VI – POLLINATION

"Pollination is defined as the process of transfer of pollen grains from anther to the stigma of the same flower or of different flower of the same species."

Pollination is of two types :-

1. **SELF POLLINATION OR AUTOGAMY :]**

If the pollen grain are transferred from an anther to the stigma of the **same flower,** or different flowers of the **same plant** is called **self pollination** or **autogamy.**

2. **CROSS POLLINATION OR ALLOGAMY:**

When the pollen grains are transferred to the stigma of other flower of the same species is called **Cross pollination** or **Allogamy .** It takes place in between two different flowers.

Cross pollination is of **two types:-**

(i) Geitonogamy :

When, pollination takes place in between the **two flowers** of the **same plant** then it Is called **geitonogamy .** From the **genetical point** of view geitonogamy is **self pollination** because all flowers of the same plant are genetically identical. But **ecologically ,** it is considered as **cross pollination.**

(ii) Xenogamy:

When the pollination takes place in between the two different flowers of **two different plants** of the same species then it is called **Xenogamy.** This is **real or true cross pollination. Genetically,** as well as **ecologically,** it is **cross pollination.**



Pollination

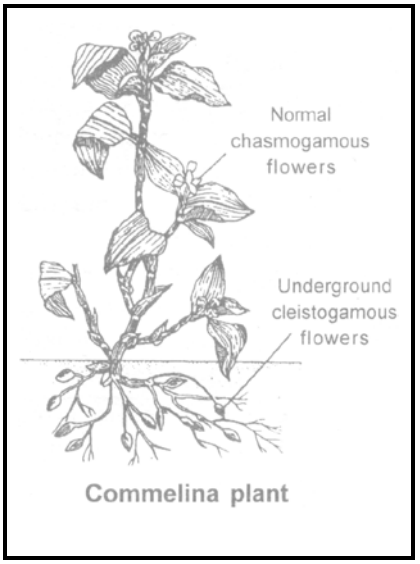
Contrivances or Adaptation for self pollination :

(i) Monocliny: - Bisexuality it means flowers are bisexual.

(ii) Homogamy :- When both the sex organs of a flower mature at the same time is called homogamy . So that chances for self pollination increased. E .g . **Mirabilis, Catharanthus.**

(iii) Cleistogamy :- In some plants bisexual flower are formed which never opens throughout the life. Such flowers are called **cleistogamous flowers.** Such as Commelina, **Viola . Commelina** plant have two types of flowers. One type of flowers are **cleistogamous** and another are **chasmogamous flowers .** E . g .Oxalis, Juncus, **Drosera.**

☞ A special type of cleistogamy is found in flowers of **legume plant**. The sex oranges are closed in a structure which is formed by joining of **some petals**. It is called **Keel**. This keel never opens . So only self pollination takes place in these plants.



Commelina plant

Contrivances for cross pollination

(i) Dicliny :- Unisexuality of the flower confirms cross-pollination. Self pollination never takes place in these flowers. It means allogamy become compulsory. Examples **– Morus, Palms, Date Palms , Cucumber and Cucurbita, Carica.**

(ii) **Dichogamy :-** In many **hermaphrodite flowers** of the plants , stamens and carpels of a flowers do not mature at the **same time.** Dichogamy is of two types

(a) **Protandry :-** The anther of a flower manture eerier than carpels , is called **protandry.** In **most of the plants of Angiosperms,** cross pollinated only because of **protandrus condition .** E.g. **Salvia.**

(b) **Protogyny :-** The carpels of the flowers manture earlier then stamens . It occurs in very less no. of plants e.g. **Ficus bengalensis , Saraca indica, Ficus religiosa , Aristolochia,** most of plants of **Cruciferae** and **Rosaceae** family.

(iii) **Chasmogamy or Anthesis:-** Opening [blooming] of the floral bud in the form of a flower is called **anthesis.**

(iv) **Herkogamy:-** In some plants, morphological barriers are formed in between the anther and stigma of the same flower, so self pollination can not occurs and pollen grains from the anther are unable to reach the stigma of the same flower. In this condition, only cross pollination is possible . e.g. **Gloriosa , Calotropis**and **Caryophyllaceae** family.

(v) **Heterostyly :-** These is difference in between the length of the filaments of stamens and length of style in flowers of some plants . Some of the plants having **long stamen** and **short style,** and in some of the plants bears **long style** and **short filament.** Due to this reason, self pollination can not possible in these plants e.g. **Prim rose** and **Linum, Primula.**

(vi) **Self sterility or self incompatibility or incompatibility:-** In this condition the pollen grains of the flower can not germinates on the stigma of the same flower. This condition is called **self sterility .** This is a **parental [Genetical]** characteristic feature which is controlled by **genes.** Such as in **Pitunia, Malva, Thea, Passiflora, Vitis, Apple(Malus)**
Incompatibility involves many complex mechanisms associated with interactions of pollen and stigmatic tissues. If the incompatibility is due to the genotype of the sporophytic/ stigmatic tissues, it is termed sporophytic incompatibility on the other hand, if it is due to the genotype of the pollen, it is termed gametophytic incompatibility. This may be due to prevention of pollen germination, retardation of growth, deorientation of pollen tube or even failure of nuclear fusion. It is controlled by genes with multiple alleles (s-allele).

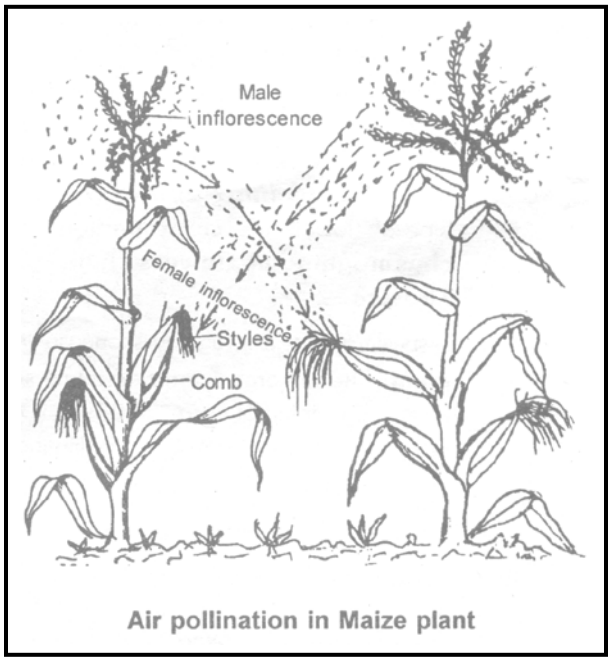
i. Growth of its pollen tube of self pollinated pollen grain is very slow and growth of the pollen tube of cross pollinated pollen grain is very fast so pollen tube of cross pollinated pollen grain is very fast so pollen tube of cross pollinated grains reach earlier inside the ovule. This is termed **prepotency.**

ii . Enlarged pollen tube turns upwards and degenerates in style.

