CLASS – 12

BIOLOGY

Chapter – 2

Reproduction in Flowering Plant

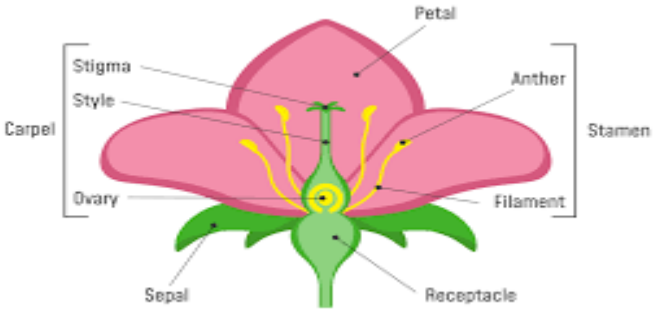
By ~Shahanshah Shahid

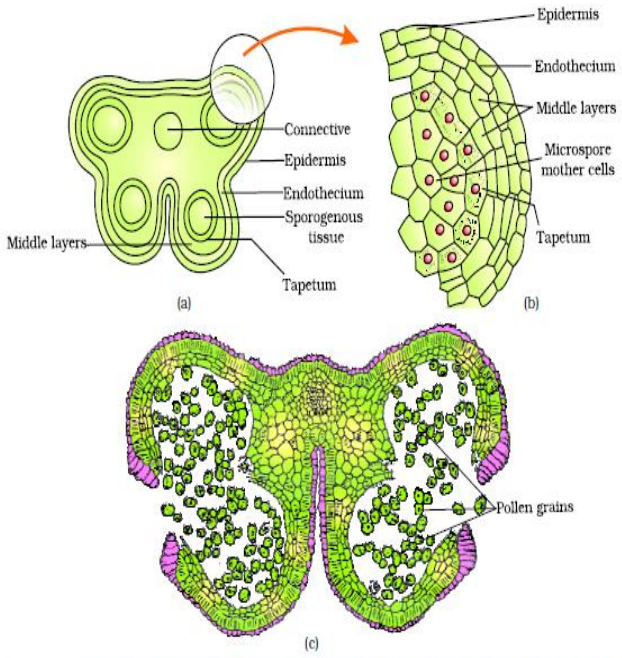
PGT- Biology

Chandra Public School, Mau (U.P)

Sexual Reproduction in Flowering Plants:

- It refers ***fusion of male and female gamete***s by forming **zygote** which *develop into new individual* by **embryogenesis**.
- **Flower** is the structure where sexual reproduction takes place.
- Floral ***axis which bearing the floral organ*** is called **receptacle** (*i.e. no elongation of internodes takes place so that various flower whorls differentiate close to each other*).
- *Outermost whole* is **calyx** (sing- sepals) and *inner of this* is **corolla** (sing- petals), third whole is **androecium** (sing- *stamen i.e. male sex organs*) and innermost whole is **Gynoecium** sing- *carpel i.e. female sex organs*).
- **Stamen:**
  - It has two parts - filament and ***anther*** (i.e. tetrasporangiate).
  - stamen are **bilobed dithecous** *(i.e. in which each lobe contain two microsporangia or pollen sac*).
  - Two lobe of anther joined by ***connective***.
  - ***# Monothecous bisporangiate anthers are present in member of Malvaceae and other plant.***
  - ***# Arceuthobium has monothecous monosporangiate anthers.***
  - ***Basified, dorsified , adinate filament.***

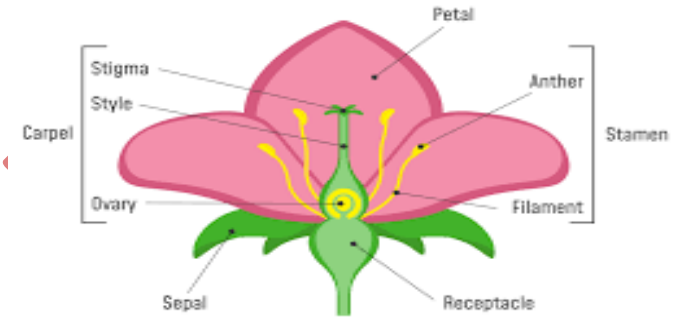




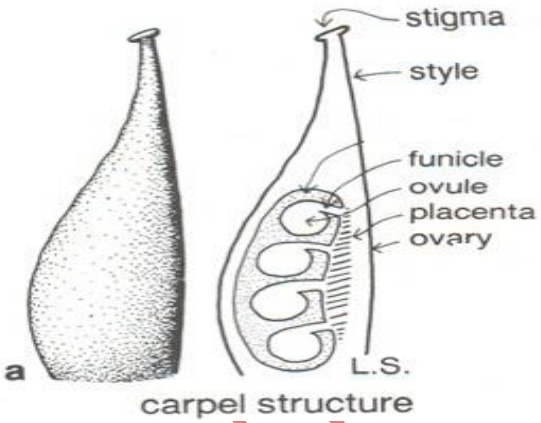
(a) Transverse section of a young anther; (b) Enlarged view of one microsporangium showing wall layers; (c) A mature dehisced anther

Carpel:

