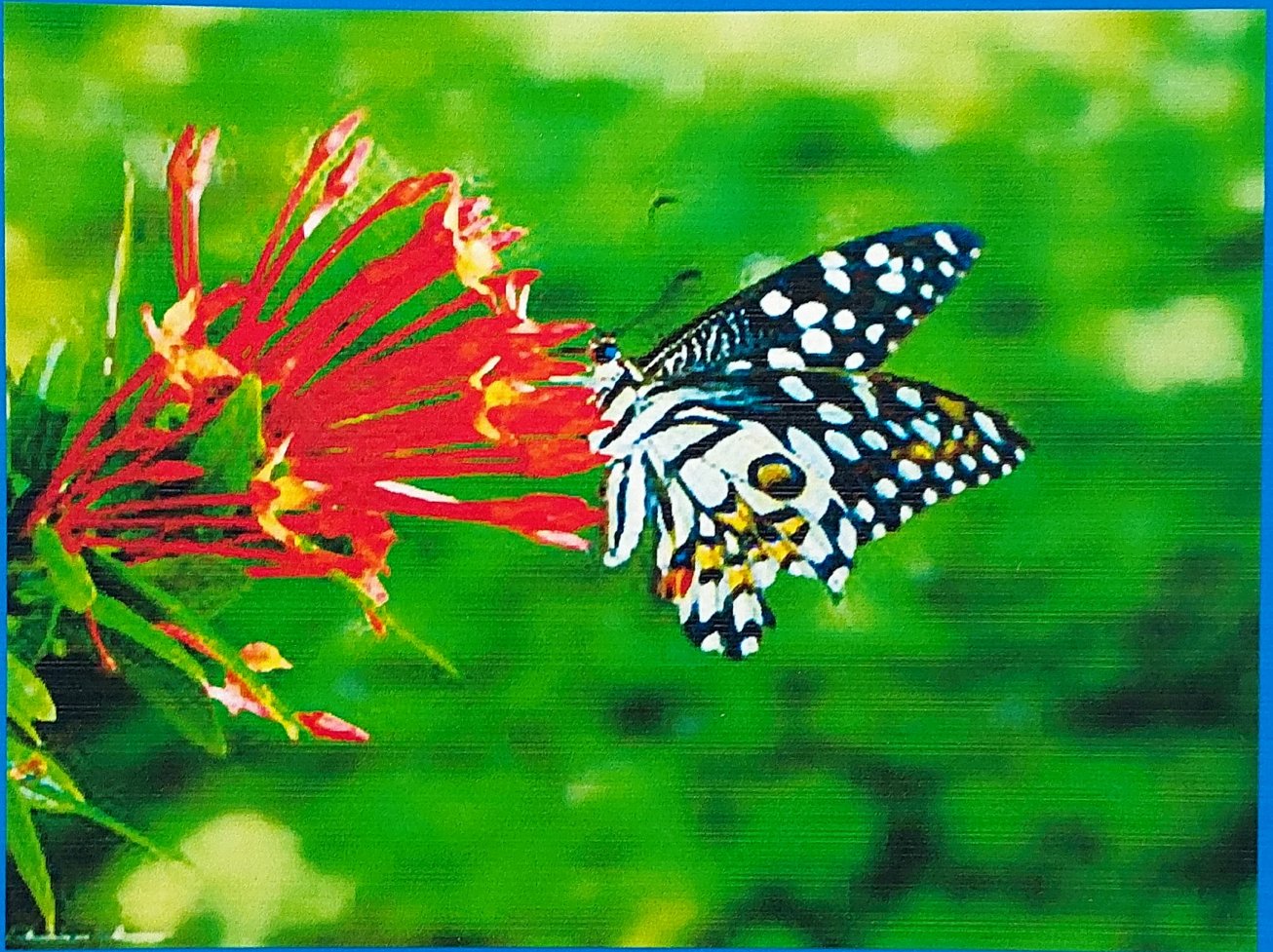


# POLLINATION IN PLANTS



**TEACHER INCHARGE:-  
DR.RENU MISHRA**

**SUBMITTED BY:-  
GOLDI EKKA  
IV- SEM  
BIOLOGY GROUP**

# CERTIFICATE

*This is to certify that Ms. Goldi Ekka of B.Sc (IV-sem) has performed her work on the topic-pollination in plants during the academic year 2014-2015*

**Date of submission:**

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7.5

NO

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**Teacher incharge**

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# INTRODUCTION

Pollination is the process by which pollen is transferred from the anther (male part) to the stigma (female part) of the plant, thereby enabling fertilization and reproduction.