VII. METHODS OF CROSS POLLINATION

1. ANEMOPHILY:

When the pollen grains are transfer from one flower to the another flower through the air is called**anemophily** and flower is known as **anemophilous flowers.** Such as **Cereal plants: - Maize** etc. Anemophily is also found in all Gymnosperms**.** The anemophilous plants produce **enormous amount of pollen grain .**The pollen grins are very **small, light weight** and **dry** and their stigma is **hairy or brushy** and **mucilaginous (Sticky).**
Yellow clouds are formed in sky during the wind pollination in **Pinus.** These yellow clouds are formed due to the pollen grains are
called **"Sulphur Showers".**
Anemophilous flowers are **neither attractive** nor with **fragrance.** They do not have nectar glands . Anemophilous flowers are generally unisexual.
E.g. – **Sugar cane, Bamboo, Coconu Cannabis,**
Grasses and **Date palms, Typha , Oak**
Hazel.



Air pollination in Maize plant

- **Potamogeton** and **Myriophyllum** are aquatic plant but it is anemophilous.
- Maximum loss of pollen grains only takes place in this pollination. It is completely **non directional process.**

2. ENTOMOPHILY:

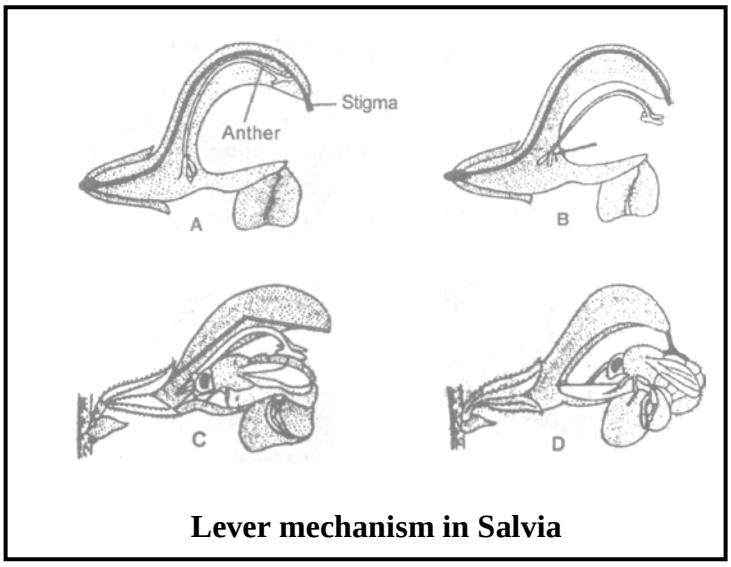
The pollination takes place with the help of **insects** is known as **entomophily.** Most of insect pollinational **(80%)** only by **Honey bess.** They are ornamental plants.

Ornamental plants utilize their maximum energy in this pollination and develops different types of **adaptation** for attraction of insects. These flowers are attractive in colour . They posses **special fragrance.** Nectar glands is also present.

The **pollen grains** of insect pollinated flowers become **sticky** due to presence of **pollen kitt.** The surface of **stigma** of flowers is **rough.**

Some of the plants develop special adaptation for insect pollination.

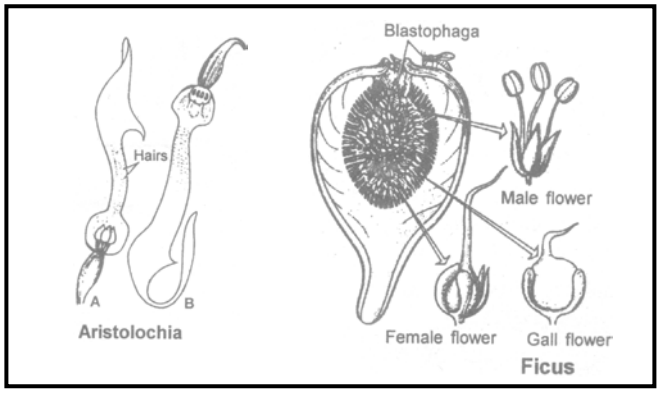
- In **Mussaenda** plant , **advertising flag** for attrition of insects.
- The **lever mechanism** or **turn pipe mechanism** is found in **Salvia** for pollination . The flowers of **Salvia** have **bilabistecorollate tube.** The connective of stamen is long. The anther or anther lobe of connective is fertile while posteriorly lobe is sterile. When the insect lands on the lower lip, the fertile lobe automatically brings down to touch the back of insect and thus depositing the pollen grains on the back of insect.

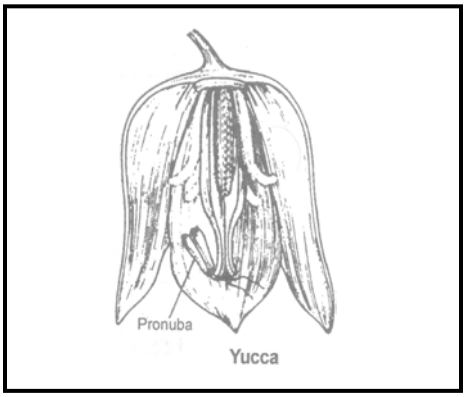


Lever mechanism in Salvia

- Some of the flower s have attractive **bracts** i.e. bright and coloured e.g. **Bougainvillea**

Yucca plant has develops an obligate symbiotic relation ship with an insect-Pronuba moth. The pollination in "Yucca takes place only by pronuba moth. This insect lays eggs in the ovary of flower. Life cycle of both depend on each other.





Note : "Trap door mechanism" is found in **species of Ficus** for pollination **[Blastophaga** insect] because **Hypanthodium type** of inflorescence is present.