- **Consist of three parts – Stigma, Style and ovary.**



- **In ovary, ovule or megasporangium develops and attached to placenta (i.e. central column) through funicle.**



carpel structure

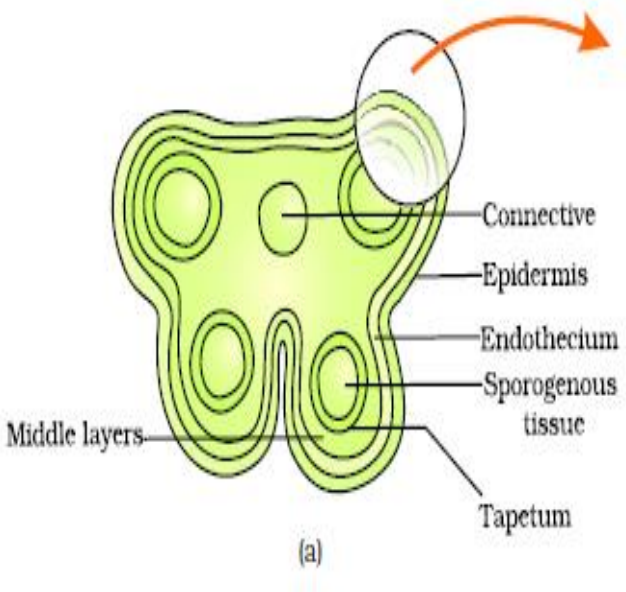
- **Functions of flower are – development of pollen and egg, pollination, fertilization, development of seed and fruit and dispersal of seed and fruits.**

Function of flower:

- Development of pollen and egg, pollination, fertilization, development of seed and fruit and dispersal of seed and fruits.

Structure of microsporangium or pollen sac:

- Microsporangium surrounded by four wall layer:

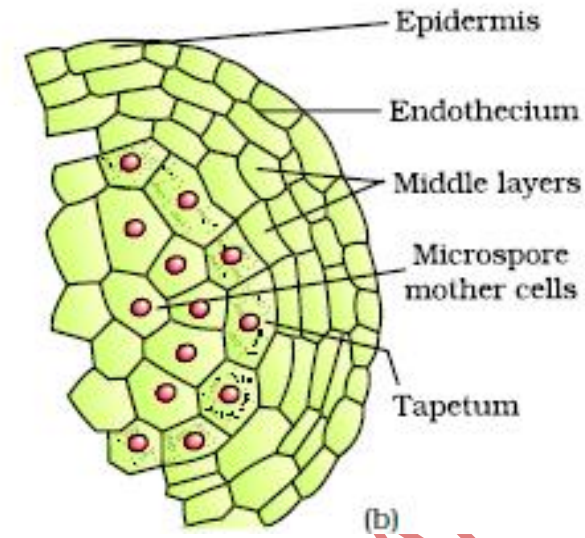


1. **Epidermis** (*i.e outer most single layered, flat cells*).

2. **Endothecium** (*i.e. help in dehiscence, single layered cells with fibrous band of cellulose which slightly lignified at maturity*). Compact radially arange , responsible for callose thickening

3. **Middle layer** (*made up of 3- 4 layer, parenchymatous, short live and degenrate at the time of formation of pollen grains*).

4. **Tapetum** (*i.e innermost layer, pyramidal shape, nourishes pollen grain , having dense cytoplasm and generally more than one nucleus, release enzyme callase secreate sporopollenin – hardest substance).*



- Center of microsporangium has **sporogenous cells or microsporocytes** (*i.e. compactly arranger homogenous cells*).

Function of Tapetum:

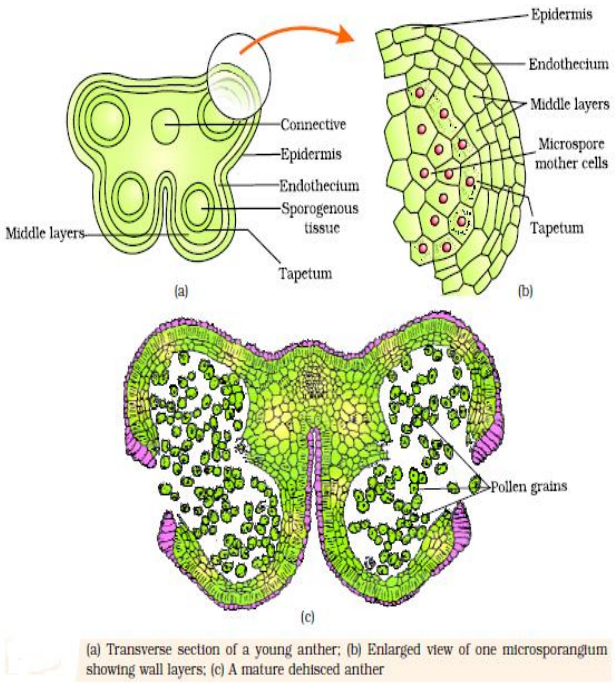
- ***Nutritive in function*** and serve as ***transport channel*** *i.e. through which mateial can reach the meiocytes during meiotic division of pollen mother cells*.
- Also help in ***fossilization*** of pollen grain because it helps in external thickening of exine by **sporopollenin** (*i.e. resistance to physical and biological decomposition*).
- It help in transfer of ***pollenkitt material*** (*pollenkitt is outer most oily laayer forming a thick coating on the pollen surface of many insect pollinated species*) and ***tryphine*** (*i.e. protein which release from pollen grain and cause hey fever and pollen allergy when pollen grain are moist*).

Development of microsporangium:

- Its development is ***eusporangiate type*** *(i.e. each sporangium develop from a group of cells rather than a single cell and with no specialized dispersal of spores*), in young anther four lobed bind with epidermis (parenchymatous cells) and in each lobe have few hypodermal cells which function as archesporial cells (*i.e. large , slightly radially elongated with dense cytoplasm and prominent nuclei*).
- **Archesporial cells** divide **periclinally** (i.e. occur parallel to the tissue or organ surface) and form :

1. **Primary parietal cells** – after division parietal layer form ***2-5 concentric layer of anther wall***.

2. **Primary sporogenous cells** – divide further and form ***sporogenous tissue***.



(a) Transverse section of a young anther; (b) Enlarged view of one microsporangium showing wall layers; (c) A mature dehisced anther

Microsporogenesis:

- The process of *formation of microspore* from a ***pollen mother cells (PMC)*** through **meiosis** is called *microsporogenesis*.

