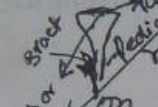
Flower (The site for sexual Reproduction)

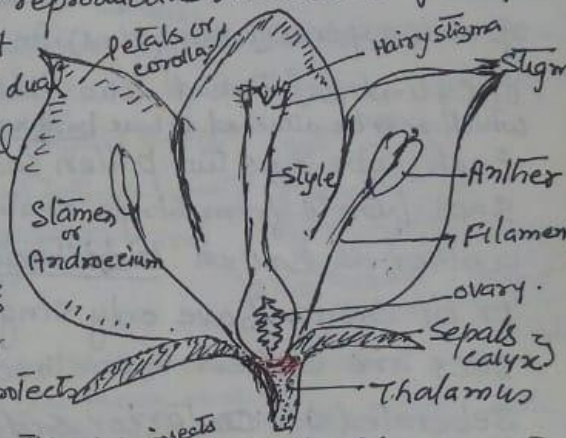


Flower is special reproductive shoot of flowering plants consisting of a receptacle (thalamus or torus) on which flower parts develops, responsible for sexual reproduction. The flowers develop on stalk below receptacle is called pedicel. A small leaf like structure arising in axil is called bract. Bract is usually situated at the base of pedicel. Sometimes small leaf like structure are present in the middle of pedicel. They are called bracticles.

Parts of Typical flower.

A typical angiospermic flower consists of a four whorl of flower appendages attached on the receptacles 1. Calyx, corolla, androecium and gynoecium. of these calyx and corolla are sterile and are non essential accessory or helping whorls. The two upper whorls i.e androecium and gynoecium are fertile and considered as essential or reproductive whorls. These floral parts are

1. **Calyx**:- This is the outermost whorl of floral leaves. The individual leaf segment of calyx is called sepal. The sepals are green in colour. In some cases coloured called petaloid They protect the other parts and prevents rapid transpiration. They may fall or sometimie remains persistant and protects developing fruits. Sometime they may attract the insects when colored. They closely resemble leaves because each of them possess leaf traces.



Parts of flower.

2. **Corolla**:- This is second whorl of floral leaves that arise inner to calyx. The individual leaf of corolla is called petal. Petal are usually coloured so as to make them attractive for insects (pollinators).
3. **Perianth**:- The flower envelop including both calyx and corolla is called perianth. when sepals and petals are not clearly differentiated is called tepel
3. **Androecium**:- This is 3rd whorl of floral appendages that arise inner to corolla. The individual appendage is Stamen (male part). Each Stamen consists of anther and filament. usually anthers are bilobed and contain 4 microsporangia (or pollen sac) but some has only one lobe with 2 microsporangia.
4. **Gynoecium**:- or pistil. This is 4th and the last whorld of floral appendages. The gynoecium is female reproductive organ consisting of 3 parts I ovary basal swollen part II Stigma. It is receptive spot or landing place of pollengrains III Style. It is connective between stigma and ovary. Ctd. PTO.

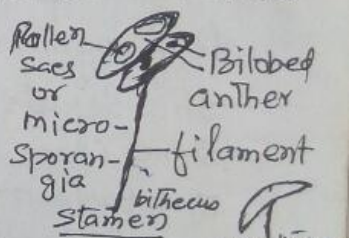
Function of flowers:- (15) (X8)

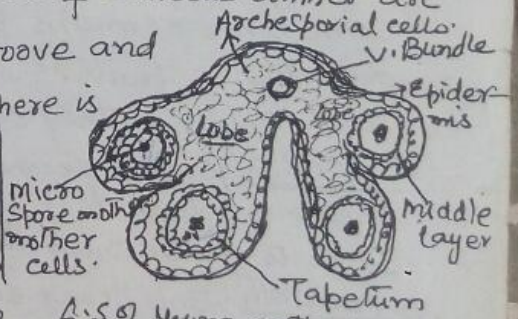
1. Flowers are modified shoot to perform the function of sexual reproduction. The fertile leaves become microsporophillus, =Stamen and megasporophyllus = Carpel, which bears anthers and ovules respectively.
2. Flowers of most of the angiosperms are shaped variously to help diverse mode of pollination
3. Flowers provide seat for germination of pollen, development of pollen tube, formation of gamete and fertilization
4. The ovary part of the carpel gets transformed into friut and the ovules transformed into seeds after fertilization.
5. Some floral parts like calyx and various modification in ovaries help in dispersal of fruits and seeds.

