(12) (14) (22) (24)

Hypohydrophily.
Pollination takes place below surface of water E.g Zostera (marine angiosperm) Llum. ceratophy
Pollen grains are long filamentous 2500μm without exine.
They can float below surface of water. Stigma is very long
pollen grains can coil around stigma and perform pollination
Epihydrophily :- Pollination takes place over surface of water E.g
Vallisinaria. It is submerged dioecious fresh water plant.
Male plant produce a large number of male flowers which rise
upon water. Female flowers are produced at the tip of pedicle.
Stigma is trifid. After fertilization plants are formed.

Insect **ENTOMOPHILY**. It is transfer of pollen grains of one flower to the Stigma of another flower with the help of insects like moths, bees, wasps butterfly, beetles etc. Characters

1. Flowers are coloured for attracting the insects. moths get attracted towards the white flowers. Butterflies and wasps towards red flowers while as honey bee gets attracted towards the bluish, voilet, yellow flower with the help of UV-radiations. Honey bees rearly visits red flower because it appears black in UV radiations.
2. Both male and female flowers have well developed sepals and petals
2. Small flower undergoes grouping in order to be seen.
11. special marking are present on petals to guide the insect to nectar hence called honey guids
3. Flowers produce odors of pleasent nature (Jasmine, rose, champa etc)
12. Pollen grains are spiny and heavy. 13. Stigma is inserted and sticky
Foul order of Rafflesia (largest flower) attracts carrion flies for pollination.
Many flowers have landing plateform for insects.
4. visiting insects are fed by nectar or edible pollen.
9. F. are generally large in size.
5. Pollen grains are heavy and covered by yellow sticky substance called pollenkit 6. stamens are inserted through sticky stigma.
7. Flowers are strong enough to bear the weight of visiting insect They may also provide shelter to insects 10. Majorly F have landing surface for insect

ORNITHOPHILY:- ornis = bird, philein = To love :. It is pollination by birds, These birds have long beak, equal to length of corolla tube Two Common birds are sunbird and humming bird. Sun bird inserts beak while sitting on shoot and humming bird inserts beak during hovering over the flower. other birds are crows parrot, bulbul etc but only a limited number of plants birds get pollinated. Characters.

1. Flowers have leathery floral parts 2. Some have funnel shaped corolla.
3. Flowers are odourless 4. Secretes nectar as well as some edible parts 5. Flowers are brightly coloured e.g. red, orange, yellow or roam blow

PTO.

(13)

CHIROPTEROPHILY

It is pollination performed by bats during night (Nocturnal) of the bats can transport pollen grains upto distance upto 30km. characters: ① Flowers are dull coloured with fruity ordour. ② Flowers secretes nectar ③ Pollen grains are produced in large number E.g 1500 - 2000 stamens

Note Malacophily = Mollusca (snail) Anthrophily = by Man. Myrmecophily = Ant pol.

Importance of cross pollination

Advantage :- ① It is useful for sterile and prepolant plants ② It helps in increase the yeild as well as adaptability ③ Genetic recombination and variation is result of cross pollination. ④ It gives plants with more resistance to disease. ⑤ It eliminate defective traits and is useful in production of new varieties. ⑥ cross pollination may brings hybrid vigour or heterosis.

Disadvantage 1. It is highly wasteful process. ② chance factor is always present by any agency. ③ It is not economial process. ④ Good characters of a race can get mixed ⑤ Undiserable characters will enter in the progeny.

Difference between

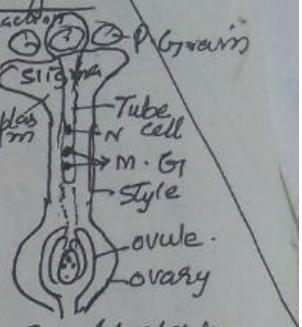
Self pollination	Cross Pollination
1. Pollen grains are transferred on same or genetically similar flowers.	1. Pollen grains are transferred on genetically different flower
2. Anther and stigma mature togather	2. The anther and stigma mature at different times
3. It occurs in open as well as in closed flowers.	3. It occurs only in open flower.
4. It is economical process for plants	4. It is not economical process as plants has to produce large number of pollen grains.
5. External agencies are not required	5 Nector, scent for attracting external agencies such as insect, birds or animals.
6. Young ones are homozygous	6. Young ones are heterozygous
7. No mixing of genetic material.	7. Mixing of genetic material occurs.
8. It can not eliminate harmful trait	8. It can eliminate harmful traits
9. useful characters are preserved	9. useful characters are not preserved.
10. It can not produce new traits	10. It can introduce new traits
11. Disease resistance is low and yeild is decreased.	11. Disease resistance is optimum. So yeild gets increased.
12. It does not help in the development of new species.	12. It helps in the developement of new species.
13. It is used as fail safe device	It is a normal process of pollination.
14. There is fall in adaptability	It enhance adaptability to changing environment.
15. There is decrease in yeild with time	Its yeild seldom falls below an avarage minimum.