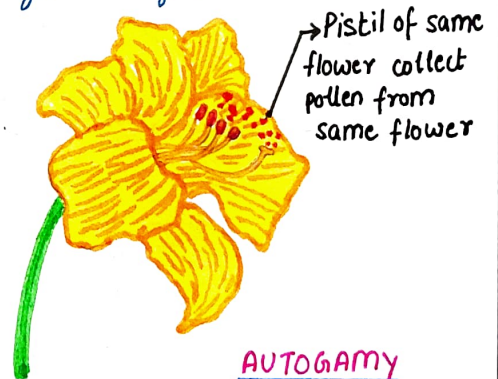
The pollination process as an interaction between flower and pollen grain vector was first addressed in 18<sup>th</sup> century by CHRISTIAN KONRAD SPRENGEL.

## TYPES OF POLLINATION

### [A.] SELF POLLINATION :

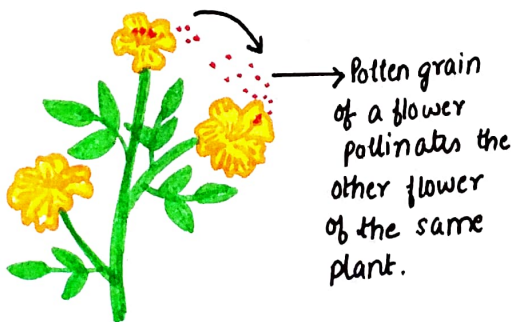
Self pollination occurs when pollen from one flower pollinates the same flower or other flower of the same individual.

Self pollination may include AUTOGAMY, when pollen moves to the plant part of same flower. Plants that can pollinate themselves and produce viable offsprings are called SELF-FERTILE.



### AUTOGAMY

Self pollination may also include GEITONOAMY, i.e. when pollen is transferred to another flower of the same plant. In this type of pollination also the pureline offsprings are produced.



### GEITONOAMY

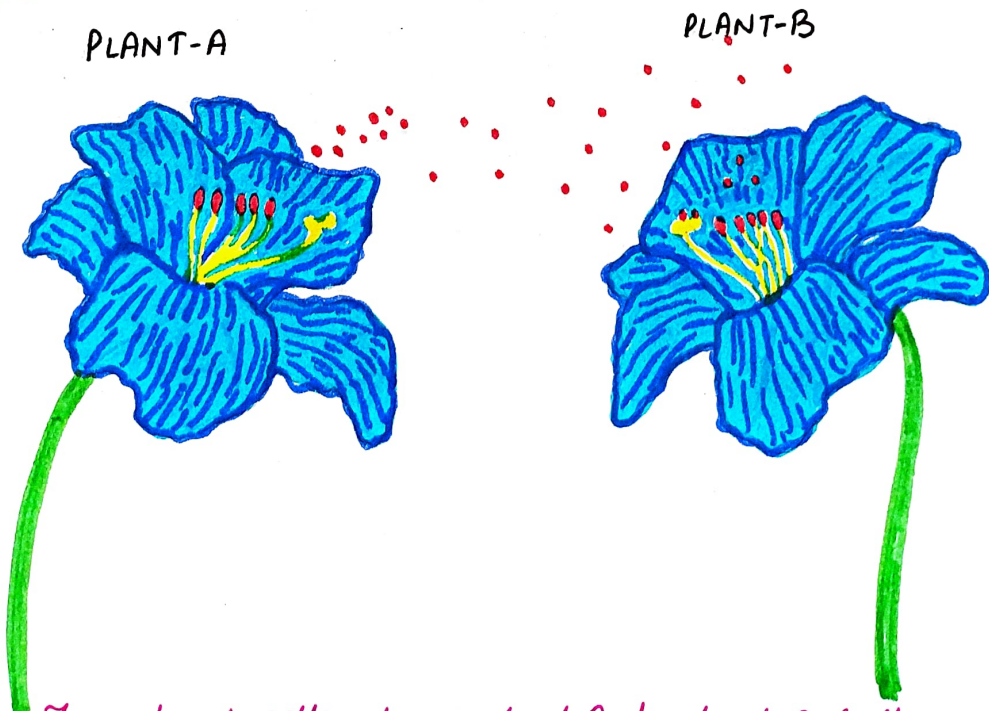
**CLEISTOGAMY:** it is self pollination before the flower opens. Some cleistogamous flower never open, in contrast to chasmogamous flower that open and then are pollinated.

