

CHAPTER 2

SEXUAL REPRODUCTION IN FLOWERING PLANTS

Topics:

- Flowers
- Pre- fertilization- structure and events
- Pollination
- Fertilization
- Double fertilization
- Post fertilization- events
- Development of seed and fruits
- Apomixes
- Polyembryony
- Types of fruits

Introduction

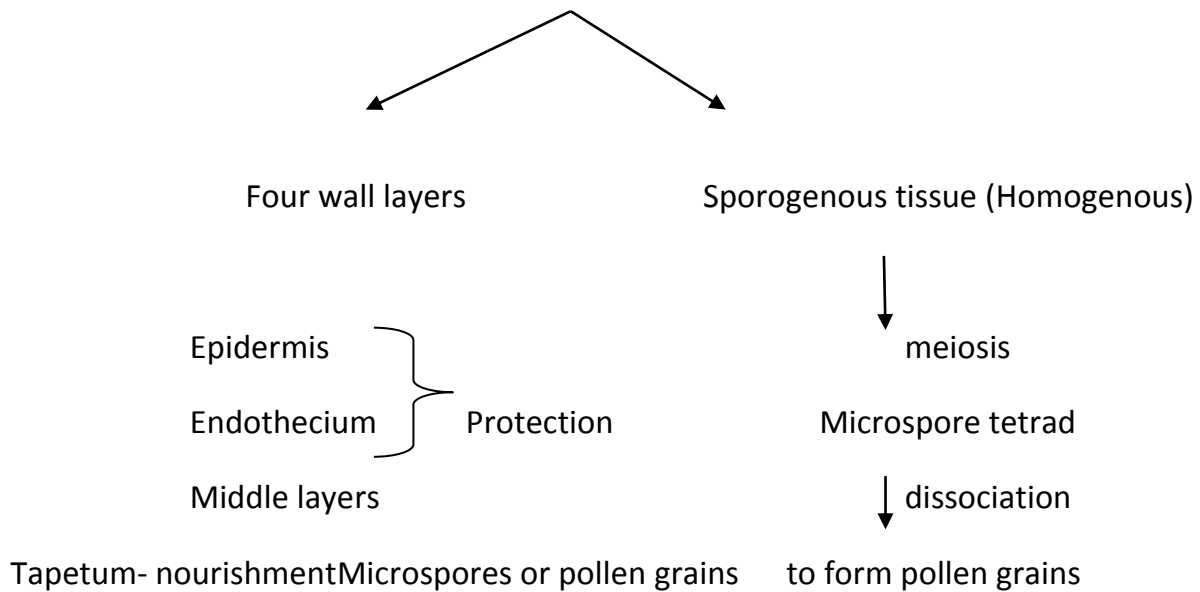
Sexual reproduction in flowering plants involves transformation of diploid sporophytic cell into haploid gametophytic cells by meiosis. Fusion of haploid gametes of opposite sex to form diploid zygote. The zygote then develops into an embryo which ultimately forms a diploid plant body. In flowering plants all these steps of sexual reproduction occur within specialized reproductive organs called the flowers.

Pre- fertilization: Structures and Events

The parts of a stamen are filament and anther. It is bilobed and dithecal. The anther is a four-lobed structure consisting of four microsporangia located at the corner, two in each lobe. Developed microsporangia are called pollen sacs.

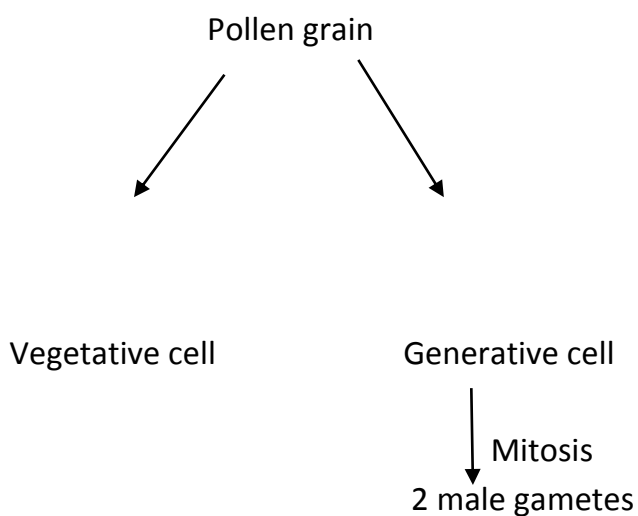
Transverse section of micro sporangium:

Four micro sporangia at the corners (pollen sacs)