- During microsporogenesis- *each microsporocyte or sporogenous cells (2n)* undergo **mitotic cell division** and form ***diploid pollen mother cells (PMC)***.
- Pollen mother cells undergo **meiosis** and form ***pollen grain (n) or microspores*** which *arrange in form of tetrad (tetrahedral, isobilateral, linear, decussate tetrad).*
- During meiosis two pattern of cell wall formation can be seen:
- **Successive:**
- In this after first meiotic division the callose wall is form that separates the two nuclei leading to formation of dyad.
- The two cells of dyad undergo second meiotic division and form tetrad (i.e. four cells).
- ***# callose wall again form after second meiotic division***.
- The type of tetrad form is called *isobilateral* and common in ***monocotyledons*** and ***polypetalae of dicotyledons***.
- **Simultaneous:**
- In this first meiotic sub-division ***not followed the cell wall formation*** (*i.e. eliminating the formation of dyad*) and after second meiotic sub-division callose wall is form in such a manner which give rise to *tetrahedral tetrad*.
- This type of tetrad are found in ***gamopetalae of dicotyledons***.

- As the anther mature and dehydrated – each microspore gets separate and form exine (i.e outer layer) and intine (i.e. inner layer).

- Now nuclei of microspore undergo mitotic division and for two cells :

1. **Vegetative nucleus** (i.e. larger in size)
2. **Generative nucleus** (i.e. smaller in size).

- Now each microspore develop into pollen grain and regard as an equivalent of a male gametophyte (i.e. because later two gametes are formed as a results of mitotic division of generative nucleus.

Structure of pollen grain:

- It is covered by a thick wall which is made up of two layer :

I. **Exine** – outer layer with spinous outgrowths, made up of ***sporopollenin*** (i.e. enable to survive in unfavorable condition).

- Pattern of exine is specific to a species which help to study the evolution or ecosystem.

- At some region exine is *thin or absent* where **sporopollenin is absent** and pollen tube emerges from this pore at the time of pollen germinaton.

ii. **Intine:** thin and smooth layer which is made up of ***cellulose and pectin***.

 # pollen of some plant cause allergic effect on men such as hay fever (watery nasal discharge with sneezing, watery eyes, and headache), eczema and asthama.

- Family producing allergic polen is *Poaceae, Asteraceae* ect.

Dehiscence of Anther:

- At the maturation of anther, the *middle layer and tapetum* disorganize leaving behind the epidermis and endothecium in wall layer.
- ***Longitudinal slit*** is most common mode of dehiscence - in this endothecial cells in the middle of anther lack thickening called ***stomium***.
- During dry weather endothecial cells shrink and become hygroscopic nature which pressure on ***stomial cells*** which rapture forming lengthwise slit or opening.

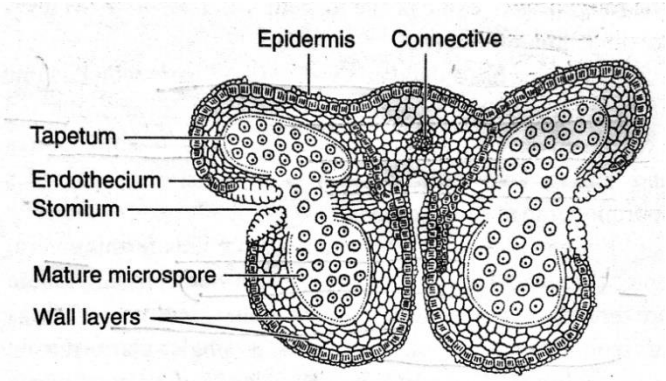


Fig 2.7 Transverse section of a mature anther showing dehiscence

- Dehiscence also takes place *through* ***valve – in Berberris***, *through* ***apical pores – in solanum polygala*** *and through* ***basal pores in Cassia***.

Pollen viability:

- Period in which pollen grain retain their potential to germinate.
- It depends on prevailing temperature, humidity and genetic potential.

 # Wheat and rice has viability only for 30 minutes while legumes has several months.

Pollen pistil Interaction:

- In pollen-pistil interaction, pistil has ability to recognize whether it is ***compatible or incompatible***.
- *If the compatible pollen falls on the pistil* then it accept the pollen and ***promote post fertilization events*** while if it is *incompatible* so it reject the pollen and prevent pollen germination and growth of pollen tube.

Pollen Germination:

- ***Humidity*** is first condition for pollen germination and stigma provides ***water*** and ***essential nutrients*** in the form of exudates necessary for the germination.
- If stigma is receptive and pollen landed on it is compatible then pollen start to germinate.
- ***During pollen germination,*** the ***intine*** along with its content emerges out as ***germ pore*** (i.e. short cytoplasmic outgrowth) and grows in the form of ***pollen tube***.
- Pollen tube growth towards the ovary show ***positive chemotropic and negative aerotropic growth*** due to ***calcium-boron-inositol sugar complex.***
- ***Sucrose solution*** secreted by *epidermal cell* of stigma act as stimulus and pollen tube produce *enzyme* that *digest the tissue of the stigma and style* which enable the passage of pollen tube to the ovule.
- During the pollen tube germination the vegetative nucleus disintegrate and generative nucleus undergo mitotic division to produce two male nuclei or male gamete.
- Depending on the entry of pollen tube , fertilization is three type : ***Progamy*** (*i.e. pollen tube enter through micropyle, common in angiosperm*), ***Chalazogamy*** (*pollen tube enter through chalazal end, eg. Casurina, betula ect.*) ***Mesogamy*** (*i.e pollen tube enter through funaculus* ***eg. Pistacia*** *or through integumant* ***eg. Cucurbita***).

