Lecture :- 01.

Date
Page 01

Sexual Reproduction in flowering plant :-

➢ Male Reproductive System.

i.e. Plant Embryology

∴ Father of plant Embryology - C.E Wolf.

∴ Father of Indian plant Embryology - P. Maheswari.

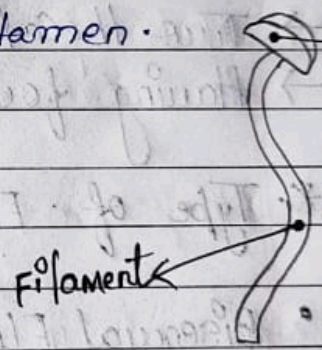
∴ Male Reproductive System :

→ In angiosperm male reproductive organ is called Androecium.

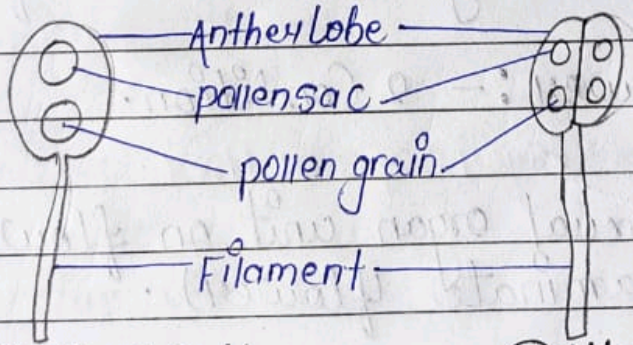
→ unit of androecium is called Stamen.

→ Stamen Consist of two part.

1. Anther.
2. Filament.



Structure of stamen.



Monothecous Anther
or
Bisporogenate Condition.

Dithecous Anther.
or
Tetrasporogenate Condition.

→ protective Covering.

⇒ Callose band of alpha-cellulose present radial wall of Endothecium which provide strength and rigidity.

→ If Callose band is absent at some place then called Stomium.

→ Dehiscence of anther take place from Stomium.

3. Middle Layer :-

→ Made up of 1-3 celled layer of parenchymatous cell.

→ Helps in Storage of food.

→ Absent in mature flower.

4. Tapetum :-

→ Inner most layer of anther.

→ which surrounds the pollen sac.

→ Single celled layer.

→ It is nutritive layer.

Some useful terms :-

- Microsporophyll — Stamen
- Megasporophyll — pistil / carpel.
- Microsporangium — pollen sac.
- Megasporangium — ovule.
- Male Gametophyte — pollen grain.
- Female Gametophyte — Embryo sac.

Structure of Anther — Made up of four layer.

1. Epidermis
2. Endothecium
3. Middle layer.
4. Tapetum.

1. Epidermis :-

→ outermost layer.
→ Single Celled layer.
→ Thick
→ protective Covering of Anther.

2. Endothecium :-

→ Single Cell layered.
→ present just below the epidermis.

- Anther Can be of two type :-
  - ➤ Monothecous Anther / Bisporogenate Condition.
  - ➤ Dithecous Anther / Tetrasporogenate Condition.

- **Monothecous Anther / Bisporogenate Condition :-**

→ Found very Rare.
→ Only one Theca / Lobe.
→ Having two pollen Sac (i.e. Bi-Sporogenate).

- **Dithecous Anther / Tetra sporogenate Condition :-**

→ Found usally.
→ Two theca / lobe.
→ Having four pollen sac (i.e. Tetra-Sporogenate).

*. **Type of Flower :-**

- **Bisexual Flower :-** Both male and Female Sexual organ unit in one flower.

- **Unisexual Flower :-** 2 Condition.

1. Only male Sexual organ unit on flower. (i.e. Staminate flower).

2. Only Female Sexual organ unit on flower. (i.e. pistillate flower).

- It helps in:

(a). Transport of Food.
(b). Storage of food.
(c). Synthesis of sporopollenin.
(Biologically most resistance protein).
(d). Synthesis of pollen kit material.