Structure of the pollen grains or male gametophyte

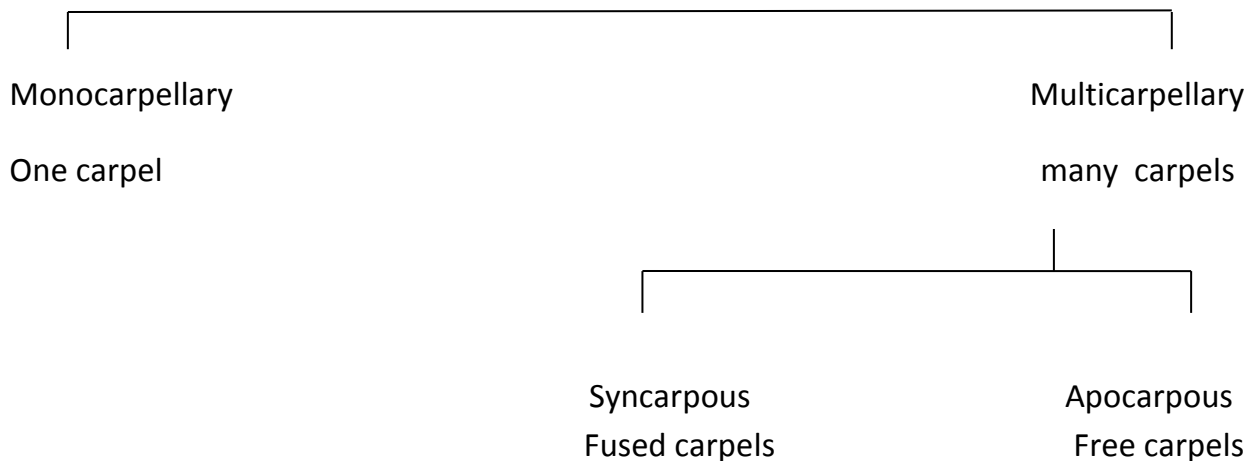
1. **Wall layers:** the outer hard layer-**exine** is made up of the most resistant organic material **Sporopollenin** which is resistant to high temperature, pH, and enzymatic action.
2. **Exine** has apertures called germ pores
3. Inner wall- **intine** is made up of cellulose and pectin



Pollen grains cause allergic reaction

Pollen grains are used as food supplement

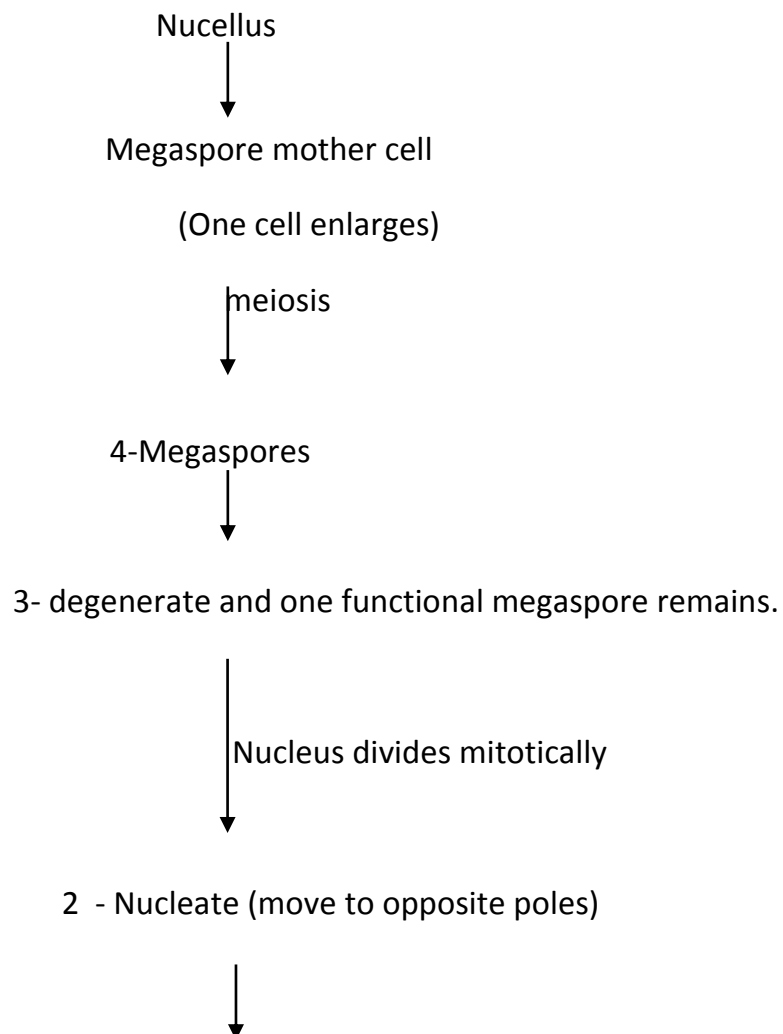
Female reproductive parts (Gynoecium or pistil)