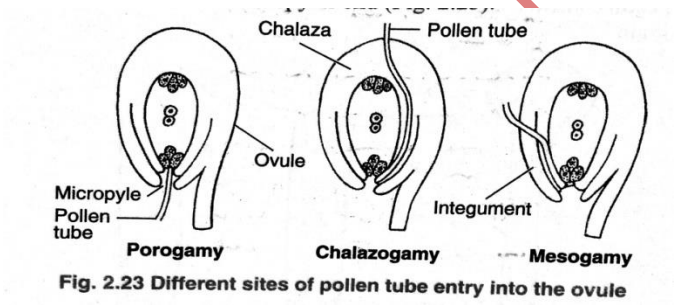


Fig. 2.23 Different sites of pollen tube entry into the ovule

Megasporangium (ovule):

- Ovule has ***nucellus*** (*i.e. parenchymatous part*) which surrounded by ***integument***, leaving the small opening at the apical end i.e. *micropyle*.
- Integument arises from base of ovule called ***chalaza*** and the point of attachment of the body of ovule to its stalk is called ***hilum***.

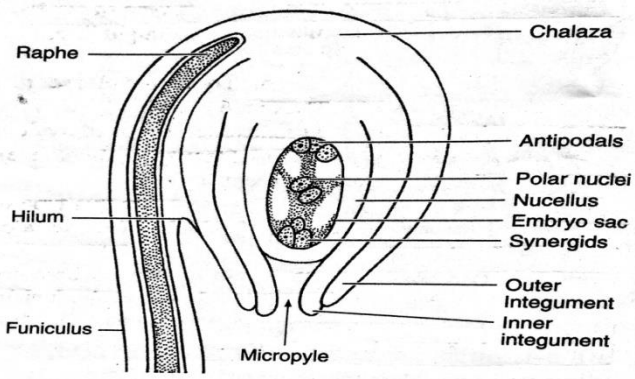


Fig. 2.9 L.S. of anatropous ovule

- Presence of number of integument layer ovule are called :

I. **Unitegmic**- found in *gamopetalae*.

II. **Bitegmic** – found in *polypetalae and monocots*.

III. **Ategmic** - found in *Santalum , Loranthus.*

Obturator:

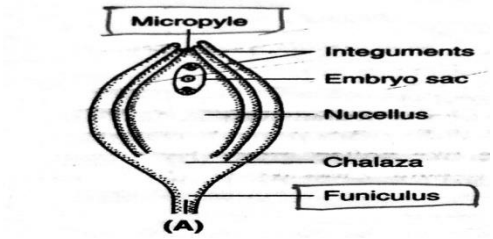
- It is ovular structure that directs the growth of pollen tube only towards the micropyle.

Types of Ovule:

- Classification of ovule on the *potion of micropyle with respect to funiculus*.

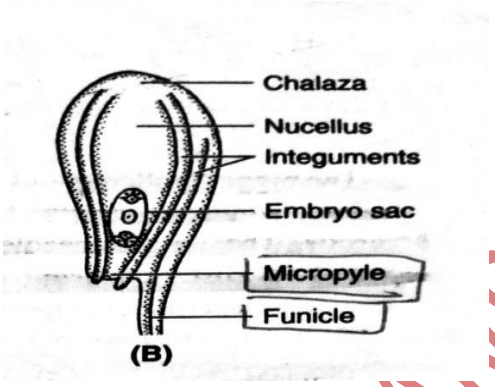
1. **Orthotropous:**

It is an ovule in which *micropyle and the funiculus are in a straight line*. ***E.g. polygonum, Piper ect***.



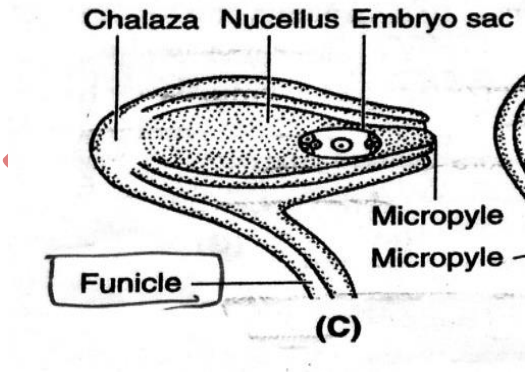
2. **Anatroopous:**

Ovule gets inverted and due to this *micropyle comes near the funicle*. ***Example: Members of family papilionaceae pea and gram.***



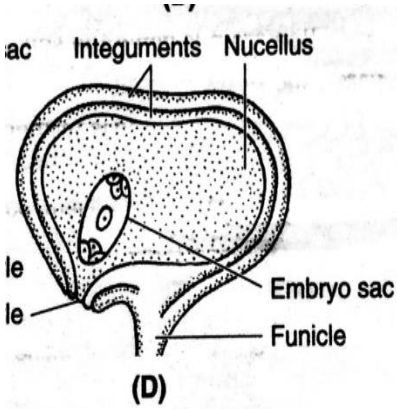
3. **Hemianatropous:**

In this *funicle is at right angle of the body of ovule*. ***Example: Members of family Ranunculaceae***.



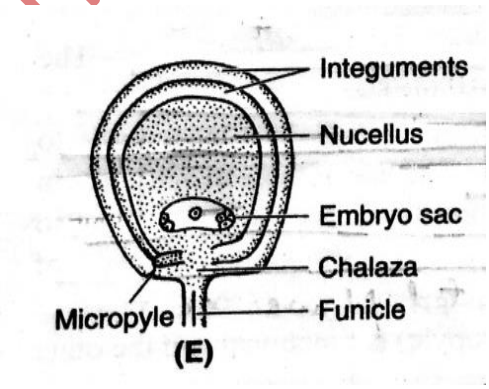
4. **Campylotropous:**

In this *funicle micropyle and chalaza lie near to each other*. ***Example: Members of Leguminosae (except pea and gram)***



