SUBJECT: EMBRYOLOGY TOPIC: POLLINATION



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TYPES OF POLLINATION

1.SELF POLLINATION (AUTOGAMY)

2. CROSS POLLINATION (ALLOGAMY)

a. GEITONOGAMY-Pollination occurs between two flowers on the same plant

b. XENOGAMY- Between two flowers on different plants

Mechanism favoring cross pollination (or) barriers to self pollination

Self sterility
 Dichogamy
 Herkogamy
 Heterostyly



dichogamy



 Dichogamy: It refers to maturation of sex organs at different time period.
 It shows two conditions

1. **Protandrous**: here anthers mature before stigma.

Example: Rubiaceae, Malvaceae, Labiatae.

2. Protogynous: here stigma matures before the anthers. Example: Mangolia, Michalia, Adhatoda.



Adichogamy Male and female organs gain reproductive activity at the same time.





Protandry



- Most flowers use this mechanisms, e.g. rose-bay willowherb
- The stamens ripen before the stigma is receptive to pollen.
- So pollen is gone by the time stigma is ready.

First day flowerstigmas receptive

Second day floweranthers dehiscing

otogyn

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 Illinois Natural History Survey

Protogyny

1st day flower

2nd day flower

tigmas

nthers

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Herkogamy

In bisexual flowers the structure of the male and female sex organs itself proves a barrier to self pollination. Presence of the any physical barrier in between stigma and stamens is also known as herkogamy. Herkogamy: In certain flowers, morphological barriers develop which makes self pollination impossible.

Example:



Calatropis



Zeuxine

Self-Sterility: Flowers in which pollens are incapable of causing fertilization. Example: Maize.









Herkogamy :-

- It is mechanical device to prevent self pollination in a bisexual flower.
- In these flowers natural barriers prevents self pollination.
- In bisexual flowers the stamens and stigma are placed at different level that prevent self-pollination.
- For examples --- 1) In calotropis, pentangular stigma is positioned above the anther.
- In Gloriosa superbo, the style is reflexes away from the stamens.
- 3) In Hibiscus the stigmas project far above the stamens.







Outbreeding devices:

- HETEROSTYLY: Flower have different types of height of styles and stamens.
- Eg. Jasmine, Primrose, Lythyrsus, Oxalis.







Short-styled Flower (Thrum)

Long-styled Flower (Pin)





Distyly: Primose (Primula vulgaris)

Tristyly: eg. Lythrum and Oxalis





Fig. 2.24. Tristyly. A, Flower with long style, medium and short stamens. B, Flower with medium style and long and short stamens. C, Flower with short style, medium and long stamens.



Agencies of pollination



ANEMOPHILY

Adaptations for Wind Pollination:

- Wind pollination is also termed as an emophily and takes place through the wind.
- 1.Flowers are small, colorless, inconspicuous, nectar less and become arranged as inflorescence.
- 2. The anthers are well exposed for the easy dispersal of pollen grains.
- 3.Pollen grains are small, light, dry, dusty, non-sticky and sometimes even winged.
- 4.The stigmas are large, hairy and feathery or branched to catch the air borne pollen grains.
- 5.Common examples of wind pollinated flowers are grass, sugarcane, bamboo and coconut, etc.

HYDROPHILY

Adaptations for Water Pollination:

Water pollination is also termed as hydrophily and mode of pollination is water. It is quite rare in flowering plants and is limited to about 30 genera, mostly monocotyledons.

i. It is very common in plant groups such as algae, bryophytes and pteridophytes. Flowers are small, colourless, inconspicuous, odourless and nectar-less and pollen grains and stigmas are generally unwettable. ii. The stigmas are long and sticky, e.g., Vallisneria, Hydrilla and Zostera.

iii. Not all aquatic plants use water for pollination. In a majority of aquatic plants, the flowers emerge above the level of water and are pollinated by insects or winds as in land plants, e.g., water hyacinth and lily.

iv. In Vallisneria, the female flower reach the surface of water by the long stalk and pollen grains are released on to the surface of water.They are then carried by the passive water currents.

HYDROPHILY- TWO TYPES

1.HYPHYDROPHILY (HYPOHYDROGAMOUS)

INCLUDES PLANTS WHICH ARE POLLINATED

INSIDE WATER

CERATOPHYLLUM

2.EPHYDROPHILY (EPIHYDROGAMOUS) –

FLOWERS ARE BORNE UNDER WATER WHILE IT

TAKES PLACE ON THE WATER SURFACE,

VALLISNERIA



FIG. 403. Epihydrogamy in Valimeria. A. A female plant. B. A male plant. A large number of male flowers and a female flower are floating on the surface. A male flower with the two erect stamens is shown enlarged.



Figure 1.16 Pollination in Vallisneria



Adaptations for Insect Pollination:

Insect pollination in also termed as entomophily.