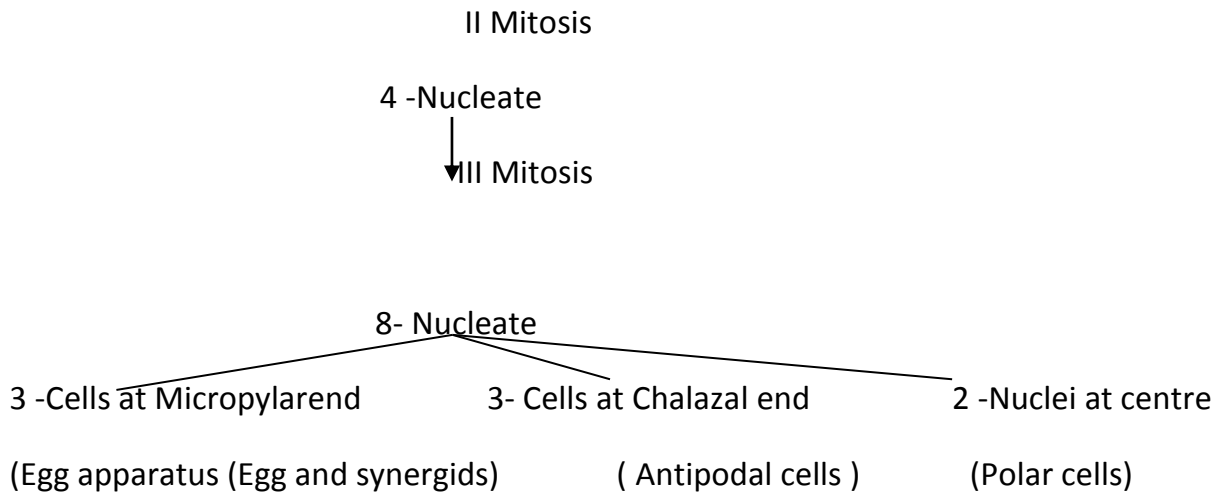


Structure of an ovule or megasporangium

The ovule has a stalk-**funicle**- **Hilum** is the junction between ovule and funicle- two integuments envelop the ovule except at micropyle. Opposite end is called **chalazal** end. It encloses mass of cells called nucellus, with an embryo sac.

Megasporogenesis:





Pollination

Transfer of pollen grains from the anther to the stigma of the pistil.

Types:

1) Autogamy

Pollination within the same flower

Ex: Oxalis, commelina, viola

Chasmogamous (exposed anther)

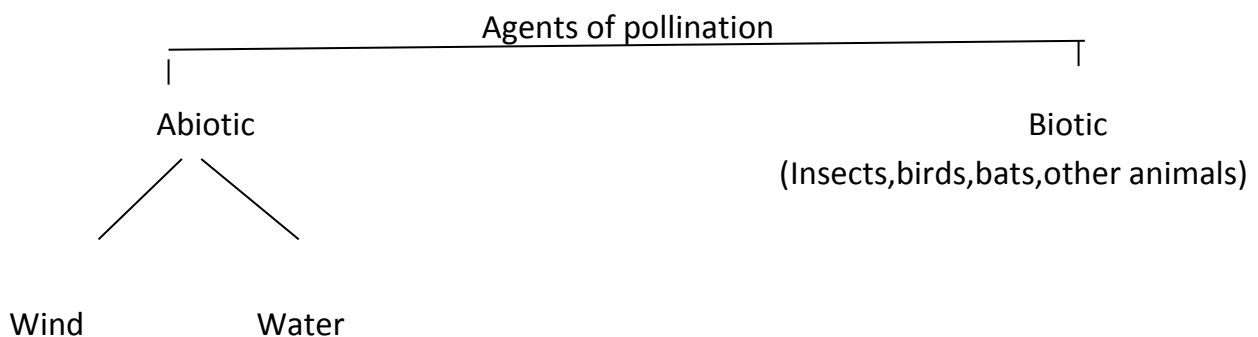
Cleistogamous (closed flower)

2) Geitonogamy

Transfer of pollen grain from the anther to the stigma of another flower in the same plant.

3) Xenogamy

Transfer of pollen grain from the anther to the stigma of a different plant.



