

ClassChapter-2Sexual Reproduction in Flowering plant

Reproduction ensures continuity of species generation after generation, as the older individuals undergo senescence and die.

Flowering plants show sexual mode of reproduction and these complex reproductive units or male and female reproductive units along with necessary structures.

Flower

Flower is a modified stem which functions as a reproductive organ and produces seed or pollen.

A typical angiospermic flower consists of four whorls of floral appendages attached on receptacle:-

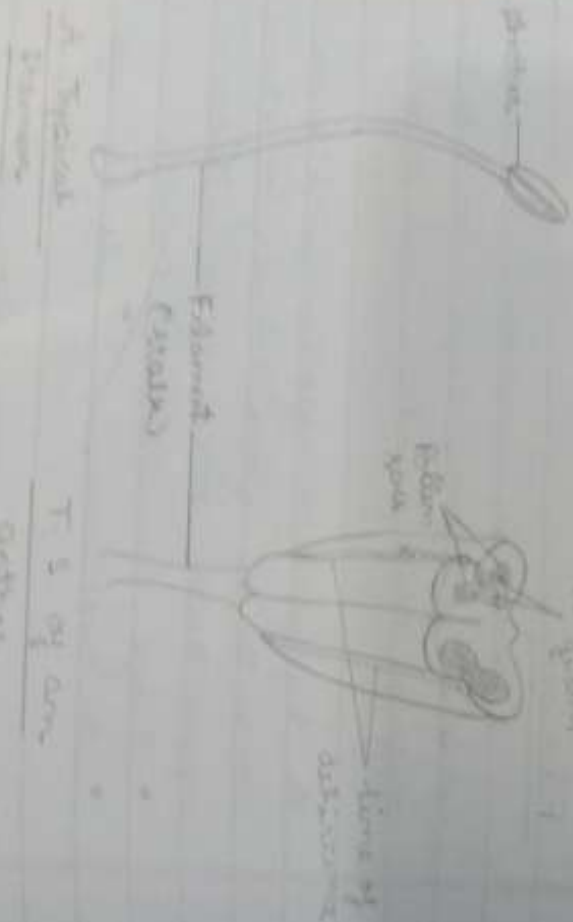
- Calyx
- Corolla
- Androecium
- Gynoecium

Flowers are morphological and embryological manuals and the sites of sexual reproduction.

Fig 1.5 a Flower



Gynoecium in Caryophyllales



Pure - fertilisation : structural and Ecological

General structural and hormonal changes lead to formation and development of floral primordia. Inflorescence is formed that bears floral buds and then flower.

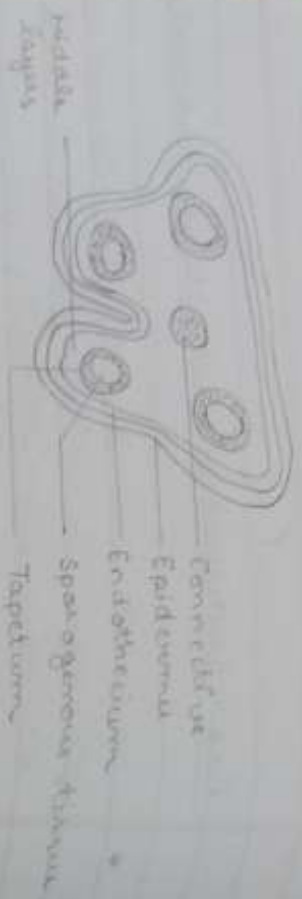
In flowers, male (androecium) and female (gynoecium) differentiate and develop in which male and female gametes are produced.

Androecium, Microgametophyte and Pollen grain :-

Androecium consists of stam and stamens. Stamens consist of long and slender stalk called filament and generally bilobed anthers. Each lobe contains two ~~pollen~~ grains (microgametes).

The anther is four-sided structure consists of four microgametophytes. Two in each lobe.

Microgametophyte develop within and bear pollen sacs which contain pollen grains.



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Microsporangium is generally surrounded by four layered walls:- epidermis, endothecium, middle layer and tapetum.

Sporogenous tissue → It is compactly arranged sporogenous cells which are present at centre of each microsporangium when anther is young.

Microspores → The process of formation and differentiation of microspores (pollen grain) from microspore mother cells (MMC) by meiotic division is called microsporeogenesis.

The cells of sporogenous tissue undergo meiotic division to form microspore tetrad. As the anther matures and dehydrates, the microspores dissociate and develop into pollen grains.



Pollen grain + seed

Pollen grain + Pollen grain super-
- seeds the male gametophyte. Pollen
grains are made of two layered
wall.

(i) Exine + Made of sporopollenin - most
resistant organic matter known. It
can withstand high temperatures
and strong acids and alkali. No
enzyme can degrade sporopollenin.

(ii) Intine + thin & cellulosic layer
→ made of cellulose and pectin.