- In **Aristolochia "Fly trap mechanism"** is found for pollination. This flower is known as **"Pit fall flower" .**

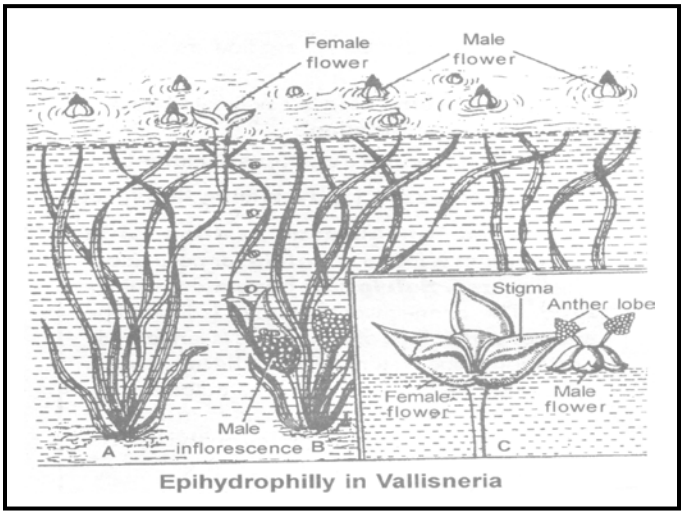
- **Ophrys speculum flower pollinated by Wasp [Colpa aurea] by means of pseudo-copulation. The appearance and odour of the flower like female wasp [Mimicry]**
- **In centaurea plant pollination takes place by "piston mechanism" .**
- **In Rafflesia, the pollination is brought about by Carrion flies and dispersal of seeds by Elephant.**
- **Nymphaea, Nelumbo and Alisma are also entomophilous plants while they are hydrophytes.**

3. HYDROPHILY :

When the pollination brings by water is known as **hydrophily.** It is of **two types:**

(i) **Epihyily :-** When the pollination takes place on the surface of water is called **epihydrophily** e.g. **Vallisneria and Ruppia.**

(ii) **Hydrophily :-** When the pollination takes – place inside the water is called hydrophily.
e.g. **Ceratophyllum, Najas** and **Zostera** and **Hydrilla. Specific gravity** is found in **pollen grains** so remains **supended** in water.



Epihydrophilly in Vallisneria

4. ZOOPHILY :

When the **pollination** brings by **animals** is called **Zoophily.** Generally in zoophillous plants, flowers are very **large, attractive** and maximum number of **nectar glands** are present (more then entomophilous).

(i) Ornithophily:-

Then process of **pollination** is takes place by **birds** is known as **ornithophily.** e.g. **Sun bird** or **humming bird** in **Bignonia** plant and by **Honey bird** in **Strelitzia plant, Callistemon** (Bottle brush), **Bombax [Silk cotton tree.] Butea monosperma.**



(ii) Chiropterophily:-

If the **pollination** brings through the **bats** is called **chiropterophily .** e.g. by **Pteropus.** These flowers are big in size e.g. **Anthocephalus kadamba, Bauhinia & Kigelia plants, Adansonia.**

(iii) Myrmecophily :-

(Termite pollination) :- This pollination brings about by **Termites and Ants. Prosopis – Kikar , Acacia, (Mimosoideae family) and some members of Rubiaceae family etc.**

(iv) Malacophily or Malmacophily :-

This **pollination** brings about by **Snails** e.g. , **Aspidistra lurida** and **Chrysanthemum** plants.

- **Erythrina** (Coral tree) plant visited by **Crows** and **Squirrels.**
- In **Arisaema** or **Cobra Plant** pollination by **snake** called **"Ophiophily".**
- **Night flowering plants** are pollinated by **Moths.** They are highly scented. Their flower generally white coloured
- **Orchids** are pollinated by **Wasps / Snails.**
- Favourable colour of **Honey bees** is **yellow,** but they are blind to red colour.
- Bud pollination is found in **Wheat** plant.

VIII. FERTILILZATION

The fusion of male gamete with female gamete is called fertilization. First of all, fertilization was discovered by **Strasburger (1884)** in **Monotrapa** plant. This process is completed in the following steps:-

[A] GERMINATION OF POLLEN GRAINS :

After pollination, **pollen grains** germinate on the **stigma .** They absurd moisture and sugar contents from stigma and swellup. The intine of pollen grain grow out through the any one germinal pore of exine, in the form of tube like out growth is called **pollen tube .** One pollen tube develops in **Capsella** and **most of Angiosperms** is called **monosiphonous** condition, but more then one pollen tubes develops in **Malvaceae** and **Cucurbitaceae** family . It is called **polysiphonous.**

☞ When the pollen tube comes down from the stigma into the style, first of vegetative nucleus enter, into the pollen tube then it is followed by generative cell. The tube nucleus always occupies in terminal position in pollen tube. The vegetative nucleus controls the growth of the pollen tube. Mean while , the generative cell divide mitotically to form **two male gametes.** Both of the male gametes are **non motile.**

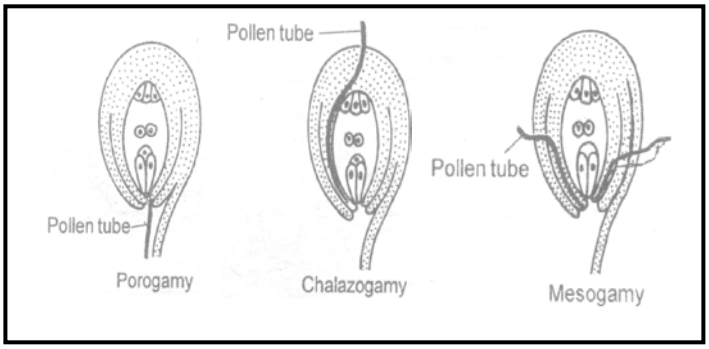
☞ **Boron** element and **calcium** ions (mainly Boron) are essential for the growth of pollen tube and best temperature for growth of pollen tube is **20-30^{0}C.** Pollen tube shows **apical growth** and **chemotropic** movement.

[B] ENTRY OF POLLEN TUBE INTO OVULE :

Finally , the pollen tube enters in the ovary at that time , ovule becomes mature . Inside the ovary **Obturators** guides the passage of pollen tube towards the micropyle. A mature ovule in which embryo sac also matured , has three paths for the entry of pollen tube :-

(i) POROGAMY:- in this , pollen tube enters into the ovule through the micropyle . It is known as **porogamy .**It is found in **most of Angiosperms [Capsella] .**

(ii) CHALAZOGAMY :- In this method , the pollen tube enter into the ovule through the chalaza This method is discovered in **Casuarina** by **Treub** [1891] e.g. **Betula** and **Juglans** (walnut) .



(iii) MESOGAMY :- In this method , the pollen tube enter into the ovule either through **integuments – Cucurbita** or through the **funiculus – Pistacia** and **Populus.**

[C] ENTRY OF POLLEN TUBE INTO EMBRYOAC:

Pollen tube can enter into the ovule through the any passage but inside embryosac, only enter through the **egg apparatus.** After the entrance inside the ovule, it grows towards the egg apparatus because synergids cells secrete the chemical (hormones) which attracts the growth of pollen tube. It means **pollen tube** shows **chemotropic movement** in ovule.