FERTILIZATION (16) (24) (24)

It is fusion of male and female gamete. It is also known as Syngamy. Pollen grains reach to female gamete with the help of pollen tube. Strasburger 1884. The phenomenon is called siphonogamy.

Germination of pollen grain on Stigma

A large number of pollen grains falls on stigma. Pollen pistal reaction starts. They only the compatable pollen gains germinate and grow. They absorbs nourishment and swells up. The tube grow out through germpore. It produce pollen tube which is covered cytoplasm only by intine. Generative cell divids into two male gamete. Pollen tube now contains two male gametes, a degenerating tube nucleus and some cytoplasm. It secretes pectinase and hydrolysing enzyme to produce pathway through stigma and style and ovary to reach embryo sac. Pollen tube enters into embryo sac through different passage of pollen tube in the stigma and style is determined chemotropically along the ovule through micropyle is called porogamy. E.g. Lily.



Femal part of flower.

→ Increase conc of Ca-B-Inositol Sugar Complex
Entry of pollen Tube occurs in 3 stages.

Porogamy:- Entry of pollen tube into ovule through micropyle is called porogamy. E.g. Lily.

Chalazogamy:- Entry of pollen tube into ovule through chalaza and funiculus is called Chalazogamy e.g. Betula Juglans (walnut).

Mesogamy:- Entry of pollen tube into ovule through integuments and Casurina called mesogamy e.g. cucurbitta, populus. e.g. Pistacia

Entry of pollen tube into Embryo sac. The pollen tube enters the embryo sac at micropyle end, here it is attracted by synergids and bursts with chemotactic substance secreted by synergids. The gameles are released through pore. Two types of gamete fusion Takes place in angiosperms. (a) Generative fertilization. It is fusion of one male gamete with egg to produce zygote (oospore) which later develops into Embryo.

II Vegetative fertilization:- It is fusion of second male gamete with two haploid polar nuclei to form triploid primary endosperm nucleus. It is also called triploid fusion.

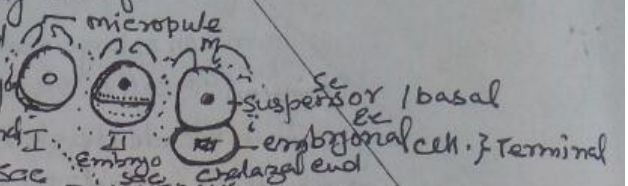
Double fertilization

It is fusion of two male gametes with two different structurs, (Egg, diploid Secondary nucleus) in same female gametophyte to produce structurs like zygote and endosperm. Double fertilization was discovered by **NAWASCHIN** in 1898 in fertillaria and Lilium.

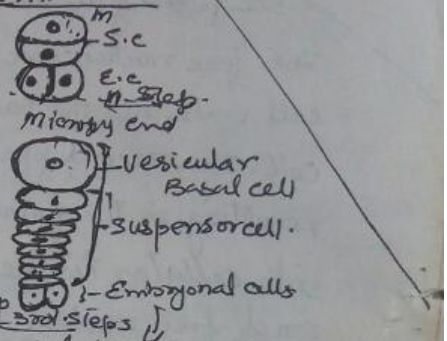
Post fertilization changes. After fertilization flower begain to fade away. There is shedding of sepals, petals, stamens, stigma, style of ovary, but in some cases sepals may remain along with fruit like bringal and tomato Following changes occurs I Endosperm formation II embryo formation III Seed and fruit formation. P.T.O. P.T.O.

Development of Embryo. Embryogeny.

