POLLINATION IN PLANTS: TYPES AND CONTRIVANCES

<u>Prepared by</u> Abhijit Kumar Dutta Assistant Professor Department of Botany Raniganj Girls' College The transfer of pollen grains from the anther to the stigma is called pollination. Pollen grains are immobile. They cannot reach the stigma by themselves. An external agent is required for this. It can be wind, water, animal, gravity or growth contact.



Types

• Autogamy (Gk. autos- self, gamos- marriage):

It is a type of self pollination in which an intersexual or perfect flower is pollinated by its own pollen. Autogamy is possible only when anther and stigma are close together.

Geitonogamy

Geitonogamy is the type of self-pollinations where the transfer of pollen grains from the anther to the stigma takes place between different flowers in the same plant.

- When the pollen of a flower pollinates the stigma of a another flower located on a different plant, wheather of a same kind or not, is called **cross-pollination or allogamy.**
- Cross-pollination within a species(intervarietal) is called **Xenogamy.**
- Cross-pollination involving different strains of plants yields Hybrids.



• **Contrivances for self-pollination:**

Although cross-pollination seems to be favoured by Nature, there are cases where self-pollination is ensured.

1. Cleistogamy:

- In these cases the flowers never open (kleistos= closed) as opposed to most flowers which show chasmogamy (i.e., flowers open normally during anthesis). In cleistogamous flowers the pollens are shed within the closed flowers so that self-pollinaion is obligatory.
- Cleistogamy is seen in the underground flowers of *Commelina* benghalensis



Fig. 2.18 Commelina with chasmogamous and cleistogamous flowers.

2. Homogamy:

opposed to dichogamy, simply means that the stamen and carpels of a flower mature at the same time to increases the chances of self-pollination.

Found in Mirabilis jalapa, Argemone mexicana



Fig. 2.17. Self pollination through Homogamy and Mechanical Devices. A, Style growing to bring stigma in contact with ripe anthers in *Catharanthus* (= *Vinca*).
B, Filaments curving over stigma in *Mirabilis jalapa*.
C, Curved style bringing stigma in contact with ripe anthers in Potato. D, Normal position of stigma in Sunflower. E, Stigma curling to receive pollen grain present on brushing hair in Sunflower.

3. Dichogamous Flowers Showing Adaptations for Self-pollination:

(a) Flowers of Ixora, Gardenia, Vinca, etc., have their anthers placed at the mouth of the corollatube (throat). As the stigma elongates from below, it pushes out through these anthers which are already ripe and are pollinated in so doing.

(b) Plants under the family Asteraceae, flowers are protandrous. In *Helianthus annuus* the bilobed stigma, is still young and hidden within the syngenesious tube of anthers when the latter ripen and shed the pollens within the tube. At this stage self-pollination is not possible as the receptive surfaces of the stigmas are not only immature but also hidden. In the second stage the bifid stigma grows through the anther tube pushing out pollens and opens out above.

Cross-pollination usually takes place at this stage through

the agency of insects. But, if cross-pollination fails, it is seen that the stigma lobes curl back so that the receptive surfaces brush against any pollen still sticking on its surface and are thereby self-pollinated



FIO. 392. Pollination in Compositae.
A. Protandrous disc floret of sunflower with mature anthers but immature stigmas hidden within anther tube.
B. Mature and expanded bifd stigma showing receptive surface (r).
C. Curling back of stigma Jobes when cross-pollination fails.

ADVANTAGES OF SELF POLLINATION:

- It maintains the parental characters or purity of the race indefinitely.
- Self pollination is used to maintain pure lines for hybridisation experiments.
- The plant does not need to produce large number of pollen grains.
- Flowers do not develop devices for attracting insect pollinators.
- It ensures seed production. Rather it is used as fail safe device for cross-pollinated flowers.
- Self pollination eliminates some bad recessive characters.

DISADVANTAGES OF SELF POLLINATION:

- New useful characters are seldom introduced.
- Vigour and vitality of the race decreases with prolonged self pollination.
- Immunity to diseases decreases.
- Variability and hence adaptability to changed environment are reduced.