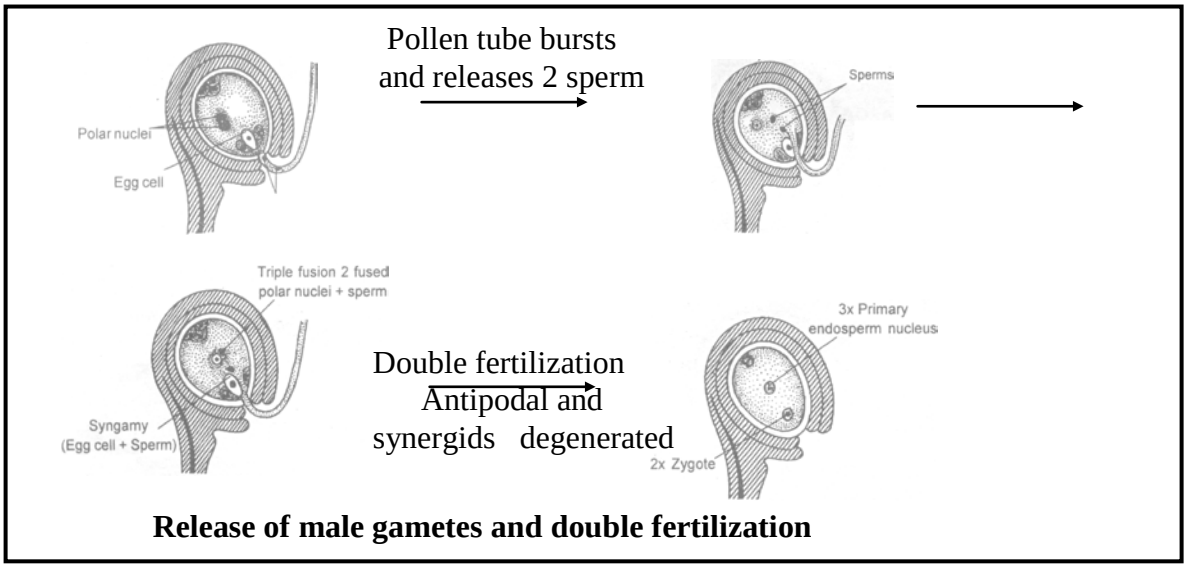
☞ Any one syergid starts degenerating when the pollen tube comes near egg apparatus . The pollen tube enter into the embryosac through the degenerating synergids.

☞ When tip of the pollen tube enters into the embryosac vegetative nucleus degenerates . The tip of the pollen tube swells and burst [Endosmosis] after reaching inside the embryosac. The pollen tube released all contents including both male gametes inside the central cell of embryosac.

☞ Two dark granules appears in the region of degenerating synergids . These are known as **X-bodeis.** They are two in no. and both X-bodies are formed by the degenerating nucleus of tube cell and synergids.

[D] FUSION OF GAMETES :

- Before or after the entrance of pollen tube into the embryosac , both polar nuclei of the central cell fused together to form a **diploid nucleus.** It is known as **secondary nucleus** or **definitive nucleus.**
- Out of two, **one male gamete** fertilized with **egg cell** and to form a **diploid zygote.** This is known as **syngamy.** This is **true mechanism of fertilization** process.
- The **second male gamete** fused with **diploid secondary nucleus** which is formed by the fusion of two polar nuclei. This fusion is known as **triple fusion** resulting, a triploid (3n) structure is called **primary endosperm nucleus.**
- **Fertilization** takes place **twice** at a time in **Angiosperm** is called **double fertilization.**
- Double fertilization was discovered by **"Nawaschin"** in **Lilium** and **Fritillaria** plants.
- **Double fertilization** and **triple fusion** is the **specific** or **universal** characteristic of **Angiosperm.** There are **five nuclei** and three gametes participate in **double fertilization.**
- A zygote is formed by true fertilization (syngamy] develops into **embryo.** Triploid primary endosperm nucleus formed by triple fusion develops into the **endosperm** which is used as nutrition for growing embryo.
- All the remaining cells of embryosac like **antipodal cells, synergids** degenerate excluding zygote and primary endosperm nucleus after the fertilization. At this time, zygote food from degenerating synergids and antipodal cells.
- Entry of more then one pollen tube into the ovule leading to occurrence of super numerary male gametes called **"Polyspermy."**



Release of male gametes and double fertilization

IX. DEVELOPMENT OF ENDOSPERM

- First of all endosperm develops from the primary endosperm nucleus after the fertilization which stored food materials . It is utilizes by the embryo during the early development then after at the time of seed germination . Food is present in the form of **starch** in endosperm. The endosperm is of **three types** on the basis development

1. NUCLEAR ENDOSPERM:

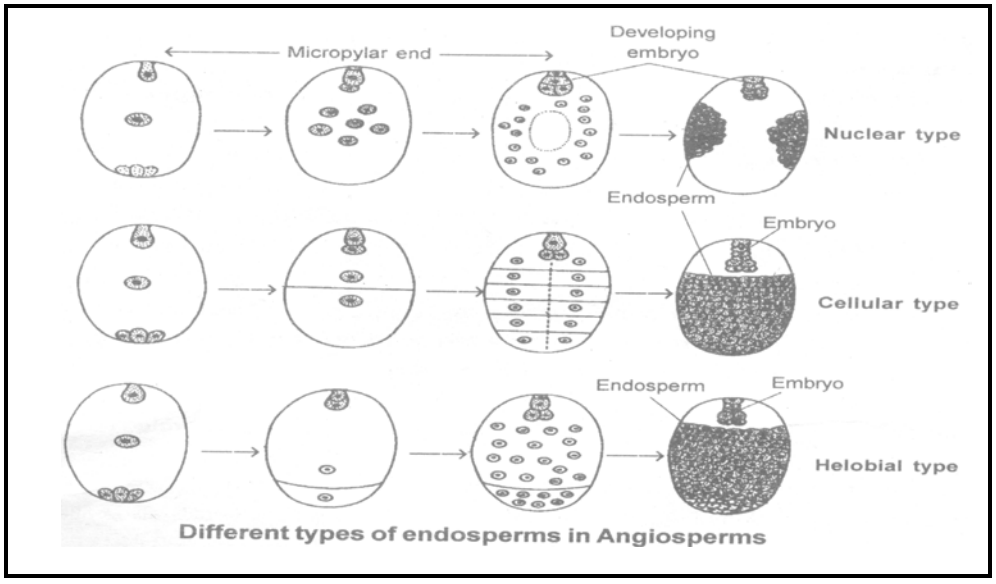
- This type of endosperm mostly found in **Dicotyledon [Polypetalae] .** Nuclear endosperm is also present in **Capsella.**
  Such type of endosperm develops by **free nuclear division** of nucleus of primary endosperm nucleus , resulting **multinucleated endosperm** is formed. Later on cytokinesis takes place, so that multicellular endosperm is formed.
- This type of endosperm is the most common in Angiosperms.
- The milky fluid is **green Coconut** is example of **nuclear endosperm**, which is called **liquid syncytium .**
- In **Melastoma,** cytokinesis never take place so that it is always remains **nuclear endosperm.**

2. CELLULAR ENDOSPERM:

- This type of endosperm is found in **Gamopetalae group.** During the development, each division of primary endosperm nucleus is followed by cytokinesis. So that endosperm is remains cellular from the beginning.

