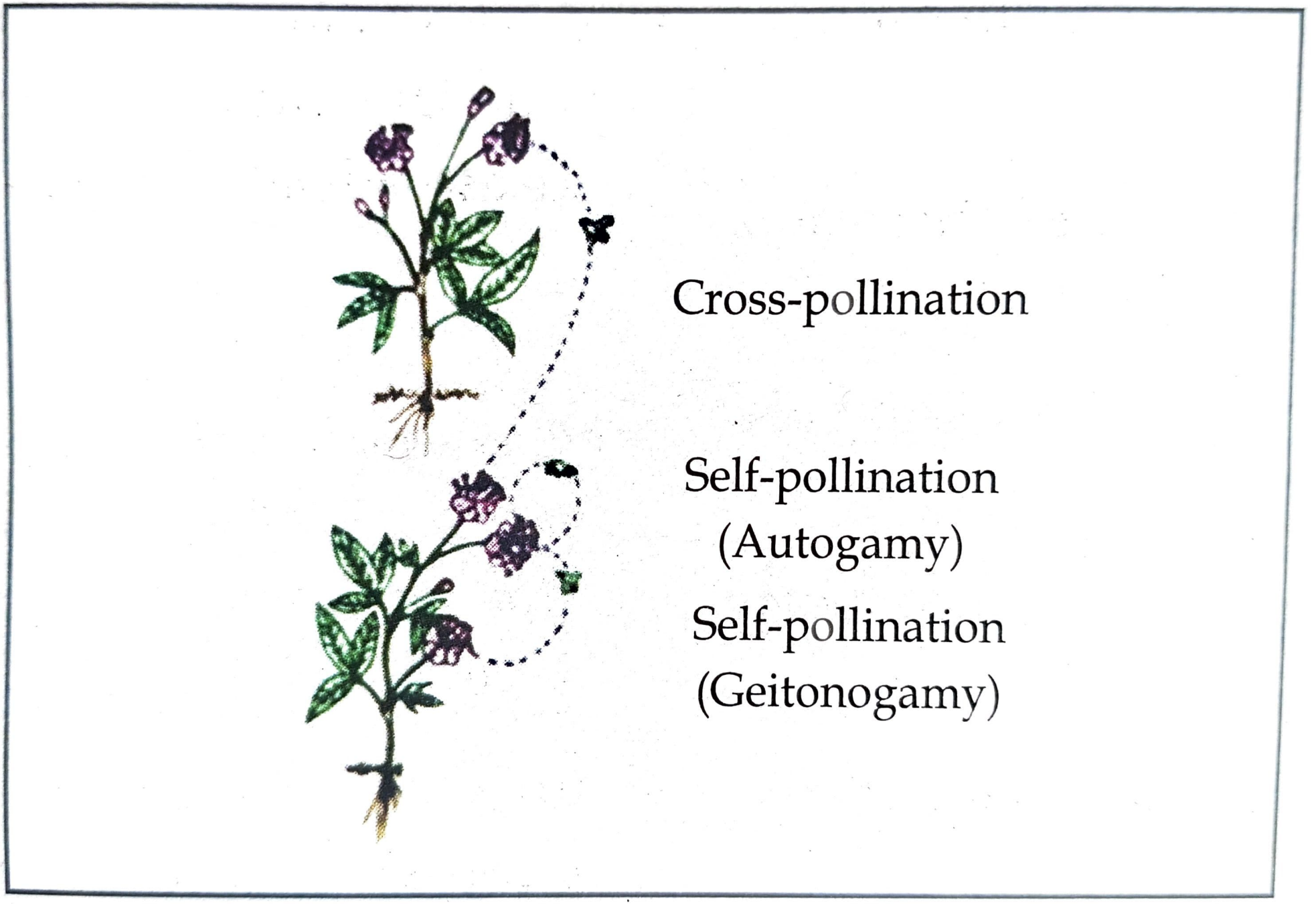

Fig. 4.1: Process of self-pollination and cross-pollination in plants

cross-pollination. A few of these features are as follows:

- Stamens and carpels may be *placed at a certain distance* from each other.
- Stigma may be covered by a *thin covering or a hood* on the top.
- Anthers may be *facing outwards, i.e.,* away from the stigma.
- Anthers may be *inserted within the corolla tube.*

Advantages of Cross-pollination

- Cross-pollination *increases the vigour and vitality* of plants.
- The offspring are *healthier and better adapted* to the environment leading to more chances of survival.
- **New varieties** can be produced by cross-pollination as it involves mixing of two different types of characters.
- Cross-pollination generally gives rise to abundant and comparatively **more viable seeds** with a better germination capacity.

Disadvantages of Cross-pollination

- Cross-pollination is *dependent upon the pollinating agents,* due to which the process is uncertain and may or may not occur.
- It is less economical and a more wasteful **process**. It always requires large quantities of pollen grains to ensure pollination out of which a considerable amount is wasted.
- The flowers have to be generally large, **colourful, scented** and with **abundant nectar** to attract pollinating agents. A lot of *plant's energy is wasted* in producing such flowers.
- It can lead to *addition of undesirable characters* or loss of important characters.

