NORTH POINT SR. SEC. BOARDING SCHOOL,
ARJUNPUR
Class –XII Subject: Biology

CHAPTER

SEXUAL REPRODUCTION IN FLOWERING PLANT

TODAYS TOPICS

- POLLINATION
- KINDS OF POLLINATION

1. AUTOGAMY
2. GEITONOGAMY
3. XENOGAMY

- AGENTS OF POLLINATION

1. WIND
2. WATER
3. INSECTS

POLLINATION

DEFINTION

1. Pollination

Transfer of pollen grain from anther of a stamen to stigma of a pistil is known as pollination.

2. Autogamy

Transfer of pollen grain from the anther to the stigma of the same flower is called autogamy.

maturity, though **8-nucleate** is **7-celled**.

2.2.3 Pollination

In the preceding sections you have learnt that the male and female gametes in flowering plants are produced in the pollen grain and embryo sac, respectively. As both types of gametes are non-motile, they have to be brought together for fertilisation to occur. How is this achieved?

Pollination is the mechanism to achieve this objective. Transfer of pollen grains (shed from the anther) to the stigma of a pistil is termed **pollination**. Flowering plants have evolved an amazing array of adaptations to achieve pollination. They make use of external agents to achieve pollination. *Can you list the possible external agents?*

Kinds of Pollination : Depending on the source of pollen, pollination can be divided into three types.

(i) ***Autogamy* :** In this type, pollination is achieved within the same flower. Transfer of pollen grains from the anther to the stigma of the same flower (Figure 2.9a). In a normal flower which opens and exposes the anthers and the stigma, complete autogamy is rather rare. Autogamy in such flowers requires synchrony in pollen release and stigma receptivity and also, the anthers and the stigma should

Definition

3. Geitonogamy
Transfer of pollen grain from anther to the stigma of different flowers on the same plant.

4. Xenogamy
Transfer of pollen grain from the anther to the stigma of different flowers on different plants.

Xenogamy is the only type of pollination which brings genetical recombination.

(a)

(b)

(c)

lie close to each other so that self-pollination can occur. Some plants such as *Viola* (common pansy), *Oxalis*, and *Commelina* produce two types of flowers – **chasmogamous** flowers which are similar to flowers of other species with exposed anthers and stigma, and **cleistogamous** flowers which do not open at all (Figure 2.9c). In such flowers, the anthers and stigma lie close to each other. When anthers dehisce in the flower buds, pollen grains come in contact with the stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators. Do you think that cleistogamy is advantageous or disadvantageous to the plant? Why?

(ii) ***Geitonogamy*** – Transfer of pollen grains from the anther to the stigma of another flower of the same plant. Although geitonogamy is functionally cross-pollination involving a pollinating agent, genetically it is similar to autogamy since the pollen grains come from the same plant.

(iii) ***Xenogamy*** – Transfer of pollen grains from anther to the stigma of a different plant (Figure 2.9b). This is the only type of pollination which during pollination brings genetically different types of pollen grains to the stigma.

Agents of Pollination : Plants use two abiotic (wind and water) and one biotic (animals) agents to achieve pollination. Majority of plants use biotic agents for pollination. Only a small proportion of plants use abiotic agents. Pollen grains coming in contact with the stigma is a chance factor in both wind and water pollination. To compensate for this uncertainties and

Agents of pollination:

1. **Abiotic : wind and water**
2. **Biotic : animals**

Characteristics of wind pollinated flower

- **Pollen grains are light in weight and non sticky**
- **Well exposed stamen**
- **Large often feathery stigma**
- **Ovary with single ovule**
- **Numerous flowers packed in single inflorescence**
- **Not showy and do not produce nectar**

Pollination by water

- **Algae , bryophytes and pteridophytes need water to transport their male and female gametes.**
- **Most of the aquatic plants like water lily or water hyacinth , flowers emerge above the level of water and pollination takes place by wind or animals.**
- **Examples of water pollinated plants are vallisneria , hydrilla from fresh water plant and sea grass or Zostera from saline water.**

Pollination by wind is more common amongst abiotic pollinations. Wind pollination also requires that the pollen grains are light and non-sticky so that they can be transported in wind currents. They often possess well-exposed stamens (so that the pollens are easily dispersed into wind currents, Figure 2.10) and large often-feathery stigma to easily trap air-borne pollen grains. Wind-pollinated flowers often have a single ovule in each ovary and numerous flowers packed into an inflorescence; a familiar example is the corn cob – the tassels you see are nothing but the stigma and style which wave in the wind to trap pollen grains. Wind-pollination is quite common in grasses.