Cleistogamous flowers by necessity are self compatible or self-fertile.

## [B] CROSS POLLINATION:

Cross pollination also called as 'ALLOGAMY' occurs when pollen is delivered to a flower from a different plant. Plants adapted to different outcross or cross-pollinate often have taller stamens than carpel or use other mechanism to better ensure the spread of pollen to other plant's flower.

Cross pollination is common in nature and it is advantageous to the plants.



Transfer of pollen from plant A to plant-B (allogamy)

# SELF POLLINATION

"Transfer of pollen grain from anther to stigma of the same flower or to different flower on the same plant is known as self pollination."

It can occur in bisexual flower as well as in unisexual flower which grow on same plant.

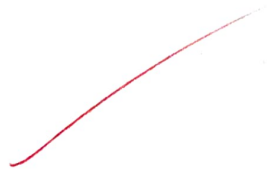
## ADAPTATIONS OCCUPIED FOR SELF POLLINATION

- ✓ The flower should be complete i.e. all the essential whorls should be present.
- ✓ shows cleistogamy i.e. pollination occur before the flower opens out.
- ✓ The anther and stigma show mature at the same time.
- ✓ The flower should be self fertile. The flower should be bisexual, and in unisexual flowers of monoecious species.
- ✓ Pollen grains produced are very large in number, in case of cross pollination, but self pollination has less number of pollen grain.
- ✓ Plants which are self pollinated do not have any physical barriers like:-
  - Unisexuality
  - Self sterility
  - Dichogamy
  - Herkogamy
  - Heteromorphism

## ADVANTAGES OF SELF POLLINATION

- ✓ No external agent is required for pollination, i.e. it is independent of pollinators.
- ✓ No extra character like nectar, odor or smell or any other specific character required to be found in self pollinated plant.
- ✓ Less number of pollen grains are required for pollination; therefore pollen grains are also not wasted.
- ✓ The purity of gametes are maintained i.e. pure lines are formed after self pollination.

## DISADVANTAGES OF SELF POLLINATION

- ✓ No variation is observed i.e. no new and healthier varieties are formed.
  - ✓ It results in weaker progeny, producing weaker seeds and plants.
  - ✓ The genetic diseases or bad characters of the plants are inherited from generation to generation.
  - ✓ Such self pollinating flowers are not much attractive and lack characteristic features.
  - ✓ In self pollination desired characters cannot be obtained easily.
- 



# CROSS POLLINATION

Transfer of pollen grains from the anther of the flower on one plant to the stigma of the flower on another plant is called cross-pollination.

Cross pollination is common in nature and it is advantageous to the plants. It always depends on pollinating agents. It occurs in all types of flowers and in both dioecious and monoecious species.

## ADAPTATIONS FOR CROSS POLLINATION

Nature favours cross pollination. All unisexual flowers and a large number of bisexual flowers are naturally cross pollinated.

The main contrivances ensuring cross pollination are as follows:-

### ► Dichliny or unisexuality :-

In unisexual flower stamens and carpels are found in different flowers. Unisexuality can be of two types:-

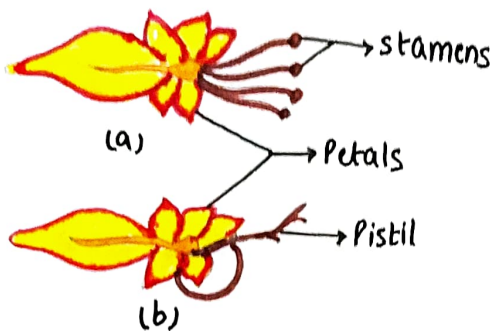
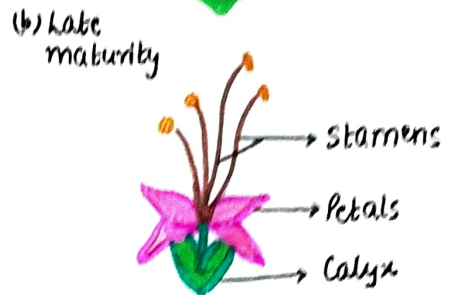
✓ Monoecious plant: when male and female flowers are borne on the same plant. Eg:- Maize, cucurbits, castor.

✓ Dioecious plant: when male and female flower are borne on different plant.