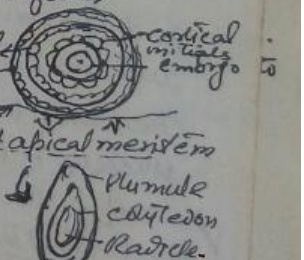
(1) In typical dicotyledonous (e.g. Cypsella, bursa-pastoris) the zygote enlarge in size, secrete its own cellulose, cellwall and divides transverse division and resulting in the formation of two unequal cells. The large basal cell is called suspensor lying towards micropylar end of embryo sac and smaller terminal cell called embryonal cell lying towards chalazal end of embryo sac



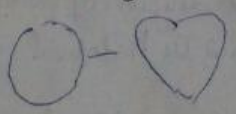
2. The basal suspensor cell divids by transverse duvision & Embryonal cell divids by longitudinal duvision to form Tetrad

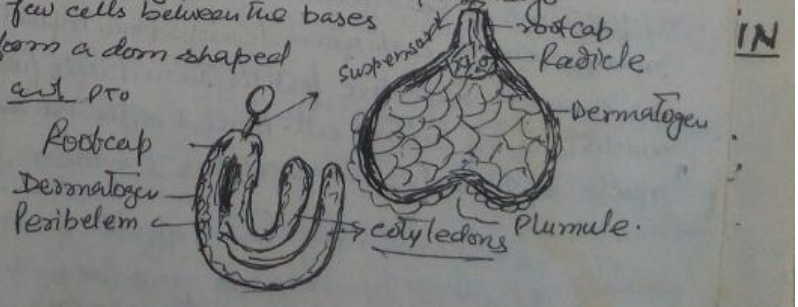


3. out of two suspensor cell lying towards micropyle enlarges in size to form Vesicular basal cell. The other cells divides by different number of transverse division to form a long Suspensor consisting of a row of 7 to 8 cells.
4. Each of the two terminal cells of the tetrad stage of proembryo divids longitudinally formed 4 celled quadrant stage
5. Each of 4 cells of quadrant stage then divides by transverse duision to form 8 celled octant stage
6. Each of 8 celled of octant stage then divids by periclinal duvision to form an outer protodermal cells and an inner cells the 8 cells stages then changes into 16 celled 8 Eight External protodermal and 8 internal cells.
7. The 8 protodermal cells divids by anticlinal duision to form the embryonic surface layer or Epidermis. The 8 inner cells in different planes to form the ground mensterms and procambium of cotyledons, hypocotyle & plumules.
8. The suspensor cell situated at the terminal end of suspensor cell is called hypophysis
9. The hypophysis divids by transverse and longitudinal division to form 3 tiers of cells. The cells of inner tier towards embryo forms cortical initials of the radicle (embryonic root). The cells of middle and outer tier forms initials of protoderm and root cap. Thus all the cells derived from hypophysis gives rise to root apical meristem



10. At this Stage the developing embryo is globular and shows radial symmetry. It is called proembryo. The pro-embryo is transformed into embryo with the development of radicle, plumule and cotyledons
11. The two cotyledo arise from two ridges of tissue appeared at the distal region of the proembryo so the globular pro-embryo changes into heart shaped embryo
12. cotyledon grows rapidly where as few cells between the bases of two cotyledons differentiated to form a dom shaped plumule (the future shoot apex).





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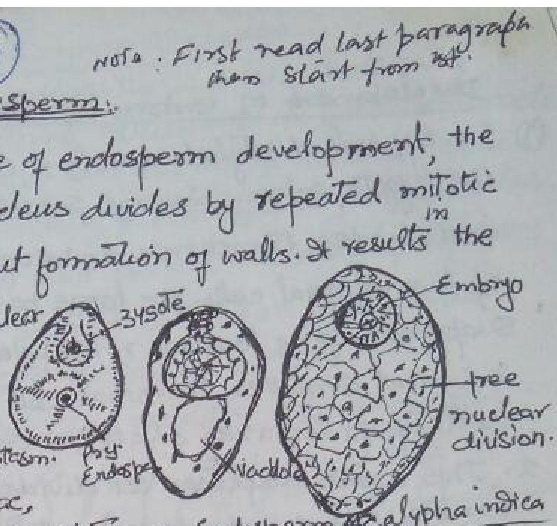
Note: First read last paragraph then start from 1st.

1. Nuclear endosperm:

In the nuclear type of endosperm development, the primary endosperm nucleus divides by repeated mitotic free nuclear division without formation of walls. It results in the formation of large number of free nuclear in the cell of the embryosac. A big central vacuole develops in the embryo sac pushing all the nuclei to the peripheral cytoplasm. The free nuclei come to lie between the embryo sac, cell wall, and the vacuolar membrane of the central cell. The second phase begain with the clevage of multinucleate peripheral cytoplasm resulting in the formation of cell wall. Finally all or most of the endosperm is converted into cellular tissue. In coconut the endosperm is multicellular in the outer part and free nuclear in the center. Nuclear endosperm is the most common type of endosperm.