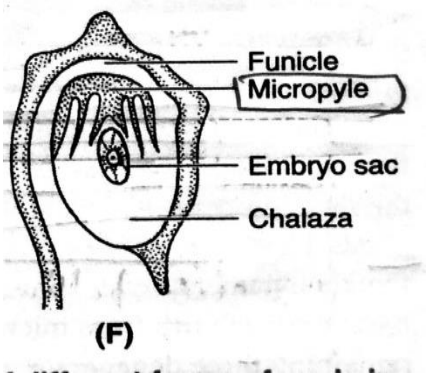
5. **Amphitropous:**

Here curvature of ovule influences the nucellus so *embryo sac become horse-shoe shaped*. ***Example: Cruciferae, lemon and papaver.***



6. **Circinotropous:**

Ovule takes a turn of 360 degree and micropyle again faces upward. ***Example: Cactaceae, opuntia.***



Megasporogenesis:

- The process of formation of megaspore from the megaspore mother cell is called ***megasporogenesis***.
- The ***hypodermal cell of nucellus*** act as archisporium (*i.e have large size, large nucleus and dense cytoplasm*).
- Archisporium cell directly act as ***megaspore mother cell or devide periclinally*** *forming two cells:*

1. **Primary perietal cell** *(outer)*
2. **Primary sporogenous cell** *(inner later function as megaspore mother cell)*

- **Megaspore mother cell (2n)** undergoes meiosis and gives rise ***four haploid cells or megaspores (n).***

 # The fate of megaspore development in female gametophyte varies from plant to plant.

- In polygonum only ***one megaspore is functional*** (i*.e. towards chalazal end or fourth from micropyle*) and ***rest three degenerate***.

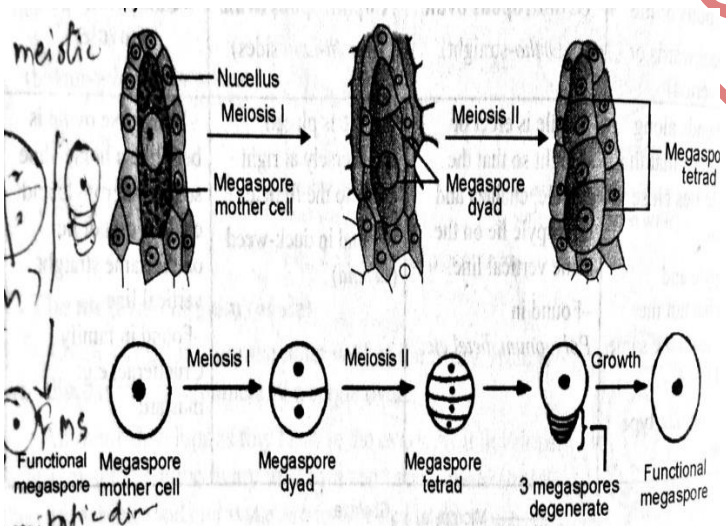


Fig. 2.17 Megasporogenesis: Development of functional megaspore

Development of female gametophyte or embryo sac:

- The functional megaspore undergoes ***3 mitotic divisions*** and produces ***8 haploid nuclei***.

 # Here the mitotic division are free nuclear (i.e. nuclear division are not followed immediately by cell wall formation).

- Depending on the *number of megaspore nuclei* takes part in development of embryo sac , it could classify into following types:

I. ***Monosporic embryo-sac*** (*i.e. only one megaspore nucleus takes part in development of embryo sac*) ***Example: polygonnum***.

II. ***Bisporic*** (*i.e two megaspore nuclei takes part in development of embryo sac*) ***Example: Allium***.

III. ***Tetrasporic*** (*i.e. four megaspore takes part in development of embryo sac*) ***Example: lilium.***

- After 8 nuclei stage, the wall formation leading to formation of typical female gametophyte or embryo-sac which undergo various developmental changes:

1. Each end of embryo sac has 4 nuclei in which *one nuclei moves towards the center* (i.e. known as polar nuclei) which fused during the time of firtilization and form ***diploid nucleus or secondary nucleus (2n)***.
2. Now the wall formation isolate six nuclei (*i.e 3 at micropylar end and 3 at chalazal end*) which result ***3 cells at micropylar end*** (*i.e. one egg* ***cell or female gamete*** *and two* ***synergids cells*** *on either side of egg cell*) and ***3 at chalazal end*** *(i.e.* ***antipodal cells***).

Synergids cells have filiform apparatus (i.e. cellular thickning at the micropylar tip) which play important role in guiding the pollen tube during fertilization.

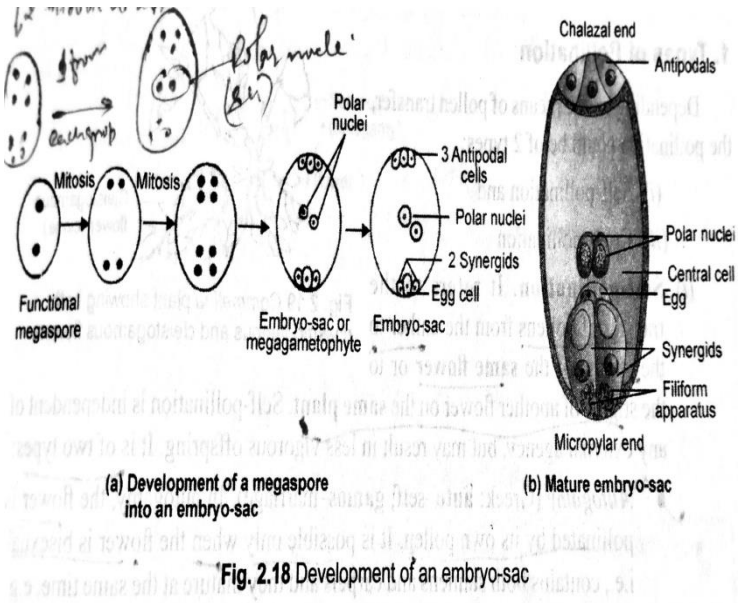


Fig. 2.18 Development of an embryo-sac

 # At maturity in angiosperm the embryo sac is 7 celled and 8 nucleated.

Pollination:

- Transfer of pollen grain from anther to stigma.
- Depending on mean of pollen transfer it is two type:

1. **Self pollination** - pollen transfer from anther to stigma of same flower (i.e. ***Autogamy*** – *occure only in bisexual flower* ***Example: Rice and pea***) or another flower in same plant (i.e. ***Geitonogamy*** – *occurs in bisexual or unisexual flower*), *no external agencies require*, results less vigorous offspring.