Lecture – 02

Date
Page 06

i.e. plant Embryology

∵ Father of plant Embryology – C.E Wolf

• Father of Indian plant Embryology – P. Maheswari.

Microsprongium / pollen Sac :-

• Inside the microsprongium pollen grains are formed by meiosis in microspore mother cell.

• A group of homogeneous cell occupy at the centre of pollen sac called Sporogenous tissue.

• The cell of sporogenous tissue differentiate to form microscope mother cell.

Microsporogenesis :- Formation of microspore / pollen grain.

• Microspore mother cell or pollen cell undergoes four meiotic division and form four microspore (Haploid microspore).

• Initially all four microspores are attached to each other with the help of Callose.

• Later on Callose Enzyme is secreted from tapetum which dissolve the Callose so all four microspore become free called pollen grain.

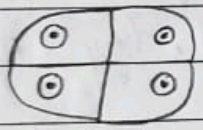
Date
Page 07

Types of Microspore Tetrad :

- Seven Celled and Eight nucleated Embryosac type pollen grains is found in hyacinth.
- First discovered by Nemec so Called Nemec phenomena.

Types of Microspore tetrad :

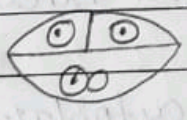
Isobilateral Type . Ex - Monocot.
Tetrahedral Type . Ex - Dicot.
Decussate Type .
Linear Type.
T- Shaped.



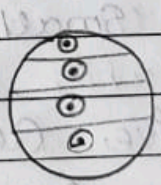
Isobilateral



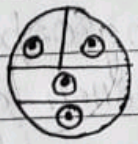
Tetrahedral.



Decussate



Linear.



T- Shaped Type.

Development of male gametophyte / pollen grain / microspore :-

- Microgametogenesis — Development of pollen grain.
- when pollen grain start developing then it divide unequally through mitotic division to form two unequal cell.