Eg:- Carica papaya, Cannabis

## ► Dichogamy

In bisexual flowers, when two sexes mature at different intervals and thus avoid self-pollination is known as DICHOGAMY. When stamens mature earlier than the stigma, it is known as PROTANDRY and the flowers are called PROTANDROUS. e.g. Coriander, Gasmire, Plantago: showing PROTOGAMY



Clerodendron: showing PROTANDRY

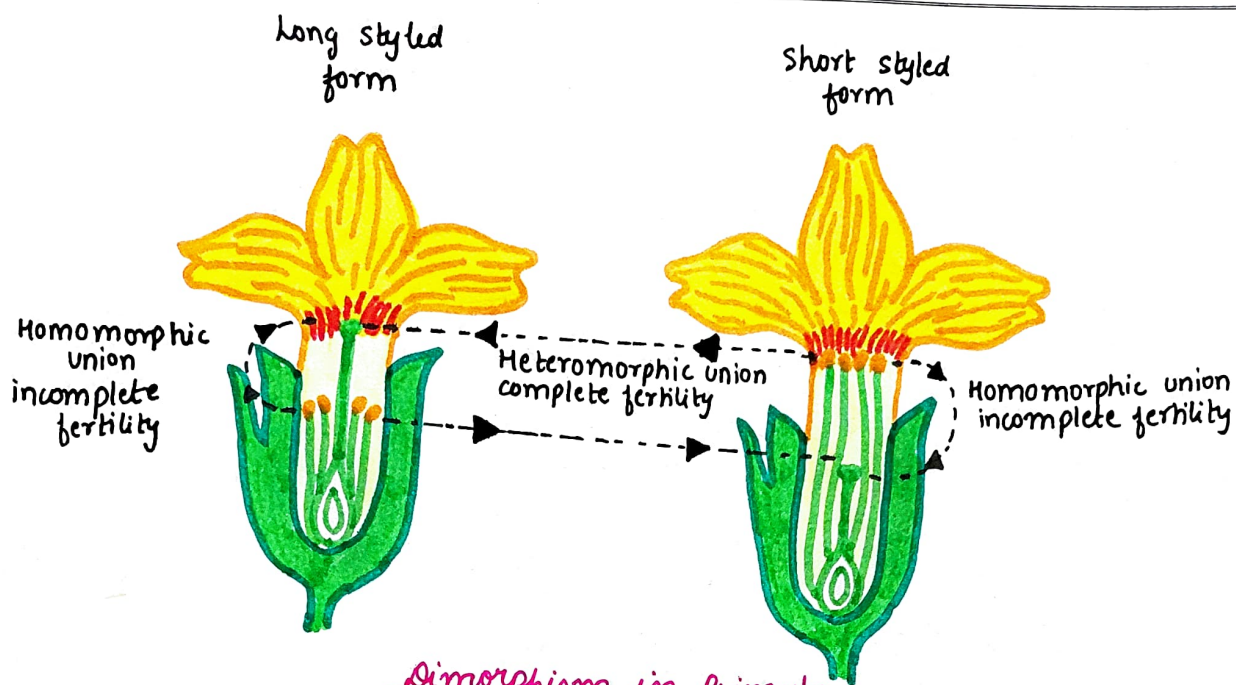
(a) Early maturity (b) Late maturity

Sunflower, Ladyfinger etc. When stigma matures earlier than the stamens, it is known as PROTOGyny and the flowers are known as PROTOGYNous. e.g. Rose, Tobacco, Crucifers etc.

## ► Heteromorphism

In certain plants, there are flowers of two (dimorphic) or three (trimorphic) different forms having anthers and stigmas at different levels. As a result of dimorphism or trimorphism in flowers, styles of different lengths are found and it is called heterostyly, and if different types of anthers are found, it is called heteroanthy.

Some of them possess a long style but short stamens and are known as PINEYED while others have short style and long stamen, called THRUM-EYED. e.g. Oxalis.