Ex = Maize, wheat, Rice sunflower Capsella, crotalaria pragenus

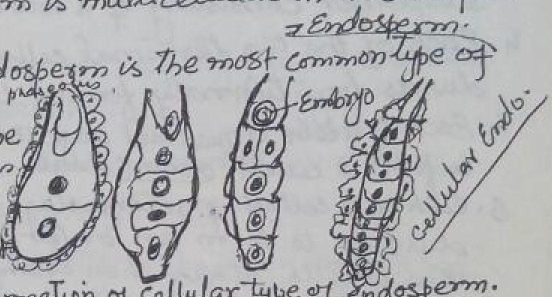


Stages of Endosperm Acalypha indica

2 Cellular Endosperm:

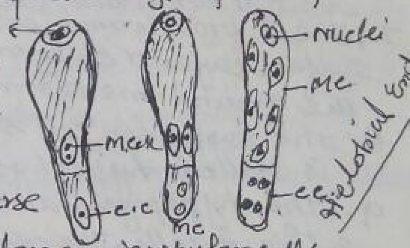
In the cellular type of Endosperm development, the first nuclear division of primary endosperm nucleus is followed by the formation of either a longitudinal or transverse cell wall in the central cell. Subsequent nuclear division and wall formation results in the formation of cellular type of endosperm.

E.g. Petunia, Datura, Balsam, Magnolia etc.



3. Helobial endosperm.

In the helobial type of endosperm development, the primary endosperm nucleus moves to chalazal end of the embryo sac. The 1st nuclear division of the primary endosperm nucleus is followed by the formation of a transverse wall resulting in the formation of small chalazal cell and large micropylar cells. Generally the chalazal cell (c.c) does not divide further and functions as haustorium. Nucleus of the large micropyle cell divides by repeated free nuclear division and further development takes place in the same as the nuclear endosperm Eg monocotyle. Ex: Asphodelus, Eremurus.



✓ First read this

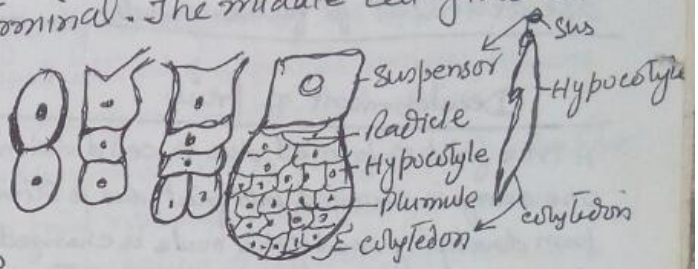
Development of endosperm

Endosperm is the food laden tissue formed during the development of angiospermous seed which provides essential nutrients to the growing embryo and also the young seedlings at the time of seed germination. In gymnosperm the female gametophyte is known as endosperm. In angiosperm the endosperm develops from triploid (3n) primary endosperm nucleus which is formed as a result vegetative fertilization. Triple fusion or fusion of male gamete with secondary nucleus of the central cell. Based on the 1st and subsequent division of primary endosperm nucleus, the endosperm is 3 types I nuclear II cellular and III helobial. PTO.

Endosperm may show effect of its genes. It is called **xenia**. If the effect of male gene goes beyond the confines of endosperm the same is called **metaxenia**

Embryogenesis in monocotyledon

The zygote divids transversally and longitudinally producing globular structure is common in Dicots & monocots. The embryo divids transversally into terminal cell and middle cell. The terminal cell divids vertically & transversally into globular embryo. It forms large cotyledon and plumule. Growth of cotyledons pushes the plumule to one side. The second cotyledon turns into Epiblast. The single cotyledon of monocot is called scutellum. It is sheild shaped and appear terminal. The middle cell gives rise to hypocotyle and radicle. Both radicle and plumule develops covering sheath called coleorhiza and coleoptile respectively and appears to be extension of scutellum.



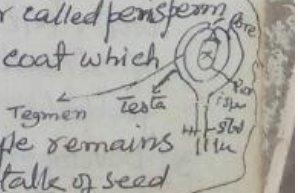
Polyembryony.

It is phenomenon of developing more than one embryo in same ovules or seeds. It can be due to following reason.