3. HELOBIAL ENDOSPERM:

- During the development of this type of endosperm, first division of primary endosperm nucleus is followed by unequal cytokinesis so that two unequal sized cells are formed (Cell towards the micropyle is large). Now free nuclear divisions takes place in each cells, results it becomes multinucleated. Eventually cytokinesis takes place at a time so that it is changed into a cellular endosperm. This type of endosperm is found in **Monocots.** It is intermediate type of endosperm.



Different types of endosperms in Angiosperms

SPECIAL POINTS:

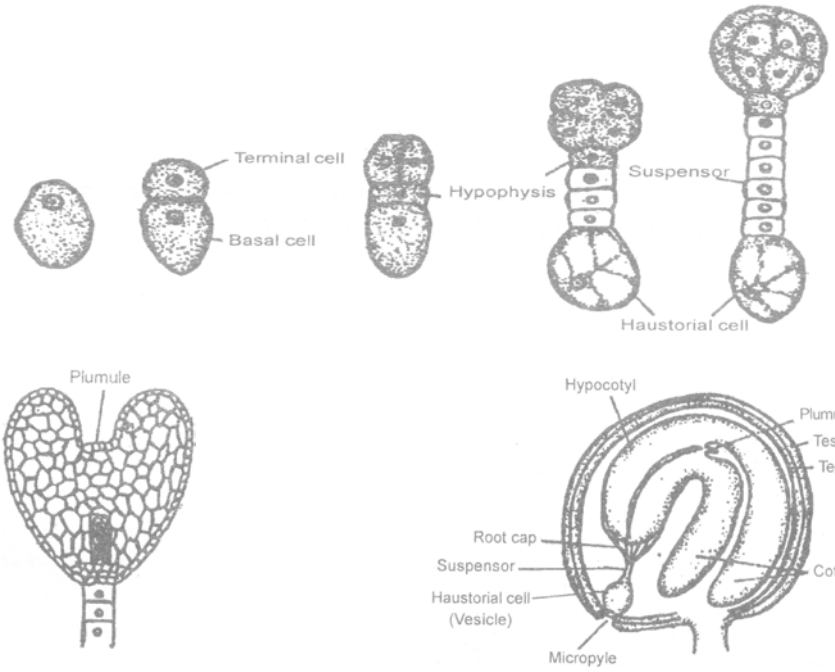
- After the observation of first two division of primary endosperm nucleus, endosperm can be identified whether it would be **nuclear,** or **cellular endosperm.**
- Endosperm is absent in some of Angiosperms e.g. In **Orchidaceae, Podostemaceae** and **Trapaceae.**
- Exceptionally, some of the plants have **diploid endosperm** instead of triploid such as in **Oenothera.**
- **Maize** and **Tomato** have **mosaic endosperm** in which patches of different colours are present.
- The **endosperm** in **Betelnut** is rough surfaced. It is known as **"ruminate endosperm".**
- The **drinking** portion is **nuclear** endosperm and **edible** portion is **cellular endosperm** in **Coconut**

X- DEVELOPMENT OF EMBRYO IN DICOT

Development of **embryo** in **Capsella** is first time discovered by **"Hanstein".**

- In Angiosperm , Zygote undergoes in resting phase. When the endosperm is formed, development of zygote starts. In the beginning it absorb food from the endosperm and increase in size then after a layer secreted by itself. Now it is called **Oospore.**
- The **first division** of Oospore is **transverse,** results two cells are formed. The one called **apical cell** or **terminal cell** or **suspensor cell.** The other cell is formed towards the **Chalaza** is called **apical cell** or **terminal cell** or **embryonal cell.**
- The basal cell and embryonal cell divide simultaneously.
- The basal cell divides transversly and apical cell divides vertically resulting , two suspensor cells and two embryonal cells formed . This stage is made up of four cells which are arranged in **'T' shaped** structure .Embryonal cells divide The basal cell and embryonal cell divide **vertically** to form four Embryonal cells. This is the **quadrant stage** of embryo .
- The **two suspensor** cells divided by transverse division forming a **6-10 celled** long filament like structure is termed **suspensor.** This main function of suspensor is to pushes the developing embryo into food laden endosperm to provide nutrition.
- The **micropylar cell** of the **suspensor** swells up. This cell of suspensor is known as **haustorial-cell.**
- The **cell of suspensor** lies near the embryonal cells is called **hypophysis.** This cell combined with radicle to form the **apex of root** [Root cap].
- These four cells quadrent embryo further divide transversely to produce eight. The eight celled stage of embryo is called **octant stage.** The eight cells of octant are arranged in two tiers.
- The four cells of the octant embryo lies near the **hypophysis** is known as **hypobasal cells** and four cell present towards the **chalaza** termed **epibasal cells.**
- The **hypobasal cells** gives rise to **radicle** and **hypocotyl** and **epibasal cells** give rise to **two cotyledons** and **Plumule** of the embryo.
- All the cells of octant divided by periclinal division so that a 16 celled **globular embryo** is formed **[Proembryo] .**
- Due to fast division of embryonal cells of globular embryo, a **heart shaped embryo** is formed. All the cells this embryo are meristematic.
- Due to the fast growth in **two lobes** of heart shaped embryo, they develop into **two cotyledons .** Both the growing cotyledons turn in **downwards** due to the **curved position of body of ovule** of **Capsella.**
- The tissues are present below the joining place of both the cotyledons are responsible to form **Plumule** and behind it **epicotyl** is formed.
- The tissues present opposite to the Plumule near the hypophysis give rise to **radicle.** The apex **root** [root cap] is formed by hypophysis.
- This **curved position** of the embryo is called **Torpedo** or **Chordate stage.**
- An axis is present between Plumule and radicle is called **embryonal axis.** It is also called **Tigellum [main embryonal axis] .**
- Both the cotyledons are present at lateral position of embryonal axis and Plumule is formed in terminal position in Dicotyledon embryo.
- This type of development of embryo is known as **Crusella** type or **Onagred type .** It is the **most common type** of development in **Dicots.**
- **Crucifer type** of development is also found in **Capsella,** so that it is considered as **typical Angiosperm** for the study of **embryonic development of Angiosperms.**
- When embryo is formed, **suspensor** dries and **degenerates** so it is known as **meroblastic development**
- **Ovule** modified into **seed** in which **testa** is formed by **outer integument** and **tegmen** is formed by inner **integument.**