I The Stamen (= Microsporophyll).

The stamens are modified leaves or microsporophyllus helps in production of microspores (Pollengrains). In majority of angiosperms each stamen consists of cylindrical thread like filaments and broad terminal bilobed anther which may be attached at base basifixed or on dorsal sid dorsifixed.

Each lobe has two pollen sacs. At maturity the two pollen sacs fuse to form single chamber or **Thecus**. Such an anther is called ex. bithecus (Malvaceae family) or in some have only single anther with two pollen sacs are called monothecus. The two lobes of bithecus anther are seperated on anterior side by a deep groove and attached on back side by the connective. There is single vascular bundle in the connective.

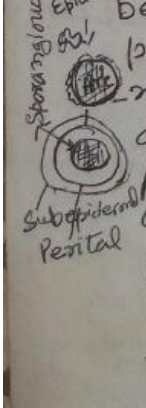


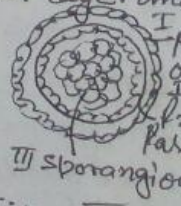


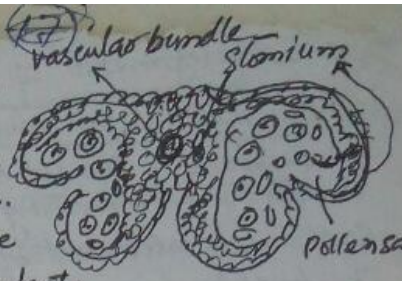
T.S of Young anther

II Development of pollen sacs.

Anther consists of actively dividing meristamatic cells surrounded by a layer of Epidermis. It then becomes two lobed. Each anther lobe develops two pollen sacs. Thus a bilobed anther develops 4 Pollen sacs situated at 4 corners of the anther. Development of pollen sacs begains with differentiation of archesporial cells in below of epidermis. The archesporial cell divides by periclinal division to give rise a subepidermal primary parietal layer and inner primary sporangeous layer. The cells of primary parietal layer divides by succive division to form covering of pollen sacs wall. The wall layers are I Epidermis Outer layer II A single layer endothecium The cells of endothecium has fibrous thickening. They remain thin walled and constitute Stomium (Clue of dehiscence)







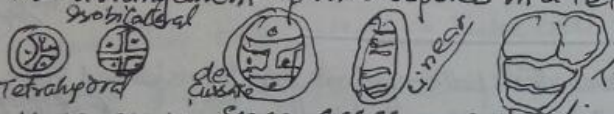
the shallow groove in between the two microsporangia of an anther lobe. The middle layer disintegrade in mature.

III A single layer of tapetum. The tapel cells may be uni, or multinucleate and possess dense cytoplasm. The cells of primary sporangious layer divide further and give rise to diploid sporogenous tissue.

Function of tapetum: I nourishment to Sporangious cells II Produce hormones & Enzymes like IAA III It helps in the formation of : (pollen tube and specific protein for pollen tube). Secretion of an oily material for maturation of pollens.

Microsporangenous

During the development of microsporangium — the sporangious cells divides in various planes and finally seperates from each other to function as microspore mother cells. Some of the microsporocytes degenerates & provides nourishment to others. The surviving sperm mother cells are connected with each other by cytoplasmic and have diploid nuclei. Each sperm mother cells develops an internal layer of **callose** which breaks the cytoplasmic interconnection with other microcytes. Then they divides by meiosis and give rise tetrads of haploid microspores by the process called cytokinesis. cytokinesis results in the seperation of four haploid nuclei into 4 seperate cells which are arranged in tetrad. Usually The arrangement of microspores in a tetrad is Tetrahydral



However in some cases may be linear eg Asclepias) decussate. T shaped These arrangement of microspore tetrad are shown above.