1. Vegetative cell.
2. Generative cell

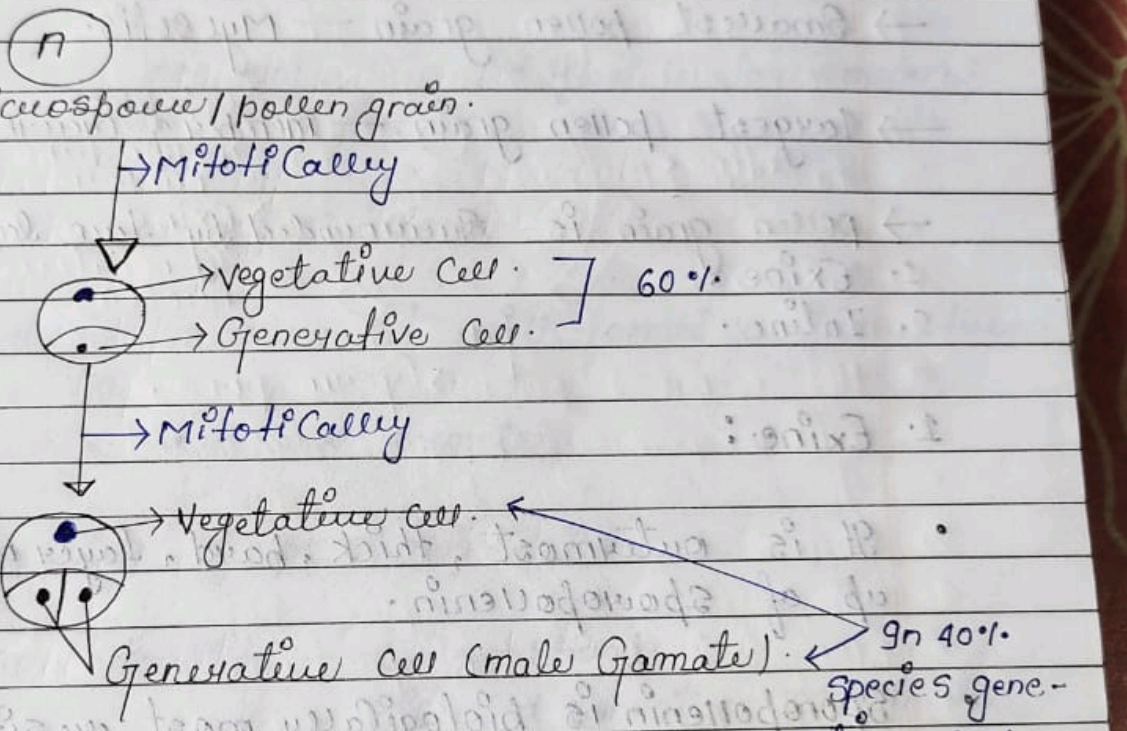
1. Vegetative cell :-

- It is bigger and rich in reserve food material and having a large irregular shaped nucleus.

2. Generative cell :-

- It is smaller cell having dense cytoplasm and a small spindle shaped nucleus.
- Generative cell float in the cytoplasm of vegetative cell.
- In majority of angiospermic plant (more than 60%) pollen grain are divided into 2 cell stage i.e. vegetative and Generative cell.

- In remaining species i.e. (less than 40%) generative cell divide mitotically to form two male gametes and pollen grains are shows (i.e. pollination occurs in 3-cell stage 1 vegetative and 2 male gamet.



Structure of microspore / pollen grain :-

→ pollen grain is the male gametophyte.

→ unicellular and haploid.

→ Spherical in shape.

→ 25- 50 micrometer in diameter.

→ Smallest pollen grain — Myosotis.

→ largest pollen grain — member of cucurbi

→ pollen grain is surrounded by two layer:-
1. Exine.
2. Intine.

1. Exine:

- It is outermost, thick, hard, layer made-up of sporopollenin.
- Sporopollenin is biologically most resistive protein on Earth, no any enzyme is discovered so far which can degrade the sporopollenin.

Germ pore — It is present in exine where sporopollenin is absent.

→ Germination of pollen grain occurs through germ pore.

→ O_2, mineral, H_2O is transported through germ-pore.

→ pollen tube executed out.

2. Intine :

→ It is innermost, Thin and flexible layer made up of Cellulose and pectin.

→ It is Continuous layer.

→ After get mature it will formed as pollen tube.

→ which Carry male gamete

character of pollen Grain :

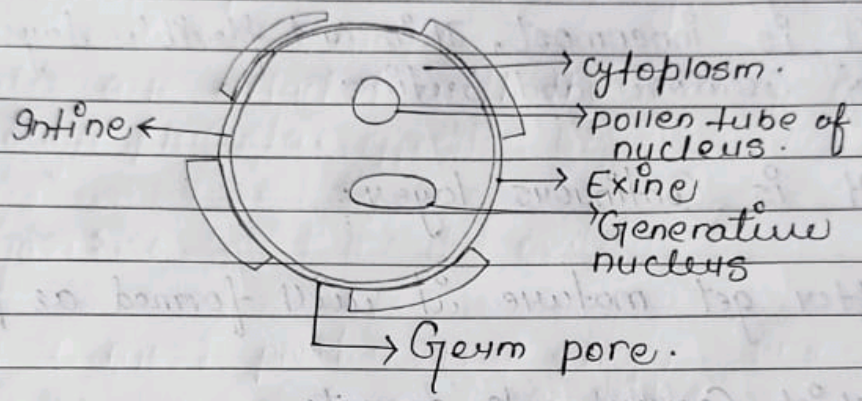
1. pollen viability — (Life-Span).
   Rice and wheat — 30 Minute.
   Rosaceae — 2/3 yr.
   Leguminous — 3/4 yr.

2. pollen Allergy — (parthenium + wheat pollen).