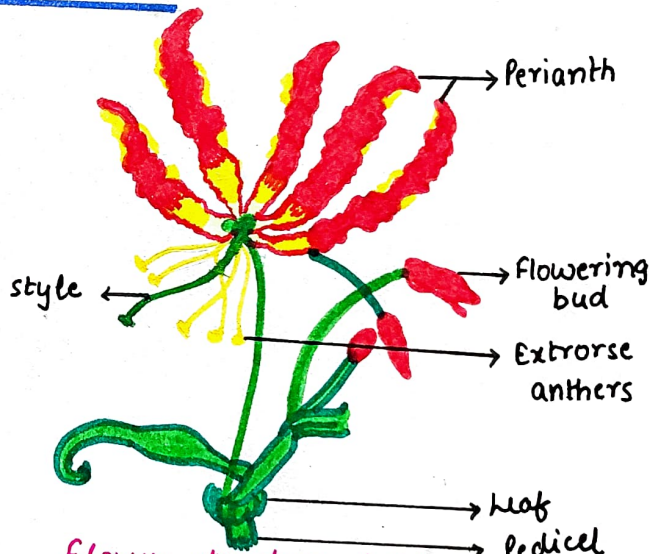


Dimorphism in Primula

► Herkogamy

The plants of some bisexual flower where the stigma and anthers mature at the same time, self pollination is avoided by some sort of barriers. The flowers show following adaptations :-

- male and female sex organs lie at some distance from each other.
- In some flowers, the pollens are held together to form pollinia which can only be carried away by insects. Eg:- Orchids and Calotropis.
- In some flowers, corolla has peculiar forms which act as barrier in self pollination. Eg. Aristolochia.

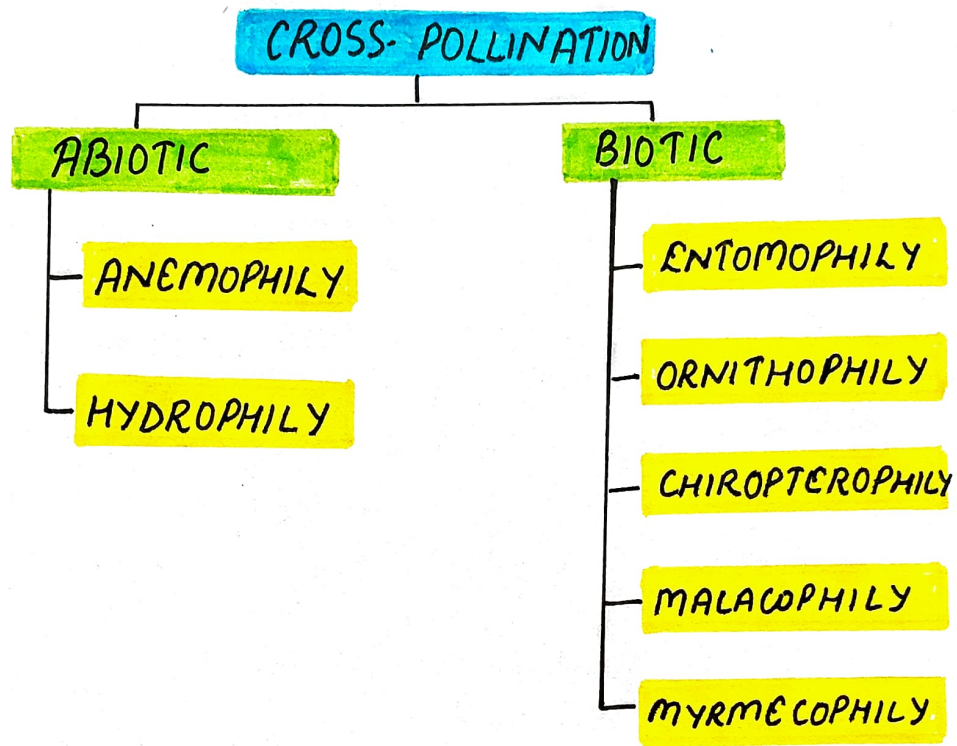


Flower structure of Gloriosa superba

## ► Self Sterility OR Incompatibility

When pollen grain of an anther do not germinate on the stigma of the same flower, then such flower is called SELF-STERILE or incompatible and this condition of flower is called SELF-STERILITY, INTRASPECIFIC INCOMPATIBILITY or SELF INCOMPATIBILITY. In these flowers, cross pollination is the only means for fertilization and production of seeds.

# Types Of Cross Pollination



# ANEMOPHILY

When flowers are pollinated by wind agencies, the phenomenon is known as ANEMOPHILY.

Anemophilous flowers are small and inconspicuous with long and versatile stamens e.g. sugarcane, maize, wheat, bamboo, Chenopodium, Date palm, grasses, Typha, coconut etc.

This type of pollination is mainly observed in Graminae.