NATURE FAVOURS CROSS-POLLINATION

Nature has always favoured cross-pollination. The agents that facilitate cross-pollination in plants are called **pollinating agents**. Commonest pollinating agents are **insects** and **wind**. However, flowers can also be pollinated by certain other agents such as **water, bats** and **birds**, etc.

In each type of pollination, flowers bear certain characters to facilitate and increase the chances of pollination.

AGENTS OF CROSS-POLLINATION

Depending upon the pollinating agent, we can classify pollination into the following types:

Entomophily

(**Gr.** *entomon* = insect; *philein* = to love)

Insects are the most common pollinating agents. Some of these insects are bees, flies, wasps, moths, butterflies and beetles. Among these, bees and butterflies carry out about 90% of the pollination. *Pollination carried out by the insects is called* ***entomophily*** and the insect-pollinated flowers are known as **entomophilous flowers**. These have the following features to attract insects:

- The flowers are **large** and **irregular** in shape.
- The petals are usually **brightly coloured** to attract insects.
- Almost all entomophilous flowers **secrete nectar** to attract insects, especially bees.
- They emit a **sweet scent** as an attractant, especially at night when the colour is not visible, such as in night jasmine.
- The *pollen grains are sticky or have spines* to attach to the insect and to be carried away easily.
- The **stigma** is also **sticky** and does not hang outwards.
- Sometimes, the *flowers provide shelter to the insects* from rain and sunlight, which accidentally leads to pollination.
- A few flowers such as the sunflower and marigold, are very small and inconspicuous. To become more showy and attractive, they *group together into a dense inflorescence*. This ensures pollination.

At A Glance

Sometimes, instead of petals, other parts of the flowers are more colourful and showy to facilitate cross-pollination.

- In *Bougainvillea*, bracts are highly colourful and attractive.
- In *Mussaenda*, one of the sepals is a large, white or colourful structure.

Anemophily

(**Gr.** *anemos* = wind; *philein* = to love)

Pollination *carried out by the wind* known as **anemophily**, is a common process. A few examples of wind-loving or **anemophilous flowers** are grasses, cereals, millets, sugarcane and maize. The anemophilous flowers have the following characteristic features:

- The flowers are **small and inconspicuous**.
- They are usually **not brightly coloured** or showy.
- The flowers **do not produce nectar** or any odour.
- The anthers produce **large quantities of pollen grains** to compensate for the wastage that occurs during their transfer to stigma.
- Stamens are **long and hang out** of the flowers exposing them to the wind.
- Anthers are **loosely attached** to the filaments for easy dispersal by wind.
- Pollen grains are **light**, **dry**, **small** and **smooth** facilitating their easy scattering in the environment.
- Stigmas are **feathery and hang out** of the flowers to receive pollen grains.

Fig. 4.4: Small and unattractive flowers of anemophilous saw-tooth oak

Hydrophily

(**Gr.** *hydro* = water; *philein* = to love)

Pollination which takes place with the help of water is known as **hydrophily**. It can take place only in aquatic plants, especially submerged ones. The water-pollinated flowers are called **hydrophilous flowers**. *Vallisneria, Hydrilla* and *Ceratophyllum* are a few examples of hydrophilous flowers.

Hydrophilous flowers have the following characteristic features:

- The flowers are **small and inconspicuous**.
- The pollen grains are produced in **large numbers**.
- The pollen grains **float on the water surface**.
- In *Vallisneria*, the male flowers get detached from the parent plant and float on the surface of water till they come in contact with female flowers for fertilisation.
- The submerged pistillate flowers have **long and slender stalks**, which bring them up to the water surface for pollination.