3. pollen product — Tablets / Syrup / Food supplements.

4. pollen Storage — Rare plant / extinct plant (store in liquid nitrogen (−196 degree c).

pollen grain of angiosperm:



Lecture: 03.

Page 13

Female Reproductive System:

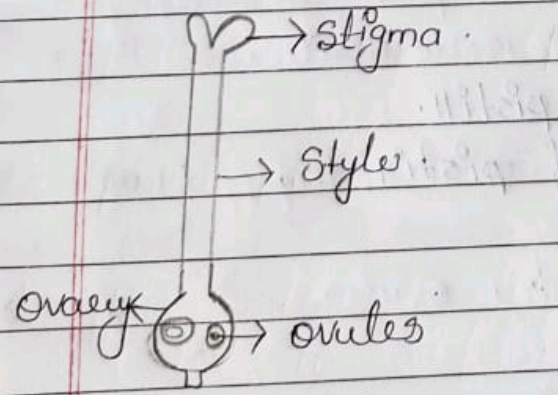
- In angiospermic female reproductive organ is called gynoecium.
- pistil / carpel is the unit of gynoecium.
- pistil / carpel is also called megasporophyll.
- If Gynoecium consist of single carpel - Monocarpellary.
- If Gynoecium consist of two or more carpel - Multicarpellary.

Multicarpellary pistil can be of two type:

1. Syncarpous.
2. Apocarpous.

1. Syncarpous :- more than one pistil fused to each other.

2. Apocarpous :- pistils are not fused to each other.



Structure of Gynoecium.

* pistil :-

→ pistill Consist of three part
1. Stigma.
2. Style.
3. ovary.

→ Ovules are present inside ovary.

→ Ovules are attached with the wall of ovary through placenta.

1. Stigma :-

- Upper most part.
- Where pollen grain are germinated.

2. Style :-

- Elongated tube like part.
- Carry pollen tube (male gamete passes the ovary).

3. Ovary :

- Basal (Bottom) part of pistill.
- Bulges part (swollen) of pistil.
- Consist of ovule.

Structure of ovule :-

- Ovule represent the megasporangium (ovule).
- Ovule is a small structure.
- Ovule attached with placenta through a stalk called Funicle
- The point of attachment of funcicle with ovule is called Hilum.
- Ovule is covered by one or two covering is called Integument.
- The main part of ovule is Nucellus.
- Nucellus is made up of a parenchymatous tissue which differentiate to form megaspore mother cell.
- The point of ovule where integument is absent is called micropyle.
- Opposite to micropyle, chalazal end present that is base of ovule.

4. Campylotropus :- Campylo = Nucellus, Tropus = Turn.
- Nucleus is curved but not Embryo sac.
- It is also called curved look.