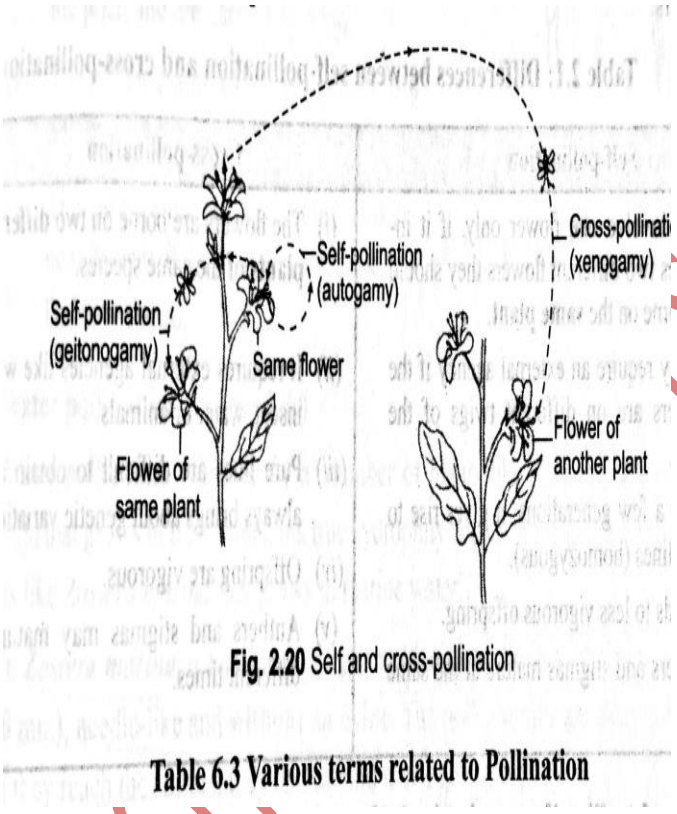


Fig. 2.20 Self and cross-pollination

Table 6.3 Various terms related to Pollination

- Autogamy plants produce two type of flower – ***chasmogamous flower*** (*i.e. Open exposing anther and stigma*), ***Cleistogamous flower*** (*i.e. do not open at all*).

2. **Cross pollination:** transfer of pollen from anther of one plant to stigma of ***another plant in same species***, external agencies required, lead *genetic variation* due to **recombination**, produce *vigorous offspring*).

Adaptation for self pollination (inbreeding devices)

- Most favorable condition for self pollination are-

1. ***Bisexuality***
2. ***Homogamy*** *(i.e. condition where stamen and carpel mature same time)***.**
3. ***Cleistogamy*** **(***i.e. flower never open***)** *E.g. family Violaceae, Balsaminaceae and polygnaceae.*

Adaptation for cross pollination(out breeding devices):

1. ***Unisexuality Example: Cucurbits, papaya, date palm, mulberry.***
2. ***Dichogamy*** (i.e. Condition where *maturation of sex organ takes place at different times*).

I. ***Protandry*** – *maturation of anther earlier than carpel* ***Example: lamiaceae, malvaceae etc.***

II. ***Protogyny*** – maturation of stigma before the dehiscence of anthers. E.g. Magnolia , banyan ect.

3. ***Self sterility or self incompatibility*** – it is *inability of gametes to fuse* i.e. gametes produce from genetically similar plant species but fail to fuse with each other. ***Example: maize wheat barley tomato sunflower carrot orchids ect.***
4. ***Herkogamy***
5. ***Hetrostyly*** – *different length of style and stamen within same fower* to ***prevent self pollination***.

Agencies for cross pollination and flower adaptation:

1. **Animophily:**

- ***Agencies- wind***, plant is known as ***anemophilous***, *produce large amount of pollen grain*.

- Pollen grain are small light weight smooth non-sticky and dry.

  Example: Cereals, Grasses, Mulberry coconut palm, date palm, cannabis, maize, wall nut and temperate tree.

- ***Flower adaptation*** *– small usually green, stamens are long and hang outside the flower, stigma are large and feathery*.
-

2. <u>Entomophily:</u>

- Flower contain *nector, bright color petals, pollen grain are large and modified with spiny or sticky walls* to get the insects.
- ***Pollinator – bees (most common), flies, wasp, moths and beetles.***

***Bees are color blind to red and mostly visited to yellow violet and purple colored flowers while moths are attracted towards the white flowers.***

Example: Salvia – bee pollination, Ficus – wasp, Yucca – moth, Ophrys – wasp, Calotropis – bees.

3. <u>Ornithophily:</u>

- ***Pollination by birds*** (*having long beaks which is large than corolla tube- **E.g Humming birds***).
- Bird pollinated flower are *tubular, cup shape, bright in colour, produce large amount of pollen with plenty of nectar.*

Example: Bombax, Bignonia, Salmalia, Butea ect.

4. **<u>Cheiropterophily:</u>**

- Pollination by ***bats.***
- Flower have strong ***fruity or fermenting odour***.

Example: banana, mango, agave, Adansonia ect.

5. <u>Hydrophily:</u>

- Pollination by ***water***.
- Flower are *small in size, inconspicuous and light in weight and do not have nectar and odour, stigma long sticky and unwettable*.

I. <u>Hyphydrophily:</u>

- Pollination takes place ***inside the water***.
- Stigma is very long and pollen grains float in water and come in contact with stigma.

Example: *Ceratophyllum, Najas, Zostera*

ii. <u>Ephydrophily:</u> male flower detached from plant and float on water and female flower have long stalk so it projects on the surface of water .