(iii) Germs pores + Apertures are voids
where sporopollenin is absent
→ germ pollen tube.

(iv) Plasma membrane surrounds
cytoplasm of pollen grain.

Mature Pollen

A mature pollen consist of
two cells with nucleus (veget-
ative and generative).

Vegetative cell

- Bigger
- Abundant food reserve
- Large irregular nucleus
- Responsible for the development of pollen grain.

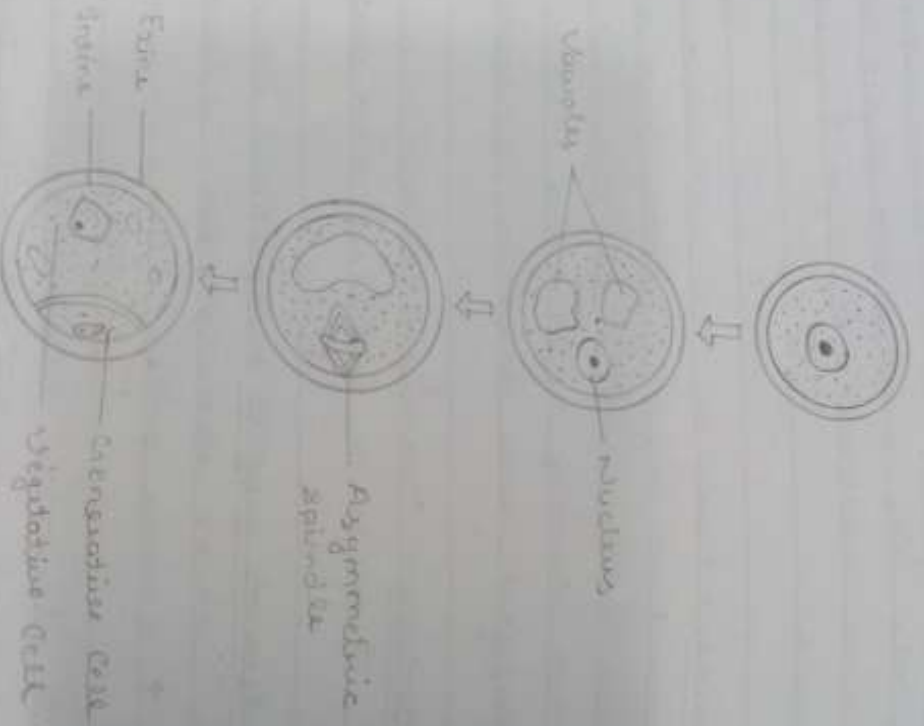
Generative cell

- Small
- Anaxial in tetragamy (close with an egg)
- Dense cytoplasm and nucleus.

- Pollen grains of many species cause severe allergies and ~~anarchial diseases~~ in some people and leads to chronic respiratory disorders - asthma, etc.

- Pollen grains are rich in nutrients and are used as pollen tablets as food supplements.

- Pollen grains of large no. of species are stored in liquid nitrogen at temp 196° called pollen bank.

Maturation of Pollen Grain

The Pistil, megasporangium & embryo sac

→ Pistil

- Gynoecium may consists of single pistil (monocarpellary) and more than one pistil (polycarpellary) which may be fused (syncarpous) or free (apocarpous).

- Each pistil has three parts the stigma, style and ovary. Inside the ovary, ovarian cavity is present where placenta is located inside megasporangia arise from placenta.

→ Megasporangium (Ovule)

- Ovule is small structure attached to placenta
- Funicle - stalk by which ovule is attached to placenta
- Hilum - junction between ovule and funicle
- Integuments - protective envelope
- Micropyle - small opening at the tip



of ovule into where pollen tube enters.

- Chalazal - basal part of ovule.
- Nucellus (2n) - mass of cells enclosed in integuments. Has abundant food reserve.

Megasporogenesis

- Process of formation of megaspore from megaspore mother cells is called megasporogenesis.
- Megaspore mother cell divide meiotically to form 4 megaspores (haploid).
- Out of 4, only 1 megaspore is functional and forms gametophyte and the rest degenerate.

→ Embryo Sac (Female Gametophyte)

- The embryo sac develops from the functional megaspore (n).
- Monosporic development → Formation of embryo sac from a single megaspore.



Adaptations in Flowers for Pollination

1) Wind Pollination →

pollen grains - light, non-sticky, winged
 anthers - well exposed
 stigma - large and feathery
 flowers - no nectar, arranged in inflorescence
Ex - corn cob, cotton etc

2) Water pollination →

pollen grains - protected by mucus
 - aerenchyma causing
Ex - Hydrilla, Zostera etc

Insect pollination →

Flowers - large, colourful, fragrant,
 rich in nectar

Pollen grains - sticky

Stigma - sticky

Ex - *Amorpha*, *Passiflora* etc

Pollen - Pistil Interactions → All the

events from pollen deposition on the
 stigma until the pollen
 tubes enter the ovary
 called



Artificial Hybridisation → Commonly used technique in plant breeding programmes to obtain desirable characters.