5. Amphitropus :- Amphi = Both, Tropus = Turn.
- Look like horse shoe shaped.
- It is also called transversely ovule.

6. Circinotropus :- Circino = Circular, Tropus = Turn.
- Circularly turn.
- It is also called circular ovule.

Type of ovule :-

1. Orthotropus :- Ortho = Straight, Tropus = Turn.
- straightly situated.
- It is also called Atropus.

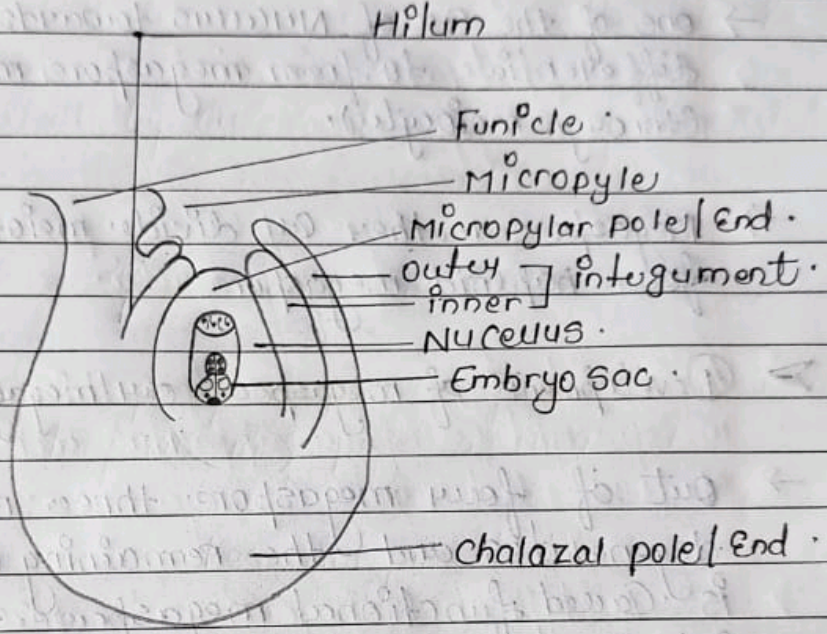
2. Anatropous :- Ana = opposite, Tropus = Turn.
- opposite situated.
- It is also called inverted ovule.

3. Hemitropus :- Hemi = Half, Tropus = Turn.
- Micropyle end turn at 90 degree.
- It is also called hemi-Anatropous.

4. Campylotropus :- Campylo = Nucellus, Tropus = Turn.
- Nucleus is curved but not Embryo sac.
- It is also called curved look.

5. Amphitropus :- Amphi = Both, Tropus = Turn.
- Look like house shoe shaped.
- It is also called transversely ovule.

6. Circinotropus :- Circino = Circular, Tropus = Turn.
- Circularly turn.
- It is also called Circular ovule.



Structure of ovule:

Lecture-04

Date
Page 18

▲ Female Reproductive System:-

➤ Megasporogenesis :- Formation of megaspore.

→ Formation of megaspore from megaspore mother cell.

→ one of the cell of Nucellus towards micropyle differentiate to form megaspore mother cell (MMC)- (through meiocyte).

→ Megaspore mother cell divide meiotically to form four haploid megaspore.

➤ Development of megaspore or megagametogenesis :-

→ Out of four megaspore three megaspore degenerates and the remaining one megaspore is called functional megaspore - which develop into female gametophyte or Embryo sac.

→ Functional megaspore is the first cell of female gametophyte.

→ Embryo sac represent the female gametophyte.

→ Development of Female gametophyte or Embryo sac from single megaspore is called monosporic development.