CROSS POLLINATION (ALLOGAMY):

- When the pollen of a flower pollinates the stigma of a another flower located on a different plant, wheather of a same kind or not, is called cross-pollination or allogamy.
- Cross pollination is performed with the help of an external agency i.e. through
- abiotic (e.g., wind, water) or biotic (e.g., insects, birds, bats, snails).
- Cross pollination is named after the agency that assists it, viz; Anemophily (wind pollination), Hydrophily (water pollination), Entomophily (insect pollination), Omithophily (bird pollination), Chiropterophily (bat pollination) and Malacophily (snail pollination).



RIPE ANTHER

FEMALI

OF MALE

MALE

-FLOWER

FEMALE PLANT

CONTRIVANCES TO ENSURE CROSS POLLINATION:

1. Dicliny (Uni-sexuality):

Cross-pollination is the rule among diclinous plants, i.e., those bearing unisexual flowers. In dioecious plants nothing else can take place. In monoecious plants the only alternative is geitonogamy which, however, has the same effect as self-pollination.

2. Dichogamy:

Anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination, (a) Protandry (Gk. protos- first, andros- male). Anthers mature earlier than stigma of the same flower. Their pollen grains become available to stigmas of the older flowers, e.g., *Helianthus annuus, Salvia*,

(b) Protogyny (Gk. protos- first, gyne- female). Stigmas mature earlier so that they get pollinated before the anthers of the same flower develop pollen grains, e.g., *Mirabilis jalapa* (Four O'Clock), *Gloriosa superba*.

3. Self Sterility (Self Incompatibility):

This is the condition when a flower cannot be fertilized by the pollen of the same flower or, sometimes, from a flower of the same strain of plants. In some orchids, flowers wither away if pollinated by its own pollen.

Many species of Solanum (potato, tobacco, etc.) and the tea plant(*Camellia sinensis*) are self-sterile because of genetic reasons. Cross-pollination is obligatory in such plants.

4. Herkogamy (herkos = barrier):

In some flowers there may be some physical barrier between the anther and the style so that pollination between them is rendered difficult or even impossible.

In many Cruciferae and Caryophyllaceae, the stigma extends far beyond the stamens so that pollens from the latter are not likely to reach the former. The extrorse anthers of *Gloriosa sp.* dehisce the anthers out of reach of its own stigmas. In *Calotropis* and Orchids, where the pollens are aggregated in pollinia, the pollination is entirely at the mercy of insects.

5. Heteromorphism:

In certain plants there are flowers of two (dimorphic) or three (trimorphic) different forms with anthers and stigmas at different levels. This dimorphism or trimorphism usually involves heterostyly (styles of different lengths) and heteroanthy (i.e., different types of anthers).

The primrose (*Primula sinensis* of Primulaceae—Fig. 389) shows an interesting case of dimorphism. In the first form, the anthers are placed deep down in the corolla lube and the stigma lies at the entrance.

The pollens of this type are smaller and the stigma papillae larger. In the second type the anthers arc placed at the entrance while the stigma is deep down. Moreover, in this case the pollens are larger and the stigma papillae smaller.

Different types of insects inoving about these flowers will naturally touch floral organs at the same level because of the difference in the lengths of their organs (proboscis, legs, etc.), so that the short style will be cross-pollinated by pollens from low anthers and



F10. 389. Dimorphism in flowers of *Primula sinensis*. 'A' type flower has larger pistil with larger stigma papillae (st) and lower anthers with smaller pollens (p). 'B' type flower has shorter pistil with smaller stigma papillae and higher anthers with large pollens.

Some species of Oxalis, *Linum* and *Lythrum* (Lythraceae) show trimorphism (Fig. 390). The three types of flowers show three positions of anthers and stigmas so that there is cross-pollination involving three heights.



Fig. 390. Trimorphism in flowers of Lythrum saluaria. Three types of flowers show pistils and stamens of three different heights. Pollination usually takes place between organs of the same height.