Example: *Vallisneria spiralis.*

<u>Artificial Hybridization:</u>

- Pollen from desired plant are collected and dusted on the stigma of the desired plant for pollination to get the desired result.

OR

Desired pollen grains are dusted on the stigma and latter is protected against the unwanted pollen with the help of emasculation and bagging.

<u>Emasculation:</u> removal of anther from bisexual flower *before the dehiscence of anther*.

<u>Bagging:</u> when emasculated flower are ***covered by butter paper*** *to avoid contamination from unwanted pollens*.

<u>Double fertilization:</u>

- Discovered by S.G Nawaschin in *Lilium* and *Fritillaria*.
- It is characteristic future of angiosperm in which ***syngamy*** *(i.e. one male gamete fused with egg nucleus and results zygote)* and ***triple fusion*** *(i.e.*

fusion odd male gamete and secondary nucleus or two polar nuclei).

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Sperm nucleus + egg nucleus syngamy Zygote (2n)

sperm nucleus + Secondary Nucleus Triple Fusion Primary endosperm Nucleus

Syngamy + Triple Fusion = Double Fertilization.

Sperm nucleus + egg nucleus = Zygote (2n) **(syngamy)**

Sperm nucleus + Secondary Nucleus = Primary endosperm Nucleus **(Triple Fusion)**

Syngamy + Triple Fusion = Double Fertilization

Post fertilization changes and event:

After the fertilization the following changes takes place:

1. **Development of endosperm**
2. **Embryo formation or embryogenesis**
3. **Formation of seed and fruits**

1. Development of Endosperm

- Development of endosperm starts from ***primary endosperm nucleus (PEN)*** by mitotic divisions.
- It start ***before the embryo development*** and on the basis of first division it could be following type-

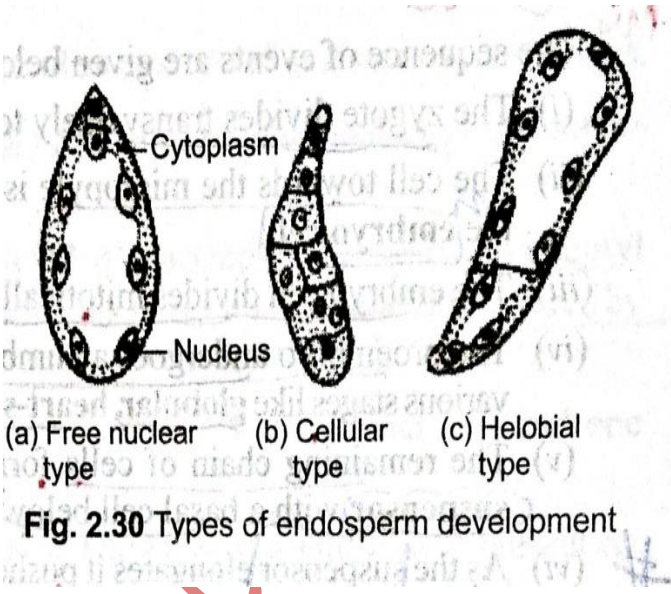

Fig. 2.30 Types of endosperm development

1. Nuclear endosperm:

- Primary endosperm nucleus undergoes *repeated division without wall formation* leading to formation of ***free nuclei*** towards the periphery by leaving the large central vacuole.
- Later the cytokinesis is begins from the periphery towards the center.

Example: coconut, calotropis, maize wheat, rice, sunflower.

2. Cellular Endosperm:

- The first and subsequent divisions of PEN are *accompanied by wall formation* to give rise to ***cellular tissue***.

Example: member of family Nympheaceae and Araceae.

3. Helobial Endosperm:

- The first division of *PEN is unequal* results ***large micropylar chamber*** (*in which division are free nuclear followed by wall formation a in nuclear type*) and ***smaller chalazal chamber*** (*in few free nuclear division takes place but later free nuclei disorganized*).

Example: Asphodelus Ruellia and Hyoscyamus.

***Coconut water from tender coconut is an example of free-nuclear endosperm and surrounding kernel or white part is example of cellular endosperm.***

2. Embryo formation or embryogenesis:

- Zygote start divide only after the certain amount of endosperm is formed because *developing embryo get nutrition from it*.
- Formation of embryo by mitotic division of zygote known as embryogenesis.
- It is common in both monocot and dicotyledone.
- Zygote divide transversely and form ***2 celled proembryo*** (*i.e. small Apical cell towards chalazal end and large basal cell towards micropyle end*).