The microspores of a tetrad seperate from one another and germinates in Setu while enclosed within the microsporangium or pollen sac. However in Typha Drosera The microspores do not seperate from tetrad. They form compound pollen grains. In many members of Orchidaceae all microspore of an anther lobe unite to form **Pollinium**

Dehiscence of anther: Inside mature pollen sac the pollen grains dry up to become powder. The tapetum becomes absorbed. The anther becomes dry up. The whole pollen sacs became single chamber one on each lobe. The wall bursts and pollen grains are release

Microspores and Pollen grains: Pollen grains are haploid, uninucleate, minute spores produced in large number as a result of meiosis in microspore mother cells inside microsporangia. Each microspore of anjiosperm has two Sometime 3 cells I. vegetative and II generative cell. It has primary distal aperture for germination. (Germ pore)

The pollen grain is covered by two wall. outer exine which is hard resistant to oxidation and leaching

II The intine. Inner layer mainly made of pecto-cellulose.

Note

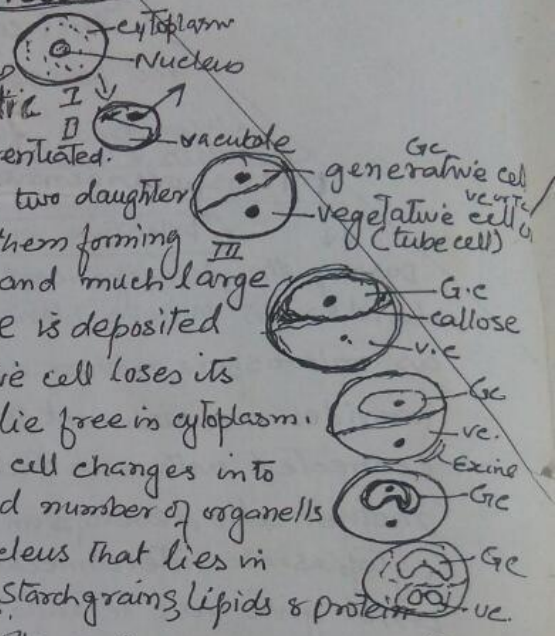
I Poisonous Pollen:- Serjania lethalis. of

II Bronchial allergy:- Inhalation of Pollen grains which acts as allergens, Cause difficulty in breathing the respiratory tract.

Development of male gametophyte

Pre-pollination development.

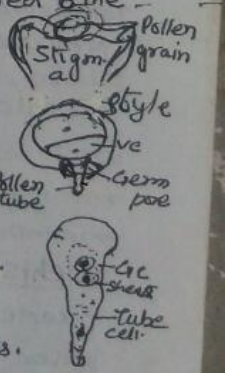
Microspore is the 1st cell of gametophytic generation. It starts germinating inside the pollen sac (microsporangium). Such a development of male gametophyte is called **Precocious**. The freshly formed microspore has rich cytoplasm with centrally placed prominant nucleus. The nucleus moves toward periphrey before entering in to mitotic I division. A large vacuole appears. The wall also gets differentiated. Microspore nucleus then divids mitotically into two daughter nuclei. An oblique wall is laid down between them forming two unequal cells. a smaller **generative** cells and much large **vegetative cell or tube cell**. A layer of **Callase** is deposited around the generative cell. The generative cell loses its contact with microspore wall and come to lie free in cytoplasm. The callose layer dissolves. The generative cell changes into globose or horse shoe shaped. with limited number of organells. The vegetative cell has lobed central nucleus that lies in vacuolated cytoplasm packed with organells, starch grains, lipids & protein.



In majority of angiosperms the pollen grains are shed from anther at this **bicelled** stage. But in some genra (both mono or dicotyledons) the generative cell divides before dehiscence of the anther and pollen grain is shed at 3 celled stage.