## ADAPTATIONS FOR ANEMOPHILY



✓ Anemophilous flowers are small and inconspicuous with long and versatile stamen.

✓ stigma of anemophilous flowers are branched, bushy

and feathery in nature for catching pollens from air easily. e.g. flowers of many cereals.

- ✓ Flowers of cereals are unisexual and occur in branches.
- ✓ Anthers are versatile in them, swing freely in air.
- ✓ Pollen grains are very large in number.
- ✓ Pollen grains are light and smooth walled.

# HYDROPHILY

When pollination takes place through the agency of water, it is known as HYDROPHILY. All aquatic plants are not hydrophilous some are anemophilous e.g. Potamogeton, Myriophyllum or Entomophilous e.g. Alisma, lotus. Hydrophily is of two types:-

- Hypohydrophily
- Epiphydrophily

**HYPHYDROPHILY:** Plants which are pollinated inside the water. E.g. Zostera, Najas etc.

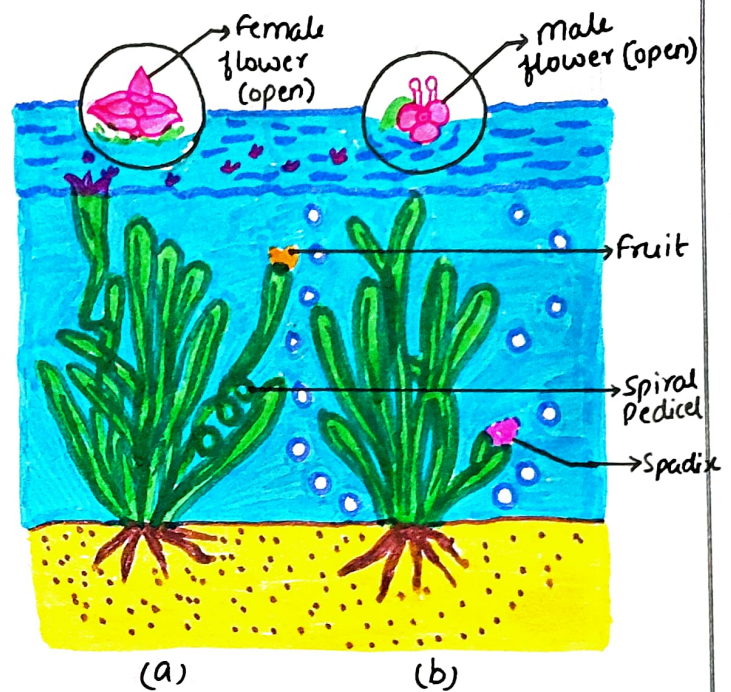
**EPIHYDROPHILY:** Plants which are pollinated outside the water. E.g. Vallisneria (ribbon weed).

## ADAPTATIONS FOR HYDROPHILY

- ✓ The colour of hydrophilous flowers are not bright and these flowers are also devoid of honey and scent. Therefore, their pollination is adapted to aquatic condition.
- ✓ Pollen grains are covered with thick mucilaginous covering to avoid destruction of pollen inside water.
- ✓ Pollen grains are usually flat and are boyance in nature so that they can swim in water and reach the stigma of female flower.

# Water Pollination In Vallisneria

Vallisneria is an aquatic plant in which pollination takes place through water. Its male and female plants are separate. The small male flowers are borne on the short stalked spadix inflorescence. The male flowers are produced in large numbers and on maturation they get detached from the inflorescence in closed



## Pollination in Vallisneria

(a) Female plant (b) Male plant

condition and float freely on the water surface. On the other hand, the female flowers are borne slightly on very large pedicel. During pollination, the perianth of female flower spreads so that the flower becomes light and pedicel opens and comes on the water surface. In this way, female flower comes in contact with the male flower. The anthers of male flower burst open and pollen grains are released and stick to the stigma of female flower and pollination occurs. After this, the pedicel of female flower again begins to coil and fruit develops from female flower inside the water only.



# ZOOPIIILY

This type of pollination is sub-divided into following types:-

- ▶ Entomophily
- ▶ Ornithophily
- ▶ Chiropterophily
- ▶ Malacophily
- ▶ Myrmecophily



ZOOPIIILY is pollination by animals.

## Entomophily



When pollination is done through insects, it is known as ENTOMOPHILY. Insect pollinated flowers become attractive in different ways to attract insects, and

the pollens of these flowers are sticky and rough surface so that they may easily stick with insect limbs.