Characteristics of different pollinated flowers

WIND	WATER	INSECT
Enormous amount of pollen	Pollen grains have Mucilaginous covering	Flower are large
Pollen grains are light and non- sticky	Not coloured	Colourful
Well – exposed stamens	No nectar	Fragrant
Feathery stigma	Female flowers move to surface of water, male flowers reach female	Rich in nectar
Mostly inflorescence is not Colourful, no nectar and Out breeding devices		Foul odours to attract flies and beetles Place to lay eggs Ex: Moth and plant Yucca

Outbreeding devices

- Dichogamy – pollen release and stigma receptivity are not synchronized.
- Heterostyly – anther and stigma are placed at different positions.
- Self- incompatibility
- Production of unisexual flowers.

Pollen- pistil interaction

- 1) The pollen grains germinate in pollen tubes and the pollen tube passes through style, reaches ovary.
- 2) Enters ovule through micropyle with the help of synergids
- 3) Two male gametes are released.

(Artificial hybridization is achieved by emasculation and bagging techniques (removal of anther and dusting stigma with anther of desired type to prevent contaminations of its stigma with unwanted pollen)

Double fertilization

One male gametes (n) + egg (n) \longrightarrow Syngamy (2n) \longrightarrow Zygote

Another male gamete (n) + polar nuclei (2n) \longrightarrow PEN(3X)

Primary endosperm nucleus develops into endosperm.

Post- fertilization events

A) Development of endosperm and embryo B) maturation of ovule into seed

C) ovary into fruit.

Endosperm development

PEN undergoes repeated nuclear divisions to form into **free- nuclear endosperm** and if the cell wall formation occurs, forms to **cellular- endosperm**

Embryo development (Embryogeny)

Zygote \longrightarrow pro- embryo \longrightarrow globular embryo



Heart shaped embryo



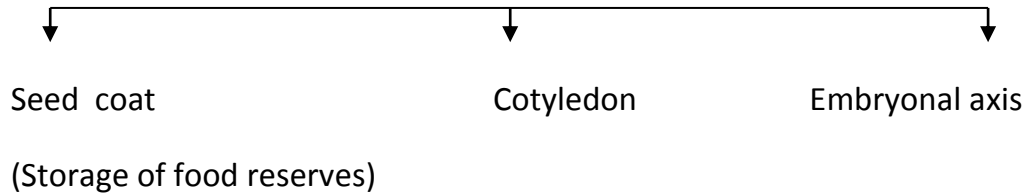
Matured embryo

Dicot embryo consist of an embryonal axis and two cotyledons.

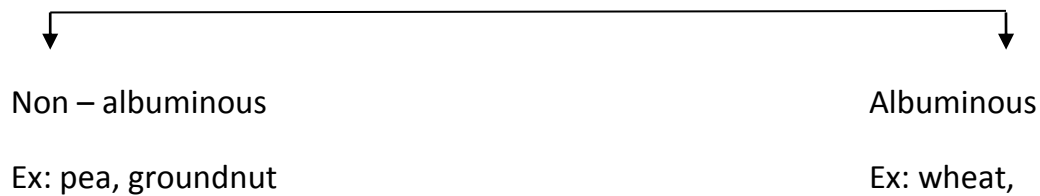
Monocot embryo

Single cotyledon (scutellum) in one side of the embryonal axis

- radical with root cap enclosed by **coleorrhizae**.
- Above the attachment of scutellum is, coleoptile.(covers plumule)
- **Seed (fertilized Ovule)**



Seeds



Residual, persistent, nucellus is called as **perisperm**

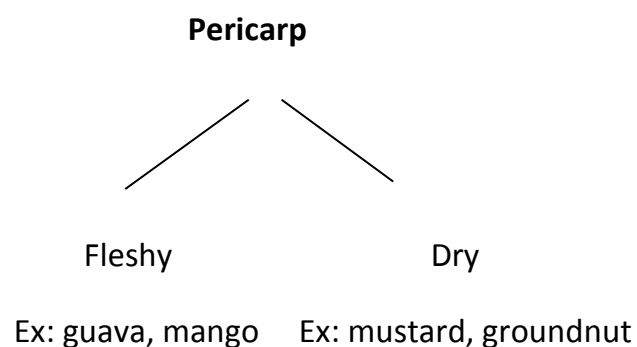
Ex: black pepper and beet

The embryo may enter a state of inactivity called **dormancy**.

seed coats near micropyle facilitate entry of oxygen and water during germination.

Embryo is dormant, till favorable conditions are onset.

Fruit is (**Ripened Ovary**) – the wall of the ovary called Pericarp.



Fruit

False fruit: if the parts other than ovary, becomes fruit it is false fruit.