1. Simple polyembryony :- Presence of more than one embryo and hence fertilization of more than one egg or oosphere e.g. Brassica.
2. Mixed polyembryony :- Entry of more than one pollen-tube in an embryo sac and hence fertilization of extra male gamete with synergids or antipodal cells. Es. allium or Poa
3. Clevage polyembryony clevage of embryo to produce more than one embryo e.s. orchids
4. Adventative polyembryony :- Growth of diploid nucellular or integuments into embryo e.g citrus, magnefera indica etc (other than egg).
5. ~~Apospory and Apogamy~~ :- formation of embryo from any other cell of embryosac without fertilization.

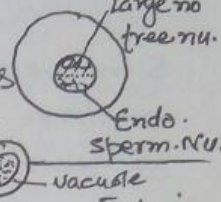
Development of Seed

Fertilization in angiosperms starts transformation of ovule into seed. Following changes usually occurs in ovule during development of seed. 1. The zygote develops into embryo.
2. The triploid endosperm nucleus give rise to nutrative tissue called endosperm. The endosperm may persist or completely degenerates (digested) during embryogenesis. The seed containing large amount of endospermic tissue are called albuminous e.g wheat, corn, onion palm etc. The seeds in which endosperm is used up are called exalbuminous e.g beans, peas, gram. etc. The exalbuminous seeds store their food in cotyledons (Remnants of nucellus persist in some seed. The residual persistant nucellus is called perisperm).
3. The nucellus of embryo is generally used up during development of embryo, but in some cases it remains outside the endosperm in the form of thin layer called perisperm.
4. The outer integuments become hard and leathry testa or outer seed coat which ensures survival of seeds.
5. The inner integuments if persists forms the tegmen & The micropyle remains in the form of fine pore on surface of seed. Funicle is changed into stalk of seed. The hilum marks the point of attach to the stalk. PTO.



Ex. black pepper, Beet water lily. Eg perisperm.

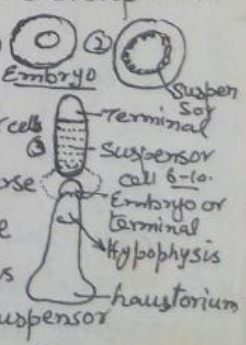
Endosperm formation (3N) It is nutritive or food laden tissue formed from vegetative fertilization in angiosperm. It is female gametophyte in gymnosperms. Endosperm is ment for nourshing the embryo. It is triploid because it is formed after vegetative fertilization where triple fusion takes place between one male gamete and two polar nuclei. Endosperm is of following types.



1. **Nuclear endosperm** :- Primary endosperm nucleus divides to form large number of free nuclei. A central vacuole appears with large cytoplasm and multinucleate condition occurs and multicellular endosperm is formed. cell wall formation is incomplete in coconut, where there is outer multicellular solid endosperm and inner free nuclear liquid endosperm.
2. **Cellular endosperm**:- wall formation occurs after every division of primary endosperm nucleus. so that endosperm is of cellular form. Eg. Datura, petunia.
3. **Halobial endosperm**:- First division of primary endosperm nucleus is followed by cytokinesis to produce 2 cells (micropylar and chalazal) within each of which free nuclear division occurs. Endosperm present in the seed is called as endospermic seed or albuminous seed E.g. castor or it may be consumed by embryo. In such case food is generally stored in cotyledon such seeds are called **Exalbuminous** or non endospermic. E.g ground nut.

EMBRYO FORMATION. (Embryogeny).

It is development of mature embryo from zygote or oospore. Embryo passes through globular stage in both monocot and dicots. Development occurs through inner side due to presence of [illegible] suspensor cells



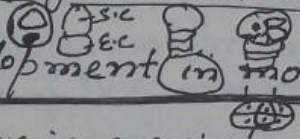
In dicotyledons the zygote undergoes elongation and divids transversally into two unequal cells. terminal and suspensor cells

(1) **Suspensor cell**:- It is large basal cell which undergoes transverse divisions to form 6-10 cells. 1st cells towards micropyle is large called **haustorium**. Increase in number of suspensor cells pushes the terminal embryo into endosperm. The last of suspensor towards embryo cell is known as hypophysis. It later on results into formation of radicle.

II Embryo cell (Terminal cell) It is present towards the antipodal. It divids twice vertically and once transversally to produce a two tired 8 celled embryo. These two tiers are (a) Epibasal (b) Hypobasal. PTO.

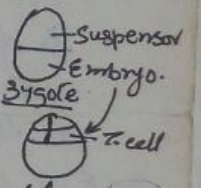
(a) Epibasal (Terminal). It forms two cotyledon and plumule later on plumule give rise to stem.
(b) Hypobasal tier (Near suspensor). It produce only hypocotyle This octant embryo undergoes periclinal division producing two layers of cells (I) outer layer :. It forms protoderm or dermatogen for the formation of epidermis (II) Inner layer. It will form procambium and ground meristem.