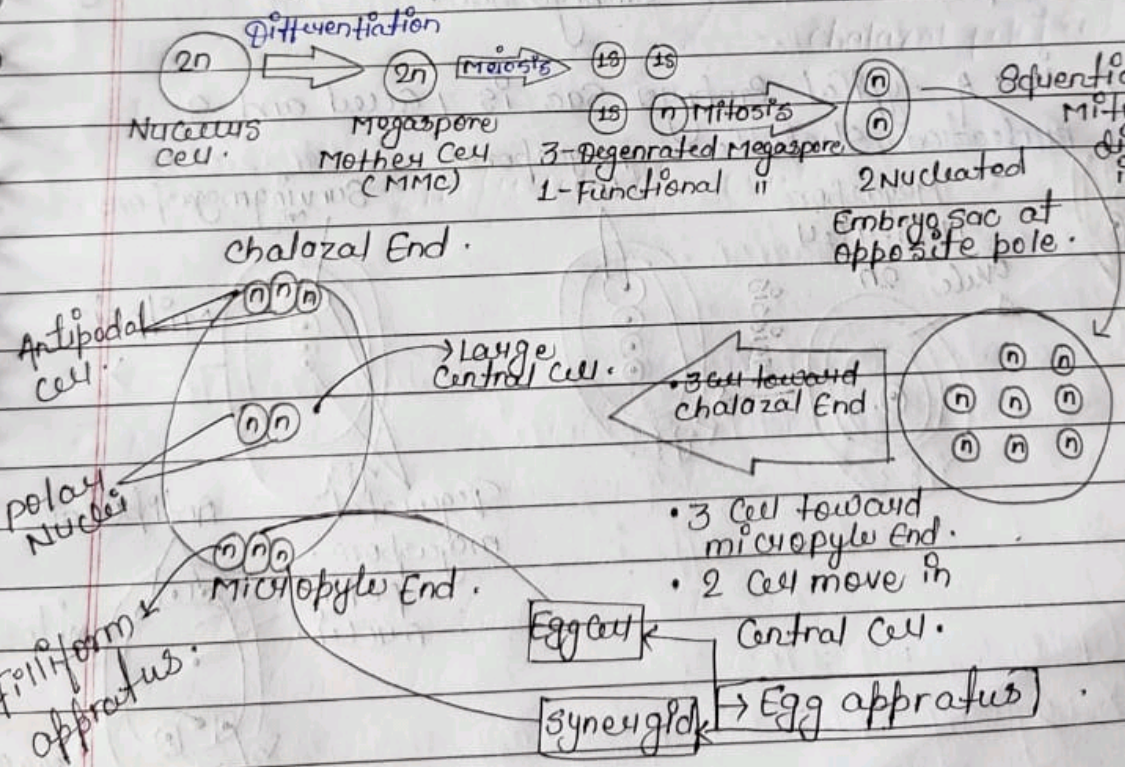
→ The nucleus of functional megaspore divide mitotically to form two nucleated embryo sac and both the nuclei moves towards opposite pole.

→ The sequential mitotic divisions occurs in both the nuclei to form eight nucleated embryo sac.

→ All these mitotic division are free nuclear division i.e. karyokinesis is not followed by cytokinesis.

→ Out of eight nuclei, six nuclei start cytokinesis and organised into Embryo Sac.

Embryo Sac formation



→ 3 cells are present toward chalzal end called antipodal cell.

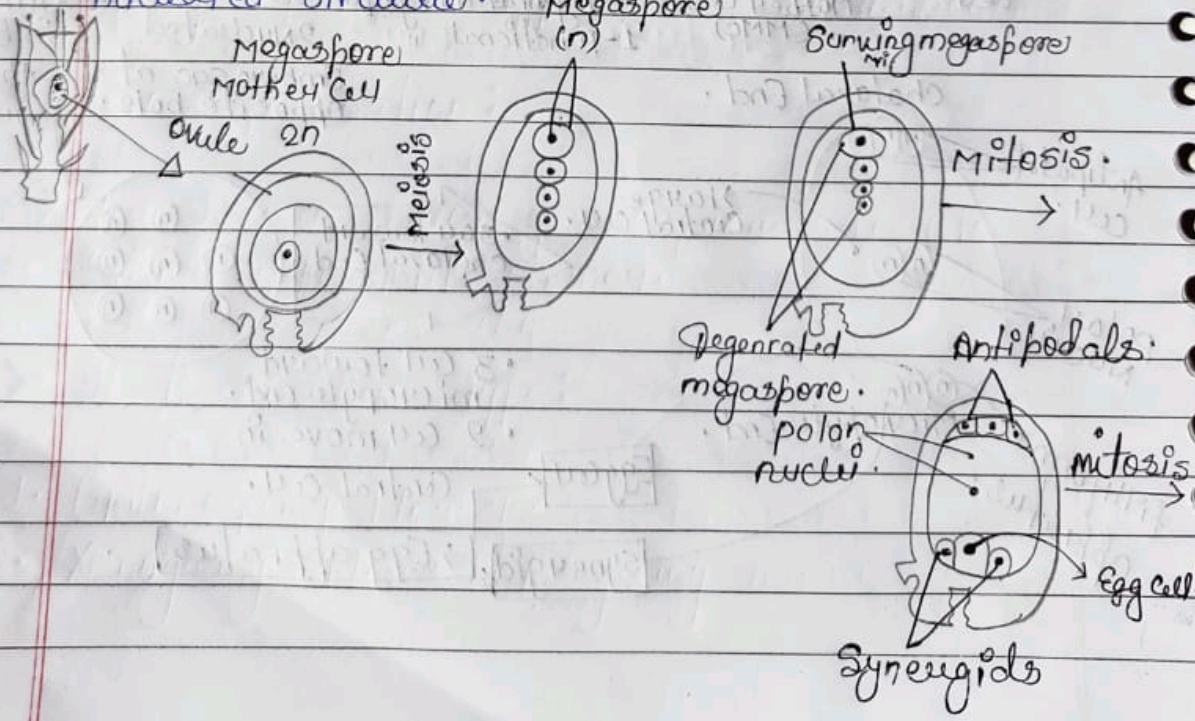
→ 3 cells are arranged towards micropyle end called egg apparatus.