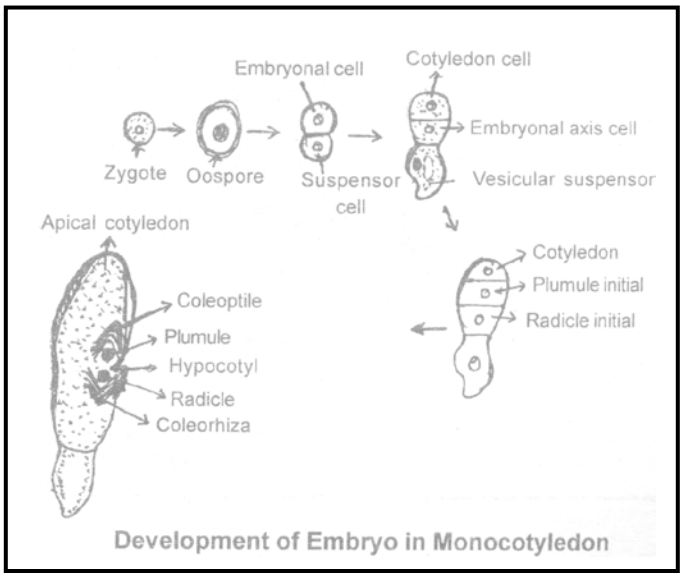
- Only **micropyle of ovule** remains **unchanged** and also present in **seed.**
- Entire **ovary** modified into **fruit.** This fruit is formed by fertilized ovary so that it is called **true fruit.**
- In some of the Angiosperms fruit is formed from the ovary without fertilization known as parthenocarpic fruit.
- In some fruit parthenocarpic is senseless (If edible part is endosperm or seed)



STAGES IN THE DEVELOPMENT OF EMBRYO IN A DICOT (Capsellabursa-pastoris)

XI – DEVELOPMENT OF EMBRYO IN MONOCOTYLEDON

The **Lilium type** of embryonic development is found in **monocotyledon**. The first division is transverse division in Oospore. Results two cells are formed the upper cell chalazal is called **embryonal cell** and lower micropylar cell is termed as **basal cell.** The basal cell does not divide further and later on it increases in size and form single celled **vesicular suspensor.**Only embryonal cell divides transversly inwhich terminal cell is called **cotyledon cell** and lower (Middle) cell is known as **embryonal axis cell.** A transverse division takes place in embryonal axis cell to gives rise two cells.



Development of Embryo in Monocotyledon

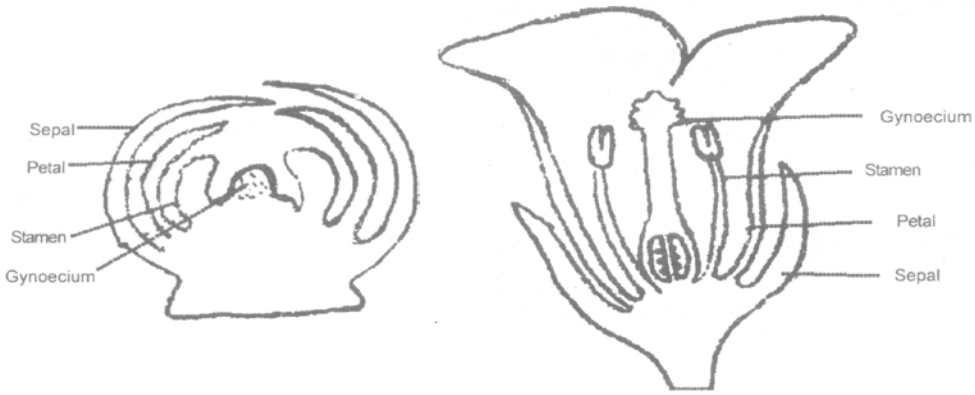
The one cell out of two, gives rise to **Plumule initial** and another gives rise to **radicle initial.**

- The Plumule initial **divides** to form a Plumule of the embryo.
- Radicle initial divides to form radicle. In this both the initials are responsible to form embryo in Lateral position.
- **An apical cotyledon** is formed by the continuous divisions of **cotyledon cell.**
- This apical cotyledon is known as **Scutellum.**
- The plumule and radicle is covered by cap like hard protective structures. The covering of **plumule** is called **coleoptile** and covering of **radicle** is known as **coleorhiza.** These structures broken during the germination. The plumule lies in **lateral** position and cotyledon in **terminal** position in Monocotyledons.
- In Angiosperms, **development** of embryo is **meroblastic** and **endoscopic** [towards the chalaza].

Development of Floral Organs in Arabidopsis

Arabidopsis thaliana is a small weed belonging to family **Brassicaceae.** It contains approximately 26000 genes and the complete gene sequence has been studies by
Plant biologists. Like other plants in **Arabidopsis** the initiation of flowering is influenced by various environmental factors, Of these **photoperiodism** and **temperature** are more important. Under the influence of the two factors the apical meristem starts producing flowers instead of vegetative structur. The development of calyx, corolla, androecium and gynoecium is controlled by **specific genes.** These are called **homeotic selector genes,** e.g. Apetala-2, Apetala-3, Agamous etc. As a result of effect of these genes, the development of **laves** is replaced by the development of **flowers.**

Similar to leaves, the floral organs developed by periclinal division in protodermal or subprotodermal cells. Initially these cells show periclinal division followed by periclinal as well as anticlinal division resulting in formation of an outgrowth. Cells of the outgrowth divide develop and differentiate to form different floral organs. In **Arabidopsis** calyx are the first to develop followed by corolla, androecium and gynoecium. The order of development of floral may vary from to plant. For example in members of family **Umbelliferae** the sequence of development of floral organs is – androecium, corolla, calyx and gynoecium.



Development of floral organs in Arabidopsis
(A) intial stage of development (B) fully developed flower

Difference between Self and Cross pollination

S.No.	Self pollination	Cross pollination
1.	Pollen grains are transferred to stigma of same or genetically similar flower.	Pollen grains are transferred to stigma of genetically different flower.
2.	Anthersand stigma mature simultaneously.	They mature at different time i.e. protandry and protogyny.
3.	It occurs in open as well as closed flower.	It occurs in only open flower.
4.	It is very economical for plants.	It is not economical as the plant has to produce large number of pollen grains, nectar , scent and coloration.
5.	External agencies are not required.	It is essential i.e. depends on agenies.
6.	Young ones are homozygous.	Young ones are heterozygous.
7.	It produces pure lines because of the non occurrence of genetic recombinations.	It produces variations due to genetic recombinations.
8.	It cannot eliminate harmful traits.	It can eliminate harmful traits.
9.	Useful characters are preserved.	Not preserved.
10.	No adaptability in the changing environment.	It provides adaptability.
11.	It cannot introduce new traits.	It can introduce new traits.
12.	Disease resistance is low.	Disease resistance is optimum.
13.	There is decrease in yield.	It increase the yield.
14.	It does not help in the development of new species.	Helps in the development of new species.