Pollination by water is quite rare in flowering plants and is limited to about 30 genera, mostly monocotyledons. As against this, you would recall that water is a regular mode of transport for the male gametes among the lower plant groups such as algae, bryophytes and pteridophytes. It is believed, particularly for some bryophytes and pteridophytes, that their distribution is limited because of the need for water for the transport of male gametes and fertilisation. Some examples of water pollinated plants are *Vallisneria* and *Hydrilla* which grow in fresh water and several marine sea-grasses such as *Zostera*. Not all aquatic plants use water for pollination. In a majority of aquatic plants such as water hyacinth and water lily, the flowers emerge above the level of water and are pollinated by insects or wind as in most of the land plants. In *Vallisneria*, the female flower reach the surface of water by the long stalk and the male flowers or pollen grains are released on to the surface of water. They are carried passively by water currents (Figure 2.11a); some of them eventually reach the female flowers and the stigma. In another group of water pollinated plants such as seagrasses, female flowers remain submerged in water and the pollen grains are released inside the water. Pollen grains in many such species are long, ribbon like and they are carried passively inside the water; some of them reach the stigma and achieve pollination. In most of the water-pollinated species, pollen grains are protected from wetting by a mucilaginous covering.

Both wind and water pollinated flowers are not very colourful and do not produce nectar. *What would be the reason for this?*

Figure 2.10 A wind-pollinated plant showing compact inflorescence and well-exposed stamens

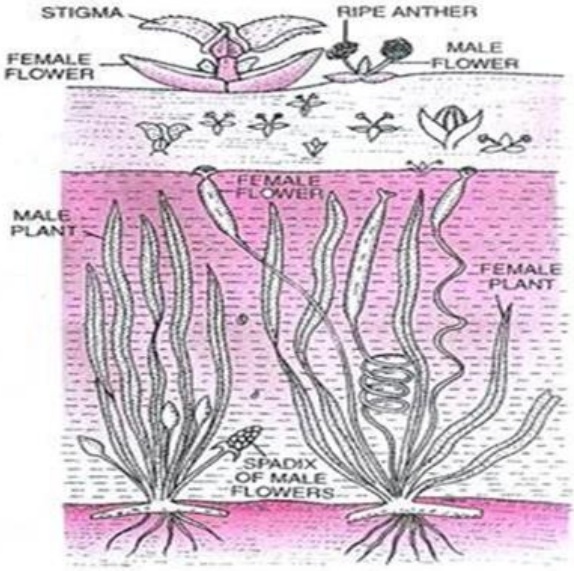


Fig. 2.21. Pollination in *Vallisneria* (Tape Grass).

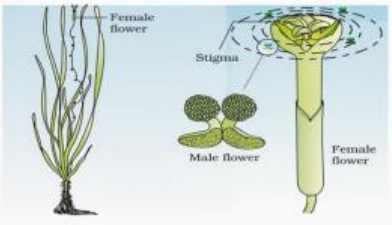
Sea grass or Zostera

- **Female flowers remain submerged in water .**
- **Pollen grain are released inside the water**

Pollination by insects

- **Smaller Animals like bee, butterflies , flies , beetles , ants , moths , birds ,bats, help in this type of pollination**
- **Larger animals like lemurs , rodents , lizards also help in this pollination**
- **Characteristics of insect pollinated flower:**

1. **Flowers are large , colourful , fragrant and rich in nectar.**
2. **Flowers are small and a number of flowers are clustered into an inflorescence .**
3. **Some flowers can produce bad smell to attract flies and beetles.**
4. **Reward will be given to animals e.g. nectar and pollen grains. Some times reward can be the place to lay eggs. Example : tallest flower Amorphophallus (6 ft in height) .**



(a)

(b)

Figure 2.11 (a) Pollination by water in *Vallisneria*; (b) Insect pollination

Majority of flowering plants use a range of animals as pollinating agents. Bees, butterflies, flies, beetles, wasps, ants, moths, birds (sunbirds and humming birds) and bats are the common pollinating agents. (Figure 2.11b). Among the animals, insects, particularly bees are the dominant biotic pollinating agents. Even larger animals such as some primates (lemurs), arboreal (tree-dwelling) rodents, or even reptiles (gecko lizard and garden lizard) have also been reported as pollinators in some species.

Often flowers of animal-pollinated plants are specifically adapted for a particular species of animal.

Majority of insect-pollinated flowers are large, colourful, fragrant and rich in nectar. When the flowers are small, a number of flowers are clustered into an inflorescence to make them conspicuous. Animals are attracted to flowers by colour and/or fragrance. The flowers pollinated by flies and beetles secrete foul odours to attract these animals. To sustain animal visits, the flowers have to provide rewards to the animals. Nectar and pollen grains are the usual floral rewards. For harvesting the reward(s) from the flower the animal visitor comes in contact with the anthers and the stigma. The body of the animal gets a coating of pollen grains, which are generally sticky in animal pollinated flowers. When the animal carrying pollen on its body comes in contact with the stigma, it brings about pollination.

In some species floral rewards are in providing safe places to lay eggs; an example is that of the tallest flower of *Amorphophallus* (the flower itself is about 6 feet in height). A similar relationship exists between a species of moth and the plant *Yucca* where both species – moth and the

- **A relationship exists in between a moth and flower of Yucca. Moth deposits its eggs inside the ovarian chamber of flower. And flower get pollinated by the moth. The larva comes out when seeds are developed.**
- **Pollen/ nectar robbers: many insects may consume pollen or the nectar without bringing about pollination.**

plant – cannot complete their life cycles without each other. The moth deposits its eggs in the locule of the ovary and the flower, in turn, gets pollinated by the moth. The larvae of the moth come out of the eggs as the seeds start developing.