Ex: Apple, Strawberry, cashew

True fruit: Ovary become fruit

Ex: Mango

Parthenocarpic fruit: Fruit developed without fertilization

Ex: banana

Importance of seeds

Dispersal to new habitat

Nourishing young seedling

Protection of new embryo

Leads to variation

Apomixis

Seed production without fertilization

Special modes of reproduction.

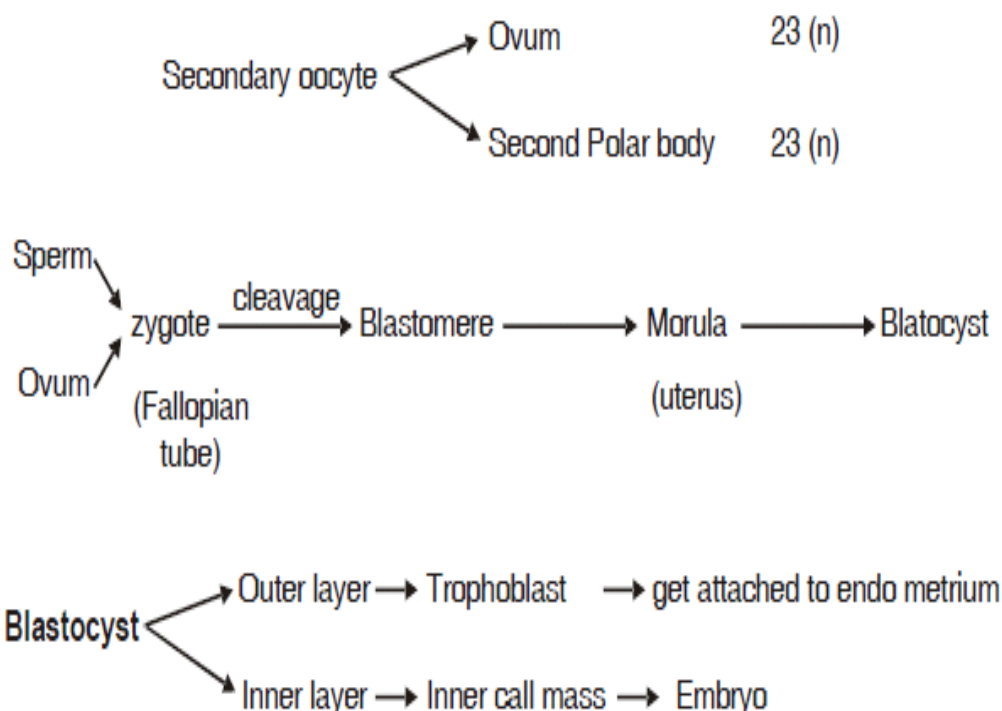
1) polyembryony

2) artificial reproduction involves emasculation, bagging and tagging techniques.

Fertilisation : Process of fusion of sperm with ovum

Site of fertilisation in human female : Ampullary – isthmic junction

Secretion of acrosome helps the sperm entry into cytoplasm of ovum through zona pellucida and plasma membrane. Sperm entry induce the completion of the 2nd meiotic division of secondary oocyte.



Placenta : An intimate connection between foetus and uterine wall of the mother to exchange materials.

Function of Placenta : Nutrition, Respiration, Excretion, as barrier, Endocrine function.

Placenta as Endocrine tissue : Placenta Produces several hormones such as – Estrogen, hCG, hPL, Progesterone and relaxin (in late phase of pregnancy).

Embryonic Development : at various month of Pregnancy After–1 month = Heart, 2 months = Limbs and digits, 3 months = External genital organ, 5 months = First movement, 6 months = body covered with fine hairs, eye lid, eye lashes, 9 months = Fully developed and ready for delivery.

POINTS TO REMEMBER

Blastula : A stage of embryogenesis which comes after morula and has a hollow fluid filled space called blastocoel.

Endometrium : Innermost glandular layer lining the uterine cavity.

Foetus : An advanced stage of embryo within the uterus.

Gestation Period : A period between fertilisation of ovum and the birth of a baby.

Hymen : A thin membrane partially covering the vaginal aperture.

Implantation : Fixing of embryo/fertilized egg in uterus. It leads to pregnancy.

Menarche : The beginning of first menstruation in female on attaining puberty.

Menopause : Permanent cessation of menstrual cycle in female. It occurs between the age 45 to 50 years in human female.

Oogenesis : Formation and development of ova in ovary.

Ovulation : Process of release of mature ovum (Secondary oocyte) from the ovary.

Parturition : Process of delivery of the foetus (Child birth).

Puberty : A stage at which immature reproductive system of boy or girl becomes mature.

Scrotum : A muscular pouch which houses two testes.

Spermatogenesis : Process of formation of sperm from male germ. Cell in the testes.