Post Pollination development

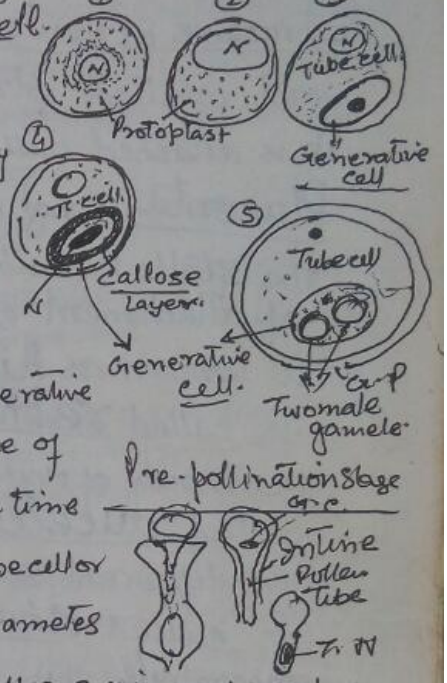
The liberated pollen grains are transferred to the receptive surface of (stigma) carpel by the process called pollination. On stigma pollen grain absorbs H_2O and swells within few minutes. It (Pollen grain) release, recognition factor for its onward journey in carpel. The vegetative cell or tube cell enlarges and come out through one of the pore to form a **pollen tube**. Pollen tube grows through style by secreting Exogenous pectinase and other hydrolytic enzyme to form a passage for its entry in to ovule. It absorbs nourishment from style. The nucleus enters in pollen tube. The protoplasmic content enters into pollen tube tip. The generative cell divids to form two malegameles. Each male gamete consists of a nucleus surrounded by thin sheath of cytoplasm. The tube nucleus has no more function and may degenerate. When there is only one tube (pollen tube) it is called monosiphony and when are many pollen tube on stigma and style it is called Polysiphony.



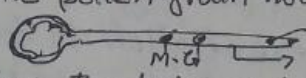
Male Gametophyte

Pollen grain or microspores is the 1st cell of male gametophyte. The life of male gamete is short as compared to the life of sporophyte. Development of male gametophyte is **precocious**. i.e it develops in microsporangium or pollen sac.

Pre-pollination:- The nucleus of pollen grain grows in size and shifts to one side near the wall. The protoplast divides to form two un-equal cells. small generative cell and large tube or vegetative cell. A layer of callose develops around generative cell which seperates the cell from pollen grain wall. Later on callose dissolves and naked generative lie freely in cytoplasm of tube cell. The cytoplasm of tube cell is rich in reserve food. Nucleus becomes large and convoluted. The generative cell is lenticular to Spherical in outline. It has large nucleus with thin layer of dense cytoplasm. In some Species the generative cell divids into two male gametes before dehiscence of anther and release of pollen grains. Therefore at the time of pollination the pollen grain is either 2 celled (tube cell or generative or 3 celled i.e tube cell and two male gametes



Post pollination Development. The pollen grain now reaches to stigma by any pollinating agent. On stigma the pollen grain absorbs water and nutrient from stigmatic secretion through its germ pore. The tube or vegetative cell enlarges. It comes out of pollen grain through one of the germ pore to form a pollen tube. The pollen tube is covered over by intine. It secretes pectinases and other hydrolytic enzyme to form way for pollen tube. The pollen tube absorbs nourishment from the cells of style for its growth. The tube nucleus descends to the tip of pollen tube. The generative cells also pass into it. It soon divides into two male gametes. Each male gamete is spherical. It has large nucleus which is surrounded by thin sheath of cytoplasm. The tube nucleus may degenerate completely. The pollen tube contains dense cytoplasm only towards tip which also contains two male gametes and degenerated tube nucleus. When there is only one pollen tube it is called **monosiphnous**, some species have 14 pollen tubes such sp's are called **Polysiphnous**.



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Female Reproductive organ.

Female reproductive organ of a flower are carpels collectively as **gynoecium**. Free units of Gynoecium is called pistal. Each pistal has 3 parts I ovary. It is basal swollen ovule containing part. II style. A long stalk like structure III Stigma upper receptive part (Disc like).