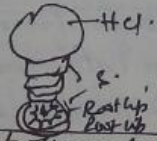
Embryo is initially globular, undifferentiated and radially symmetrical. It is named as pro-embryo. Later on it develops into embryo with the formation of radicle, plumule and cotyledon. It becomes heart shaped and then assumes the typical shape. Cotyledon grows rapidly but plumule remains small and undifferentiated In orchis and utricularia the embryo does not show distinction of plumule cotyledon and radicle.



Embryonic development in monocot.

The zygote divids transversally producing a vesicular suspensor towards micropyle end and embryo cell towards chalazal. The embryo cell divids transversally into terminal cell and middle cell. The terminal cell divids vertically and transversally into globular embryo. It forms large cotyledons and plumule. Growth of cotyledon pushes the plumule to one side. The second cotyledon turns into Epiblast. The single cotyledon of monocot is called **Scutellum** It is shield shaped and appear terminal. The middle cell give rise to hypocotyle and radicle. Both radicle and plumule develops covering Sheath called coleorhiza and coleoptile respectively and appear to be extension of Scutellum.

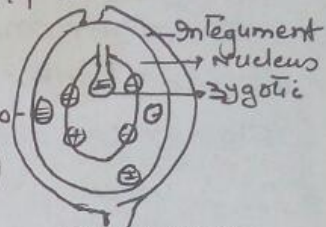




Q. Write short note on polyembryony.
Ans. It is phenomenon of developing more than one embryo in some ovule or seed. It can be due to following reason.
(a) Simple polyembryony :- Presence of more than one embryo sac and hence fertilization of more than one egg or oosphere E.g. brassica.
(b) Mixed polyembryony :- Entry of more than one pollen tube in an embryo sac and fusion of extra male gamete with synergids or antipodal cells e.g. Allium, Loa.
(c) Cleavage polyembryony :- Cleavage of embryo to produce 2 or more than 2 embryo e.g orchis
(d) Adventative polyembryony :- Growth of diploid nucellar or integument cell into embryo e.g. Citrus, Magnefera. end Q.

Polyembryony (Po)

Po. is the phenomenon of formation of more than one embryo during the development of seed. while polyembryony generally occurs during seed development, Rao 1965 has found polyembryony to develop during seed germination in vanda caused by clevage of single polyembryony. polyembryony was discovered by **Leeuwenhock** 1719 in citrus



Polyembryony.

Polyembryony is of 4 types.

1. Simple polyembryony:- Presence of more than one embryo Sac and hence fertilization of more than one egg or oosphere E.g. Brassica.
2. Mixed Poly:- Entry of more than one pollen tube in an embryo sac and fusion of extra male gamete with synergids or antipodal cells e.g. Allium, Poa, Casuarina, citrus
3. Cleavage poly:- Cleavage of embryo to produce 2 or more than 2. embryo e.g. orchids. Pinus
4. Adventative poly:- Growth of diploid nucellar or integument cells cell into embryo. e.g. citrus, Mangifera, Opuntia, Trillium etc.

Note **Seed viability**:- It is period of time for which seeds retain the ability to germinate viability can be determined genetically as well as environmentally. Enviroment condition can change viability (Humidity, temp) and Genetically seeds viability ranges from few days (oxalis) one season e.g Brich 2-5 years in most crop plants to 100 years e.g Trifolium). 1000 years in Lotus etc 10,000 year old seed of Lupinus arcticus (Lupinus).

Pollen-Pistal interaction.

Pollen grains of various plants descend over stigma of a flower. All of donot germinate. only the compatible pollen of the same species are able to germinate. Germination is connected with compatibility-incompatibility reactions between proteins present over the pollen grains and the stigma. If reactions are favourable the pollen grains pick up H_2O and nutrients from the stigma. It results in growth of pollen grains to form pollen tubes. Interaction between pollentubes and pistal continues till the pollen tubes reach the ovules.

In absence of compatibility-incompatibility reactions, Pollen grains will germinate invariably provided H_2O and nutrient are available. Place a drop of 10% Sugar Sol. overslide and sprinkle few pollen grains over it (chick pea) waite for 10-15 min, pollen tubes come out from pollen grain. we see compatibility and incompatibility allow the pollen grains to grow and discovered hybridizations.

eg