1.Insect-pollinated flowers are large, colorful, fragrant and rich in nectar. A number of flowers are clustered into an inflorescence to make them conspicuous.

ii. Flowers have nectar glands and are highly fragrant to attract insects.

iv. Nectar and pollen grains are floral rewards for the insect pollinators.

v. In some species, floral rewards are to provide safe place to lay eggs, e.g., for the tallest flower of Amorphophallus (about 6 feet in height).

vi. In plant Yucca, moth and the 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 plant gets pollinated by the moth. The larvae of the moth come out of the eggs as the seeds start developing.

Salvia of Labiatae (The Sage Flower):

Salvia has got a bilabiate corolla with two fertile epipetalous stamens. The stamens and pistil remain hidden under the upper lip

The flower is protandrous filament of each stamen is long and lever-like,

The basal lobe of the anther is sterile while the upper lobe is fertile. A slight pressure on the lower anther lobe brings the upper lobe down). Salvia is bee-pollinated. Bees alight on the lower lip of the corolla and enter the flower to reach the nectary at the end of the corolla tube. In so doing, they push against the united lower anther lobes thereby bringing down the fertile anther lobes which dust the bee's back with pollens.

When the pistil of the flower becomes ripe, the stigmas protrude out of the upper lip so that any bee entering the flower brushes against the stigma thereby pollinating it with pollen already on its back.



Fig. 397. Pollination in Seleie. A & B. L.s. of flower showing immature pistil and movement of stamen when pressed in the direction of the arrow. C. A bee becoming dusted with pollen. D. A flower with mature stigma.

ZOOPHILY- pollination is performed by vertebrates such as birds and bats Zoophilous flowers are again subdivided into

- (A) Entomophilous (insect-pollinated),
- (B) Ornithophilous (bird-pollinated),
- (C) Chiropterophilous (bat-pollinated) and
- (D) Malacophilous (slug- and snail-pollinated)

CHEIROPTEROPHILY



Bats are very important pollinators in tropical and desert climates. Most flower-visiting bats are found in Africa, Southeast Asia, and the Pacific Islands.

The <u>flowers that are visited by bats</u> are typically:Open at night;

- Large in size (1 to 3.5 inches);
- Pale or white in colour;

Very fragrant, a fermenting or fruit-like odor; and/or

Copious dilute nectar.

Phalaenophily – pollination by moth, examples in the evening primrose (*Oenothera biennis*), some tobacco (*Nicotiana* spp.), most honeysuckle (Lonicera spp.), Verbena, and Lantana.

Cantharophily – pollination by beetle.

Melittophily or hymenopterophily – Pollination by honey bees

Psychophily – pollination by butterfly, example the Indian paintbrush (*Castilleja* sp.) by swallowtail butterfly.

Sapromyiophily – pollination by flies such as the carrion, dung, and mushroom fly, example in carrion flowers which emit foul odors

Myrmecophily – pollination by ant, example in the Dwarf owl-clover (*Orthocarpus pusillus*).

Necrocoleopterophily – pollination by carrion beetle, example in the carion flower *Hydnora africana*.

ORNITHOPHILY



The common bird pollinators are humming birds, sun birds and honey eaters.

Birds can obtain only one staple food from flowers and that is nectar.

The bird pollinated flowers have funnel – shaped or tubular corollas which are brightly coloured.

The floral parts are commonly leathery and they produce copious amount of nectar and large quantities of pollen which are sticky.

ARTIFICIAL POLLINATION

- This technique is used for the purpose of Hybridization.
- It involves pollination of desired female parents with pollen from the desired male parent, taking all precautions to prevent contamination of stigma with undesired pollen.
- In unisexual plants the procedure is simple but its complicated in bisexual ones.
 - 2 processes that takes place in bisexual flower :
 - Emasculation
 - Bagging



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- A difficulty in hybridisation arises when the two desired parents bloom in different seasons, or if they grow in different parts of the world
- This is because pollen of most plants have a short life
 span, normally only in a few species retain viability for
 over 2 days

In order to extend pollen viability period storing them under special conditions is desirable Pollen storage: some methods of pollen storage are:

- 1. Dry and cold storage controlling temperature and humidity
- Cryogenic preservation- storing in liquid nitrogen at -196
 C
- 3. Organic solvents- acetone, benzene ,ethanol ,phenol etc. are generally regarded as toxic to organisms – but pollen grains kept in these can germinate and undergo fertilization

Applications of pollen storage are:

- 1. To hybridise plants that flower at different times and locations or show non synchronous flowering
- 2. To provide a constant supply of short lived pollen
- 3. To ensure the availability of pollen throughout the year
- viability of pollen are tested in order to the efficacy of pollen storage . Various viablity methods used are:
 pollen germination and pollen tube growth in living pistils , tetrazolium test , FDA test, in vitro pollen
 germination etc