The stigma of these flowers is also sticky so that they can receive pollen grains easily.

# Ornithophily



When flowers are pollinated by birds, the phenomena is known as ORNITHOPHILY. The most common bird pollinators are sun bird, humming bird, crow, bulbul, parrot, mynah etc. The bird visit are large variety

of flowers such as Bombax (red silk cotton), Erythrina (coral tree), Callisterna (bottle brush), Bignonia, Agave etc. Flowers are brightly coloured and produce plenty of nectar and large quantities of pollen. Humming bird pollinates while hovering over the flowers and sucking nectar. The bird can derive about half of its body weight of nectar in a single day. The nectar is chiefly made of sugar and provides a sweet drink to the bird.

# Myrmecophily

When flowers are pollinated by ants, this phenomena is called as MYRMECOPHILY. The whole colony of ants travel such plants for nectar or food and thus pollen sticks to their



appendages and are pollinated to other plant.  
Eg. Anemone nemorosa (fruit)

# Chiropterophily

It is mode of pollination performed by bats. The flowers they visit are large, dull-coloured and have strong scent. Chiropterophilous flowers produce abundant pollen grains. These flowers secrete more nectar than ornithophilous flowers and open at night emit a good fragrance. e.g. Kigelia pinnata (sausage tree), Adansonia (baobab tree), Bauhinia rugalandra, Anthouphalus (Kadam tree) etc.



# Malacophily

Pollination by slugs and snail is called MALACOPHILY. Land plants like Chrysanthemum and water plant like Lemna shows malacophily. Arisaema (aroid: snake plant) is often visited by snails.



# Pollination In Ficus

The flower of Ficus plant is surrounded by hollow pear-shaped hypanthodium inflorescence. The receptacle has a narrow orifice through which



insect enters into the flower. It has three types of flowers, i.e. male, female and gall. The male flowers are situated at the apex close to orifice while on the lower side are the long styled female

flowers and the short styled gall flowers, which are also female. Figs are pollinated by the Blastophaga which crawls into the receptacle and lays eggs into the ovules of the gall flowers, which can easily reach inside due to its ovipositor and short style. The larvae developing from eggs feed on the ovules and form galls. After passing the pupa stage, larvae develop into mature wasps and crawl out of the fig. In doing so, they brush against the male flowers present near the orifice carrying pollen grain on their bodies. These pollen-laden insects then enter fresh fig where they pollinate the long-styled female flowers and lay their eggs within the gall flowers.

1. A pollen-laden female wasp enters the syconium of an unripe fig through an opening known as the OSTIOLE.

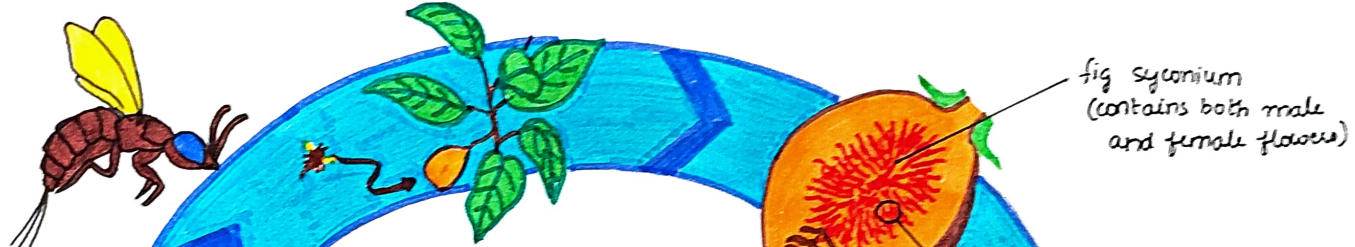


fig syconium (contains both male and female flowers)

2. The wasp lays eggs within some of the flowers in the syconium in the process the insect pollinates the other female flowers

3. Flower ovaries that contain wasp larvae form enclosing gall-like structures. The pollinated flowers without larvae produce seeds for the fig plant.

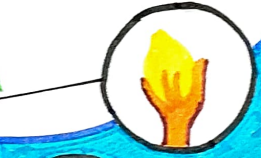
4. As the fig matures, male wasp emerges first from the gall. Then they travel the syconium in search of female wasp fertilizing them while the females are still in their galls.

5. Male flowers have matured by the time male female wasp emerges from their galls.

8. The female wasp, carrying pollen, flies to another fig tree in search of a syconium in which to lay her eggs. She dies within the syconium soon afterward.