Difference between Embryo and Endosperm

S.No.	Embryo	Endosperm
1.	It is formed by fertilized egg (syngamy)	It is formed by fusion of secondary nucleus(triple fusion)
2.	It is always diploid structure.	It is generally triploid structure
3.	It gives rise to new plant	It provides nutrition to the developing embryo. Such type of structures are never formed.
4.	Cotyledons, plumule and radicle are formed in embryo	It is only found in endospermic seeds otherwise It degenerates with the formation of seed.
5.	Embryo is present in seed.	Endosperm does not die in the absence of embryo .
6.	Embryo dies in the absence of endosperm	There is no germination is found in endosperm.
7.	Germination of seed takes place.	

Difference between Egg cell and Secondary nucleus

S.No.	Egg cell	Secondary nucleus
1.	It is present near the micropyle, inside the embryosac.	It is present in the middle of the embryosac It is not surrounded.
2.	Generally egg is surrounded by two synergids.	
3.	Only single is present in it.	It is formed by fusion of two polar nuclei.
4.	It is haploid structure.	It is diploid structure.
5.	It is fertilized with one male gamete and to form a diploid zygote (Embryo)	It is fused with one male gamete and to form a triploid primary endosperm nucleus (Endosperm)

Difference between male and female gametophyte

S.No.	Male Gametophyte	Female Gametophyte
1.	It is developed from microspore or pollen grain.	It is developed from megaspore.
2.	It dose not remain embedded permanently in microsporangium.	It is remains embedded permanently in microsporangium.
3.	Male gametes come out of pollen grain due to the formation of pollen tube.	Female gamete always remains inside, covered by membrane of microsporangium.
4.	There are two phases of growth – prepollination and post pollination.	Only single phase of growth.
5.	It is three celled structure in mature stage.	It has seven cells in mature stage.
6.	It will disintegrate after fertilization.	Two new structures are formed after fertilization, that is endosperm and Oospore.

Difference between Epigeal and Hypogeal germination

S.No.	Epigeal germination	Hypogeal germination
1.	Cotyledons come above surface soil during the germination and remains attached till the formation of new leaves.	Cotyledons remains under the soil surface.
2.	Due to the growth of hypocotyl and cotyledon pushed above the ground.	Due to the very less growth of hypocotyl, cotyledons do not come above the ground.
3.	Growth of epicotyl does not take place.	Due to high growth of epicotyl, plumule comes above ground and Cotyledon remains inside the ground.
4.	Cotyledons become green and perform leaf like function	Cotyledon remains under the soil and do not perform leaf like function
5.	Cotyledon is responsible to form first leaves, then after dries and fall on the ground	Cotyledon decomposed inside the soil.

NUMBER OF CHROMOSOMES IN DIFFERENT PARTS OFPLANT

	SPOROPHYTE	
1.	Zygote	2n
2.	Embryo	2n
3.	Endosperm	3n
4.	Radicle	2n
5.	Plumule	2n
6.	Cotyledon	2n
7.	Nucellus	2n
8.	Integument	2n
9.	Microspore mother cell	2n
10.	Megaspore mother cell	2n
11.	Ovary wall	2n
12.	Carpel	2n
13.	Sepal, Petal	2n
14.	Stamen	2n
15.	Leaf, Root, Stem	2n

GAMETOPHYTE

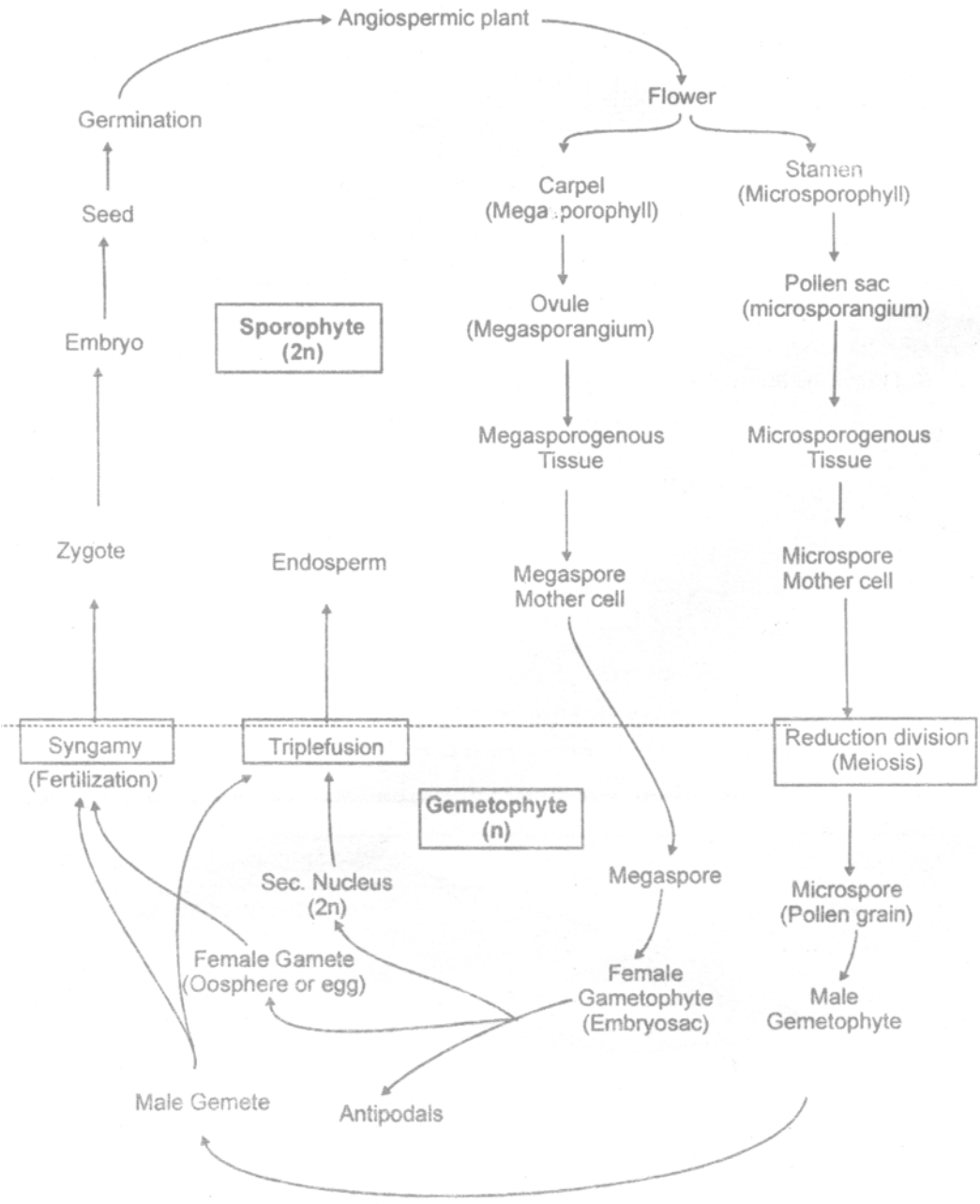
S.No.	Part of Plants	Number of Chromosomes
1.	Microspore	n
2.	Tube cell	n
3.	Male gamete	n
4.	Megaspore	n
5.	Embryosac	n
6.	Synergid	n
7.	Antipodals	n
8.	Egg cell	n
9.	Polar nuclei	n + n