Why don't you observe some flowers of the following plants (or any others available to you): Cucumber, Mango, Peepal, Coriander, Papaya, Onion, Lobia, Cotton, Tobacco, Rose, Lemon, Eucalyptus, Banana? Try to find out which animals visit them and whether they could be pollinators. You'll have to patiently observe the flowers over a few days and at different times of the day. You could also try to see whether there is any correlation in the characteristics of a flower to the animal that visits it. Carefully observe if any of the visitors come in contact with the anthers and the stigma as only such visitors can bring about pollination. Many insects may consume pollen or the nectar without bringing about pollination. Such floral visitors are referred to as pollen/nectar robbers. You may or may not be able to identify the pollinators, but you will surely enjoy your efforts!

- **A relationship exists in between a moth and flower of Yucca. Moth deposits its eggs inside the ovarian chamber of flower. And flower get pollinated by the moth. The larva comes out when seeds are developed.**
- **Pollen/ nectar robbers: many insects may consume pollen or the nectar without bringing about pollination.**

plant – cannot complete their life cycles without each other. The moth deposits its eggs in the locule of the ovary and the flower, in turn, gets pollinated by the moth. The larvae of the moth come out of the eggs as the seeds start developing.

Why don't you observe some flowers of the following plants (or any others available to you): Cucumber, Mango, Peepal, Coriander, Papaya, Onion, Lobia, Cotton, Tobacco, Rose, Lemon, Eucalyptus, Banana? Try to find out which animals visit them and whether they could be pollinators. You'll have to patiently observe the flowers over a few days and at different times of the day. You could also try to see whether there is any correlation in the characteristics of a flower to the animal that visits it. Carefully observe if any of the visitors come in contact with the anthers and the stigma as only such visitors can bring about pollination. Many insects may consume pollen or the nectar without bringing about pollination. Such floral visitors are referred to as pollen/nectar robbers. You may or may not be able to identify the pollinators, but you will surely enjoy your efforts!

OUTBREEDING DEVICES TO DISCOURAGE SELF POLLINATION:

1. **POLLEN RELEASED AND STIGMA RECEPTIVITY ARE NOT SYNCHRONISED.**
2. **ANTHER AND STIGMA ARE PLACED AT DIFFERENT POSITION SO THE POLLEN CAN NOT COME IN CONTACT WITH STIGMA OF THE SAME FLOWER.**
3. **SELF INCOMPATIBILITY : POLLEN GERMINATION OE GROWTH OF POLLEN GRAN WILL BE INHIBITED BY THE SAME FLOWER OR DIFFERENT FLOWER ON THE SAME PLANT.**
4. **A.)UNISEXUAL FLOWER : THIS CAN STOP AUTOGAMY AND GEITONOGAMY WHEN MALE AND FEMALE PLANTS ARE SEPARATE EXAMPLE PAPAYA A.**

4. B.) BUT IF BOTH MALE AND FEMALE FLOWERS ARE PRESENT ON SAME PLANT (CASTOR/ MAIZE) , IT PREVENTS AUTOGAMY BUT NOT GEITONOGAMY.

Outbreeding Devices : Majority of flowering plants produce hermaphrodite flowers and pollen grains are likely to come in contact with the stigma of the same flower. Continued self-pollination result in inbreeding depression. Flowering plants have developed many devices to discourage self-pollination and to encourage cross-pollination. In some species, pollen release and stigma receptivity are not synchronised. Either the pollen is released before the stigma becomes receptive or stigma becomes receptive much before the release of pollen. In some other species, the anther and stigma are placed at different positions so that the pollen cannot come in contact with the stigma of the same flower. Both these devices prevent autogamy. The third device to prevent inbreeding is self-incompatibility. This is a genetic mechanism and prevents self-pollen (from the same flower or other flowers of the same plant) from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil. Another device to prevent self-pollination is the production of unisexual flowers. If both male and female flowers are present on the same plant such as castor and maize (monoecious), it prevents autogamy but not geitonogamy. In several species such as papaya, male and female flowers are present on different plants, that is each plant is either male or female (dioecy). This condition prevents both autogamy and geitonogamy.

Assignment no. 4

1. What are chasmogamous flower? Can cross pollination occurs in cleistogamous flower? Give reason for our answer.

2. Who are called pollen / nectar robber?

3. A symbiotic relation is maintained in between a moth and plant Yucca. Explain.

4. With a well labelled diagram explain the process of pollination in Vallisneria. How is it different from Zostera?

5. Write the characteristics of wind pollinated flower.

6. Which type of pollination can bring genetical variation in plant?

7.Mention two strategies to prevent self pollination in flowers.

8. What is self incompatibility? Why does self pollination not lead to seed formation in self incompatible species?