→ Egg-apparatus Consist of two synergid and one egg cell.

→ The remaing two nuclei are present in large central cell called polar nuclei.

→ A special type of cellular thickning is present in Synergid filliform apparatus which guide the entry of pollen tube into Embryo sac.

→ i.e. A typical Embryo Sac is 7 celled and 8 nucleated Structure.



- Antipodal cell :-

→ provide nourishment to the egg cell.
→ It is rich in lipid Content.

- Egg Apparatus : Formed by two Component, egg cell and Synergid.

- Egg cell :- Haploid female gamete.
forming a zygote after fertilization.

- Synergid :- help the pollen nucleus reach the egg cell for fertilization.

- Filliform Apparatus :-

→ The filliform device is a finger - like projection.
→ Made up micro fibrils in a sheath.
→ Guide the Entry of pollen tube and release of Sperm cells.

- polar Nuclei :- They together fuse with the male nucleus other than one who fuses the egg.

After fusion the polar nuclei form endosperm which acts as the food supply unit for the seeds in dormancy.

Lecture: 05.

Date
Page 22

pollination :-

- Transfer of pollen grain from anther to stigma.

➤ Of same flower.
➤ Different flower of same plant.
➤ Different plant of same species.

- pollination is 2 type

→ Self pollination.
→ Cross pollination.

1. Self pollination —:

→ Transfer of pollen grain from anther to stigma of same flower.

→ Autogamy is the type of self pollination.

2. cross pollination :—

→ Transfer of pollen grains from anther to stigma different flower.

➤ It is of two type :-

1. Geitonogamy Flower.
2. Xenogamy Flower / Allogamy

- Autogamy Flower :-

→ Transfer of pollen grain from anther to stigma of same flower.

→ It is also called self pollination both functionally and genetically.

→ In some plant like viola, Commelina, oxalis - two type of flower found in same plant.

a. Chasmogamous flower : chasmogamous - open marriage

b. Cleistogamous flower : cleistogamous - not open marriage.

- Chasmogamous Flower :- Chasmogamous - open marriage

→ Blooming or opening of floral bud in the form of flower.
→ In this flower both anther and stigma are exposed.
→ There is a chance of cross pollination.

- Cleistogamous Flower : cleistogamous - not open marriage.

→ Flower never open/anthesis in their life stage even after maturation.

→ These flower anther and stigma lies very close to each other so self pollination take place.

→ Flower produce seed shed in the absence of pollinators.

Advantage of Self pollination:-

1. Maintain parental character.
2. No Need to produce large number of pollen grain.
3. Flower don't develop any devices for attracting insects.

Disadvantage of Self pollination:-

1. New character are not formed.
2. Inbreeding Depression.

• Cross pollination:-

Transfer of pollen grains from anther to stigma of different flower.

➤ It is of two type:-

1. Geitonogamy Flower.
2. Xenogamy Flower / Allogamy.

1. Geitonogamy Flower:-

Geitono - Neighbour, Gamy - marriage.