Difference between pollination and fertilization

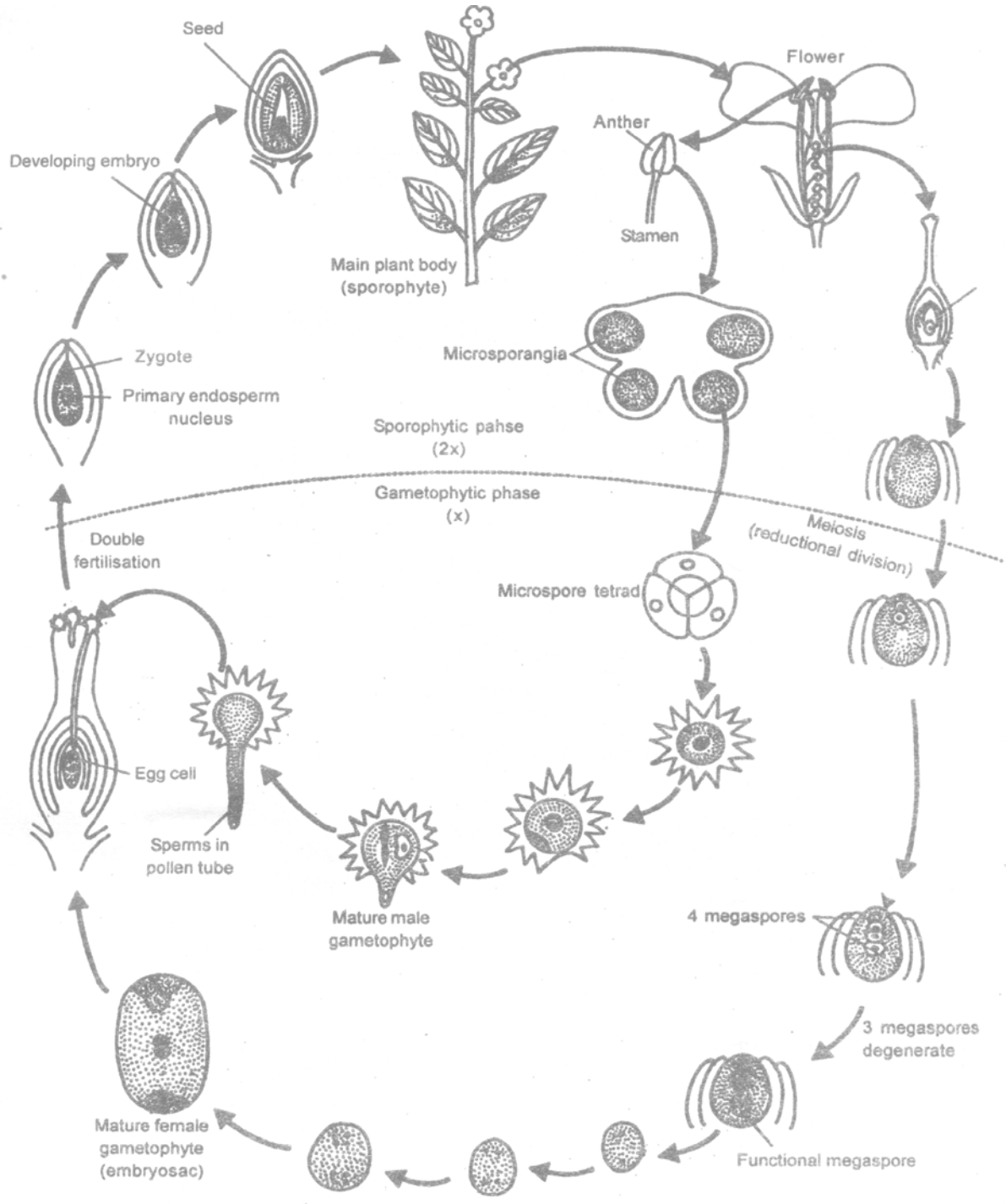
S.No.	Pollination	fertilization
1.	Transfer of pollen grains from anther to stigma of the flower is called pollination.	Fusion of male gametes and egg cell in embryosac situated inside the ovule is called fertilization.
2.	This process take place before fertilization.	This process take place after pollination.
3.	For the completion of this process, insects, water, air like agencies are essential	There is no any external medium is utilized in this process
4.	Pollen tube is not formed	Pollen tube is formed which transfer male gametes up to egg cell.
5.	This process take place on outer parts of flower, so that it is external mechanism	This process take place inside the flower, so that it is internal mechanism.

Difference between Monocotyledonous and Dicotyledonous seed

S.No.	Monocotyledonous seeds	Dicotyledonous seeds
1.	Only single cotyledon is present with embryo	Two cotyledon are present with embryo
2.	Generally cotyledon is thin or papery	Cotyledons are thick
3.	Generally seeds are endospermic	Generally seeds are non endospermic , some times may be endospermic
4.	Cotyledon is also called scutellum	Not called by this name
5.	In seed plumule is covered by coleoptile	Coleoptile and coleorhiza are not formed.
6.	and radicle is covered by coleorhiza.	
7.	Plumule is in lateral position and cotyledon are is in terminal position	Plumule is in terminal position and cotyledons are present in lateral position
8.	Radicle degenerates after sometime and adventitious roots are formed at that place.	Radicle is responsible to form primary root.
	In some of the seeds, seed coats and cotyledon fused together e.g. Wheat etc.	Such types of seed are not found.



OUT LINE DIAGRAM OF LIFE CYCLE OF ANGIOSPERMS


Seed
Flower
Anther
Developing embryo
Stamen
Main plant body
(sporophyte)
Microsporangia
Zygote
Primary endosperm
nucleus
Sporophytic pahse
(2x)
Gametophytic phase
(x)
Meiosis
(reductional division)
Double
fertilisation
Microspore tetrad
Egg cell
Sperms in
pollen tube
Mature male
gametophyte
4 megaspores
3 megaspores
degenerate
Mature female
gametophyte
(embryosac)
Functional megaspore