7. After collecting pollen from mature male flowers within the ripe fig, the mated female wasp escape through the tunnel.

6. Without ever leaving the syconium, the wingless male wasp dig escape tunnels for their mates and then die.



# Pollination In Salvia

Salvia is a bilabiate flower. The upper lip is formed by fusion of two petals whereas the lower lip by fusion of three petals. The upper lip is slightly curved in which male and female sex organs are situated.

The lower lip acts as platform for insect.

The salvia flower has two stamens which mature before carpel. The filament of each stamen is short but connective is very long. One anther of stamen is sterile and the other is fertile. Connective function is lever on filament.



In flower, a lever plate is situated before the honey cavity which is connected with stamen. As soon as any insect gets inside to suck honey, it comes in contact with the lever plate resulting into the vibration in connective and pollen grains from fertile anther come out and stick on the back and wings of insect. Now this insect after sucking honey reaches another flower whose carpel is matured and stigma protruded out from upper lip, comes in contact with the stigma thereby pollinating it with pollen already present on its back.

## REWARDS OF POLLINATION

- ✓ **Conspicuousness** - petals/perianth leaves become brightly coloured. Sometimes, bracts, sepals and even stamens become petaloid. Flowers become large and attractive.
- ✓ **Scent** - characteristic odor or smell is observed in some plants which attract birds and insects thereby enabling pollination.
- ✓ **Nectar** - nectar gland position differ from plant to plant, these gland secrete honey for insects. Insects visit flowers for nectar
- ✓ **Edible sap** - those plants which do not secrete nectar have edible sap which attracts insects.
- ✓ **Edible pollen** - pollen grains of some flowers are eaten by some insects.
- ✓ **Special mechanism** - several insect-pollinated flowers show special mechanism for dispersal of pollen grains:-
  - Irritability
  - Explosive mechanism
  - Ballistics

## ADVANTAGES OF CROSS POLLINATION:-

- ✓ It overcomes self-sterility and protandry found in many economically important plants. For this, orchardists grow two or more varieties of plants in order to ensure better yield.
- ✓ Yield always remains above an average minimum.
- ✓ It eliminates defective traits. The harmful recessive traits remain unexpressed due to the phenomenon of heterozygosity.
- ✓ It introduces a number of alleles.
- ✓ Cross pollination is used to produce new varieties of plants.
- ✓ It increases resistance to diseases.
- ✓ Cross pollination enhances adaptability of the offspring to changes in the environment.
- ✓ The offspring formed after cross pollination are better fitted in the struggle for existence.

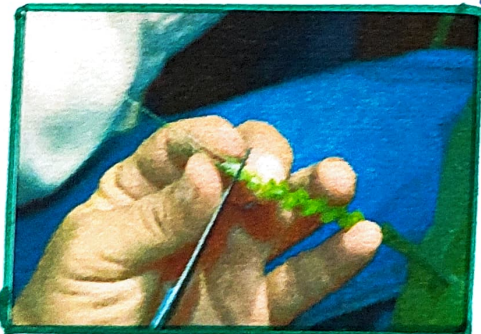
## DISADVANTAGES OF CROSS POLLINATION:-

- ✓ It is highly wasteful process, because of the large number of contrivances required to ensure it.
- ✓ For cross pollination by any agency, a chance factor is always there.
- ✓ It is not an economical phenomenon for plants.
- ✓ Good characters of a race can be diluted.
- ✓ Undesirable characters will enter in the progeny.



# ARTIFICIAL POLLINATION

**ANTHROPHILY**: It is artificial pollination performed by human beings during breeding experiments among selected varieties. Pollen grains are collected in small pockets from the male parent. The same are dusted over the stigma of the female parent with the help of an uncontaminated brush. Artificial pollination is further accompanied by artificial hybridization. In this technique, it is important that only desired pollen grains are used in pollination and the stigma of the desired plant is protected from contamination from unwanted pollen. This is carried out by the two process of emasculation and bagging. **EMASCULATION** is the practice for removing anthers in their bud condition



from the bisexual flower of plants selected as female parent by means of a pair of fine forceps. **BAGGING** is the covering of both emasculated and non-emasculated flowers with butter paper or polythene in their bud condition to prevent contamination from unwanted pollen. When the stigmas of emasculated flowers mature, the bags are removed for a while. The stigmas are dusted with desired pollen grain. The flowers are rebagged till fruits are developed. However, flowers are bagged to prevent contamination.



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