Anthers are removed from bisexual flowers using forceps. This is ~~emasculation~~ emasculation and is done before anther dehiscence. The emasculated flower is covered with a paper bag to prevent contamination from unwanted pollen. This is called bagging.

On attaining maturity, mature pollen from desirable plant are dusted on stigma of bagged flower and ~~rebagged~~ rebagged for fruit development.

Double Fertilisation → When syngamy and triple fusion takes place simultaneously in the embryo sac, it is termed as double fertilisation.

Syngamy → When a male gamete fuses with egg nucleus to form a diploid cell called zygote. This event is called syngamy or ~~fertilisation~~ fertilisation.



Triple Fusion → When two male gametes fuse with polar nuclei at the centre to produce a triploid primary endosperm nucleus (PEN). This is termed as Triple fusion.

Post-fertilisation Events

The following events after double fertilisation are collectively called post-fertilisation events.

- Development of endosperm from primary endosperm nucleus (PEN).
- Development of embryo from zygote.
- Development of seeds from ovule.
- Development of fruit from ovary.

Endosperm Development → Endosperm develops first followed by an embryo. Endosperm develops from PEN. The PEN undergoes successive nuclear divisions to give rise to free nuclei and this stage of endosperm development is called free nuclear endosperm. This division is followed by cytokinesis and thus endosperm becomes cellular. It is now called cellular endosperm.





ovule embryo



seeds

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Side of the embryonal axis is called ventral

(i) The side of the axis towards the base of the embryo is called ventral

ventral

(ii) The side of the axis towards the base of the embryo is called ventral

(iii) The side of the axis towards the base of the embryo is called ventral

(iv) The side of the axis towards the base of the embryo is called ventral

(v) The side of the axis towards the base of the embryo is called ventral

Seed

Seed is a fertilized ovule which is the final product of sexual reproduction. It consists of seed coat, embryo and embryonal axis.

Types of Seeds

Non-Albuminous

The seed with no endosperm. Ex: Pea, Groundnut.

Albuminous

The seed with endosperm. Ex: Wheat, Maize.

Advantages of Seeds

- (a) Seeds possess better adaptative strategies for dispersal to form new colony.
- (b) The reserve food of seed support the growth of seedling till they become nutritionally independent.
- (c) The hard seed coats provide protection against injury.
- (d) They provide genetic recombination and variation as they are the product of sexual reproduction.
- (e) Depending upon the mobility of seeds, they are used to raise crop in favourable season.

Fruit

The ovary matures to form fruit and the ovarian wall develops into the wall of fruit called pericarp.

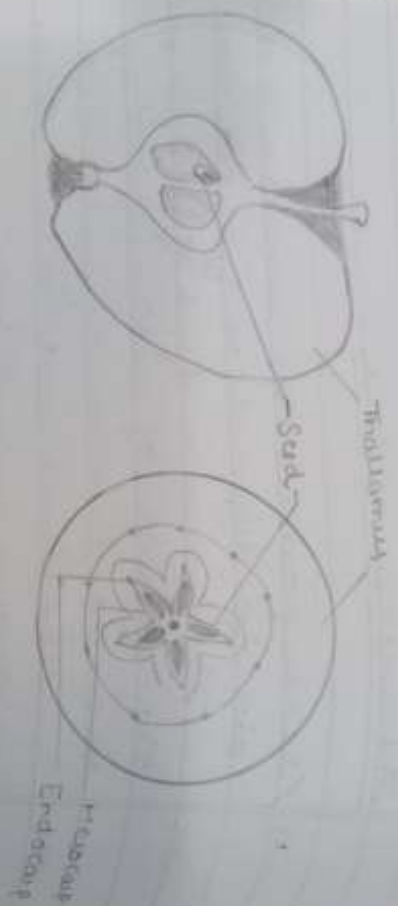
Types of Fruits

True Fruit

Fruit that develops only from ovary.
Ex → Pea, wheat.

False Fruit

Fruit that develops from ovary and the thalamus or other part of the flower.
Ex → Apple, strawberry.



False fruits of Apple

Good

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Parthenocarpic Fruit → Fruits that are formed without fertilisation are called parthenocarpic fruits. These do not have seeds, e.g., banana. Parthenocarpic can also be induced artificially by growth regulators.

Special Mechanism of Reproduction

(i) Apomixis → the phenomenon of asexual reproduction that imitates sexual reproduction by formation of seed without fertilisation is called apomixis or agamospermy.

(ii) Polyembryony → the occurrence of more than one embryo in a seed is called polyembryony.
Ex: Orange

Divyanshu
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