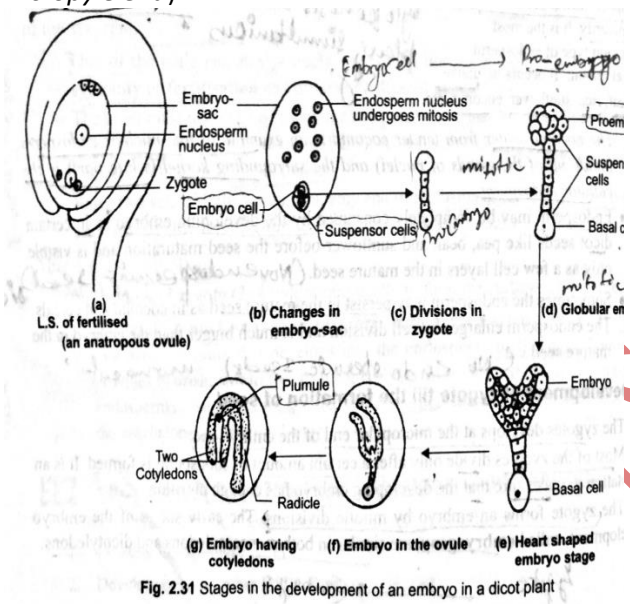

Fig. 2.31 Stages in the development of an embryo in a dicot plant

- Now the basal cell undergo many division and form ***suspensor*** of 6-10 cells with basal cell and apical cell undergo number of ***mitotic division*** and form ***quadrant*** (*i.e. 4 cell*), ***octant*** (*8 cells*), ***16 celled proembryo*** (*i.e globular shape*) and finally heart shaped embryo.
- The ***suspensor*** *helps to push the embryonic cells into endosperm to get nutrition*.
- Few cells of embryo nearest to suspensor develop into ***hypocotyl*** and ***radicle*** while other cells give rise to ***epicotyl, plumule and cotyledons.***
- In case of dicot embryo the *portion of embryonal axis above the cotyledon* is called ***epicotyl*** (*i.e. terminate into plumule)* and *below the cotyledon* is called ***hypocotyl*** *(i.e. terminate into radicle or root tip*).
- In monocot single cotyledon which is reduced and known as **secutellum**.
- In monocot the portion of embryonal axis-

a) *Above the secutellum*- is called ***epicotyl*** and it also has ***plumule*** which surrounded by *protective sheath of hollow foliar structure* called ***coleoptile***.

b) *Below the secutellum* is called **hypocotyl**. It also has ***radicle*** and ***root cap*** enclosed in an undifferentiated sheath called ***coleorrhiza***.

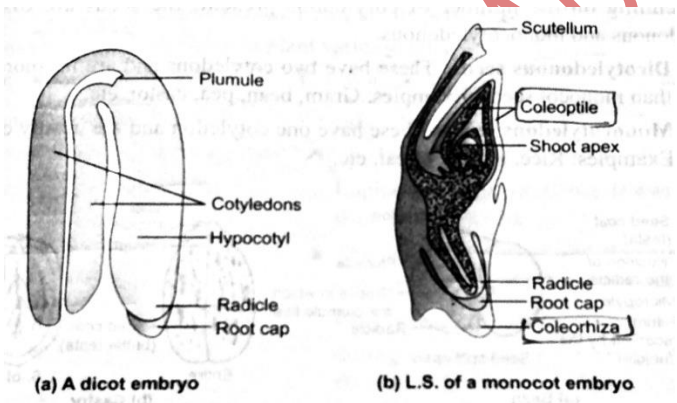

Fig. 2.32 Mature embryo

***Suspensor cells next to proembryo are called hypophysis from which root epidermis, root cortex and root cap are derived.***

3. Formation of seed :

- Seed is mature fertilized ovule which posses ***embryo*** (i.e. arise from egg cell), ***cotyledon***, ***endosperm*** (*i.e. derive from endosperm nucleus) and* ***seed coat*** *(i.e. derive from two integumants*).
- Seed are classified on two basis

1. ***Presence of endosperm*** (*i.e. endospermic or albuminous seeds)* ***Example:*** *rice, maize, coconut and caster bean* and ***absence of endosperm*** (*i.e. endospermic or ex-albuminous seed*) **Example:** Gram, Pea, Bean and Pulses.

2. ***Number of cotyledon*** (*i.e. monocotyledonous seed and dicotyledonous seed*).

Seed Dormancy:

- ***Resting state of seed*** in which the *metabolic activity of seed gets reduced*.
- It could be broken with various mean.

Seed Viability:

- Period in which seed remain viable (*i.e. alive or healthy*). And have the potential to germinate.

1. Formation of fruit

After fertilization, ovary start to grow and develop into the fruit so fruit may regard as mature or ripened ovary.

***Number of vegetables (i.e. tomato, brinjal, lady's finger, and cucumber) that contain seed are actually fruit.***

- Fruit consist of two parts:

a) ***Pericarp*** (i.e. develop from ovary wall).

b) ***Seed***(i.e. develop from the ovule).

- The pericarp differentiate into :

1. **Epicarp** *(i.e. form outermost skin*).
2. **Mesocarp** *(i.e. form the edible part of fruit*).
3. **Endocarp** (*i.e. innermost hard region that enclosed the seed*).

Special mode of Reproduction:

1. **Apomixis:** In this the seed are formed ***without fertilization*** in which embryo form from ***haploid*** *(i.e. non recurrent apomixis*) or ***diploid*** (*i.e. recurrent apomixis*) cells of ovule.

2. **Parthenogenesis:** It is special type of apomixis in which seed develop from ***unfertilized female gammete*** (*i.e. without fertilization*).

- In this the seed could be haploid or diploid it depends on the *cell of female gamete from which it develop*.

3. **Parthenocarpy:** The development of fruit *from ovary without fertilization called* **parthenocarpy**.

- Here fruit is developing from an unfertilized ovary so ovule so not develops into seed and results seedless fruit.
  Example: *Banana, Grapes, Apple, Pear and Pineapple*.
- Parthenocarpy also induce by treating Auxine in unfertlized ovary.
  Example: tomato and cucumber.

4. **Sporophytic budding:** Development of embryo from the ***sporophytic part*** of the plant (*i.e. cells of nucellus or integuments*).

   Example: *orange, mango, Opuntia and onion*.

5. **Polyembryony:** it is condition when many *embryo posses in same seed*. It occurs due to following reason:

I. Presence of ***more than one egg cell in embryo*** sac or ***more than one embryosac in the ovule*** and all get fertilized.

II. Number of embryo ***develops simultaneously from different part of ovule*** (*i.e. synergids and antipodal cells*).

III. Numbers of embryo develop from the tissue of ***nucellus*** and ***integuments***.

Example: *conifers, onion, groundnut, mango, lemon and orange*.

Home Work:

1. *Study the types of stamen on the basis of cohension of stamens, relative length of stamens and adhesion of stamens.*
2. *homework advantage and disadvantage of self and cross pollination*
3. *Advantage of seed and fruit.*
4. *Importance of seed for development of fruit.*
5. *Tabulate that after fertilization which part of ovary and ovule takes part in formation of seed and fruits.*