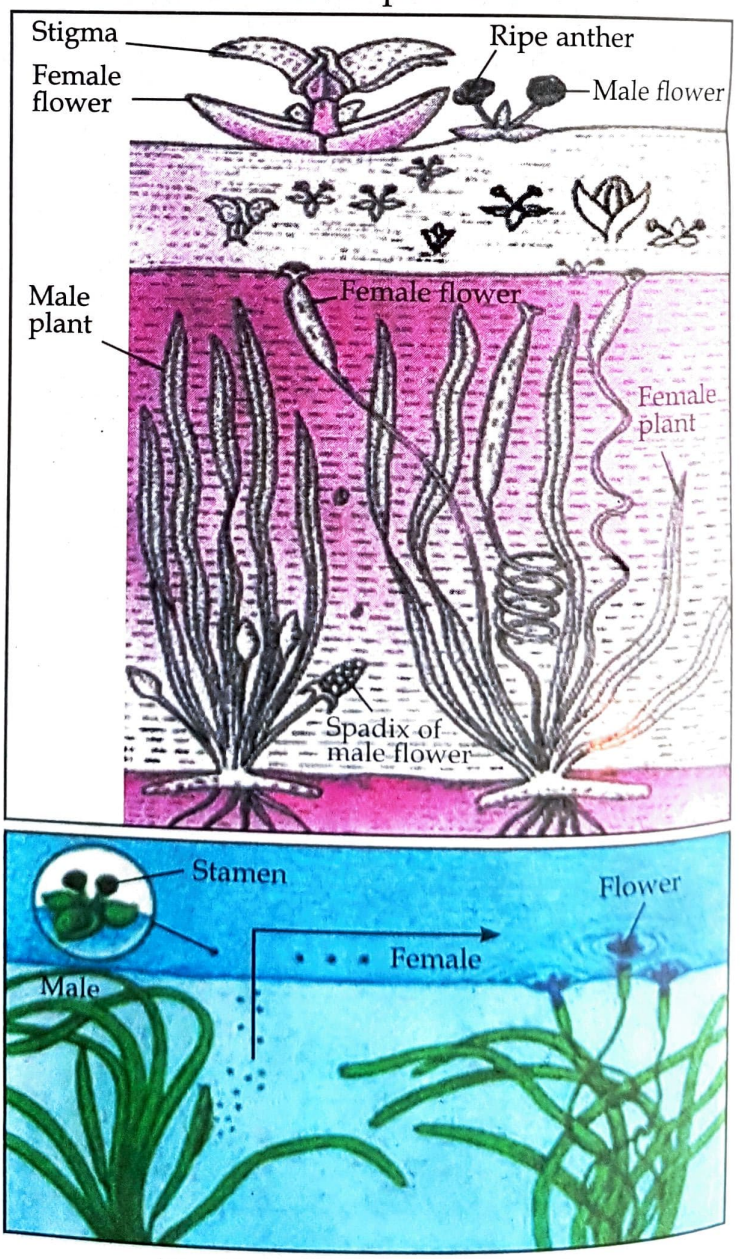

Fig. 4.5: Hydrophily in *Vallisneria*

Zoophily

(**Gr.** *zoon* = animal; *philein* = to love)

Other than insects, many animals like birds and squirrels also act as agents of pollination. Depending on the animal as pollinating agents, zoophily can be of the following types:

Ornithophily

Ornithophily is the pollination carried out by the birds. The characteristics of ornithophilous flowers such as *Bignonia* and *Canna*, are as follows:

- The flowers are **large** and produce **abundant nectar**.
- The flowers are **brightly coloured** and **scentless**.

(*a*) (*b*)

Fig. 4.6: (*a*) Ornithophily (*b*) Chiropterophily

Chiropterophily

In a few plants, such as *Anthocephalus* and *Bauhinia*, **bats act as the agents** of pollination. **Chiropterophilous** flowers have the following features:

- The flowers are *large and dull-coloured emitting strong scent.*
- The flowers produce *abundant pollen grains and nectar.*

Malacophily

Malacophily is the kind of pollination **affected by the snails**. Such kind of pollination takes place in the snake or cobra plants.

Elephophily

In *Rafflesia*, pollination is carried out **by elephants**. These flowers are very large and present at the ground level. The pollen grains stick to the elephant's feet and are carried to the stigma of another flower.

ARTIFICIAL POLLINATION

When pollination is carried out purposely by human beings to produce plant varieties of desired quality, it is called **artificial pollination**. This is done as follows:

1. The **male parts** (anthers) of an immature flower of one variety are **removed** prior to self-pollination. This is called **emasculation**.

2. The emasculated flowers are then *covered with a paper bag* to prevent pollination by the pollen grains of other flowers.

3. When mature, the **pollen grains** from flowers of second variety are *transferred to the stigma* of emasculated flower resulting in cross-pollination.

In 1856, **Gregor Mendel** did his experiments on garden pea by using the above technique of artificial cross-pollination, which resulted in the discovery of the famous laws of genetics.

1. Write **any three** characteristic features present in flowers that undergo
   (*a*) self-pollination,
   (*b*) cross-pollination by entomophily, and
   (*c*) cross-pollination by anemophily.
2. Write the advantage of the following characteristic features in plants:
   (*a*) Bright, large and scented flowers
   (*b*) Dense inflorescence
   (*c*) Large number of pollen grains
   (*d*) Loosely attached anther filaments
   (*e*) Sticky pollens and sticky stigma
3. What are the different kinds of pollination that take place in plants? Depict in the form of a flow chart.
4. Write the advantages and disadvantages of self-pollination and cross-pollination.
5. Briefly describe pollination by insects in sweet pea.
6. Differentiate between the following:
   (*a*) Autogamy and allogamy.
   (*b*) Protogyny and protandry.
   (*c*) Entomophily and anemophily.
   (*d*) Heterostyly and herkogamy.

KRISHNAGAR ACADEMY

BIOLOGY -

POLLINATION

&

Fertilization

CLASS -9

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