→ Transfer of pollen grain from anther to stigma of different flower.

2. Xenogamy Flower / Allogamy : Xeno - diffrent.

Transfer of pollen grain from anther to stigma of different plant of same species.

It is functionally and genetically cross pollination.

Advantage of cross pollination :-

1. products are of best quality.
2. New varieties can be producted.
3. Abundant seeds are produced.
4. Cross-pollination improves the resistance from disease and changes in the environment.

Disadvantage of cross pollination :-

1. parental chracter can't regain.
2. Always need a agent for pollination.
3. Large no. of pollen grain needed.
4. Wastage of pollen grain.

Type of pollination on the basic of pollinating agent:

→ The agent who is responsible for pollination is called pollinating agent.

→ plant use two type of Abiotic agent for pollination.

1. Air
2. water.

→ plant also uses biotic agent like — Animal.

→ generally the plant which is pollinated by a biotic agent doesn't produce colour, nectar and fragrance.

- pollination by Abiotic agent:

1. Anaemophilly — pollination by Air.

→ Flower produce enormous amount of pollen grain.

→ pollen grain is small, Dry and light weighted.

→ Stigma is sticky due to presence of mucilage.

→ Ex:- Cereals, Grasses etc.

2. Hydrophilly — pollination by water.

- It is of two type

1. Epihydrophilly : pollination occur on the surface of water.

2. Hypohydrophilly : pollination occur inside water.

Ex :- Hydrila, zostera (Seaweed) etc.

- In some aquatic plant like water hyacinth and water lily pollination occur by air or insect.

*. pollination by biotic agent :

zoophily : pollination by animal.
→ generally zoophilous flower are large attractive rich in nectar and fragrance.

➤ zoophily is of different type :

1. Entomophily :-

→ pollination by insect.

→ These are generally large, Colourful, rich in nectar and fragrance.

→ pollen grain are sticky due to presence of pollen kit material.

- Pollen kit material is yellowish material secreted by the tapetum, which attracts insects and help in pollination.
- Pollen kit material are sticky in nature and also protect pollen Grain from UV rays.
- most of the insect pollination occur by Honey Bee.
- Some flower which produces false odour and pollinated by Butter and housefly.

2. Ornithophily :-

→ pollination by birds.
→ Sun bird and humming bird in begonia plant.

3. Chiropterophily :-

→ pollination by bat.
→ Kadamba, musa etc.

4. Mirmecophily :-

→ pollination by ant and termites.
→ Mango, Blackberry etc.

5. Malacophily / Malmacophily :

→ pollination by Snails.
→ Ex – chrysanthemum etc.

Outbreeding Device :

- Since Continuous Self pollination leads to accumulation of recessive character generation after generation is called inbreeding device.
- Some plant adaptation to promote cross pollination called outbreeding device.
- Outbreeding device are those devices which developed by plant itself to overcome the self pollination defects.
- Ideas of outbreeding devices :

* Dicliny :

→ It is also called unisexuality.
→ like Dioecious plant – this type of plant passes only one types of flower either male or female so only chance of cross pollination.

Ex- papaya, Date palm.

*. Dichogamy -:

→ In some Bisexual flower male and female reproductive organ mature at different time called dichogamy.

- It is of two type:

➢ protoandry :- male mature earlier than female.
Ex: Sunflower, marigold etc.

➢ protoandry :- Female mature earlier than male.
Ex:- Banyan tree.

3. Herkogamy :-

➢ In some Bisexual flower a morphalogical barrier is present between anther and stigma is called Herkogamy.

- Ex:- Calotropis, Gloriosa (glory of garden) etc.

4. Heterostyli :-

In some bisexual flower two or three different length of style is present is called hetrostyle.

→ It may be distyli or tristyli.
→ Ex: primerose etc.

5. Self Incompatibility :-

→ It is a genetic mechanism in which stigma reject the pollen grain of same plant.

- Ex:- orchids, Grasses.