Structure of ovule. An angiospermic ovule is typically an ovoid and whitish structure. It occurs inside the ovary where it is attached to parenchymatous cushion called **Placenta** singly or in clustered. The ovule is stalked the stalk is called **funiculus** or funicle. The point of attachment of the body of the ovules with funicle is known as **Hilum**. A ridge is formed over ovule is called **raphe**. Funicle is vascular (xylem & phloem) Main body of ovule is composed of parenchymatous cells called **nucellus** covered by 1 or 2 **Integuments**. in different species. Place of origin of integuments is called **Chalaza**. A pore is present known as **micropyle**. Hypodermal cells of nucellus undergoes differentiation to form primary archesporial which further divides into two cells ① Primary parital cells. It is present on outer side and may further divided into parietal tissue.

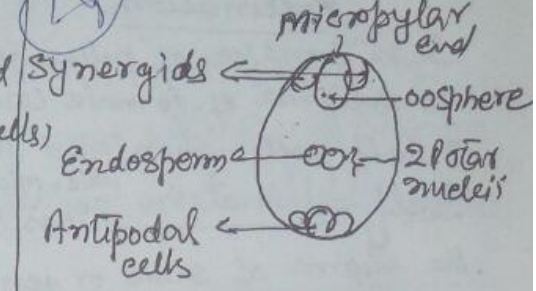
Primary sporogenous cell: It lies on inner side which divides to form sporangeous tissue. one sporangenous cell (2N) divides to form megaspore mother cell. It undergoes meiosis to form 4 haploid megaspore. i.e. Tetra. arranged in linear row. Generally megaspore at chalazal end is functional megaspore of embryo sac. The functional megaspore enlarges and its nucleus divids by mitosis into two nuclei, chalazal and micropylar cells. The two nuclei further undergoes two mitotic division to form 8 nuclei. 4 to each side one nucleus from each end move to center to form two polar nuclei wall formation occurs forming in all 7 cells. These cells are of 3 types.

1: **Egg apparatus** At the micropylar end, 3 cells are formed together called as egg apparatus. These cell are formed in triangular shape.

PTO.

(11) (249) (19)

with centeral oosphere and two lateral synergids (helping cells)

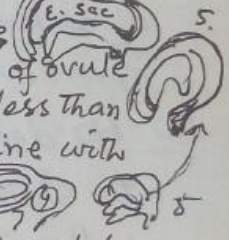


c) Antipodal cells.

Three cells at chalazal end called antipodal cells. These cells provides nourishment from nucellular cells. These degenerates ultimately central cell is formed of 2 polar nuclei. These cell often meet at center to form single diploid (secondary fusion) nucleus. It is only diploid structure in embryo sac.

Forms of ovules

1. **Orthotropus**:- Atropus = Erect. The body of ovule lies stright and upright over the funicle. Hilum, chalaza and micropyle occurs in some stright line e.g. piperaceae. Polygonum
2. Anatropus = Inverted :. The body of ovule is inverted and gets fused with funiculus along its whole length on one side. The funiculus forms ridge called raphae. Hilum and micropyle are near to chalaza on opposite side It is most common and about 80% of angiosperms.



3. Hemitropus Hemitropus :. It is between orthro and anatropus type of ovule The body lying at right angles to funniculus fused with body less than half length. Hilum, chalaza and micropyle being in some stright line with chalaza e.g. Ranunculus, Primulacea and crucifers
4. campylotropus :- The body is covered byt embryosac is stright. Hilum chalaza and micropyle come nearby e.g. capsella. Some leguminous chenopodiocea
5. Amphitropus :. Both body ovule and embryosac are curved, Eg cruciferae
6. Circinotropus The funiculus is large and coiled around ovule e.g opuntia

Male gametophyte	Female gametophyte
1. It develops from pollen grains (Microspore	1. It develops from megaspore
2. It does not remain embeded permenantly in microsporangium.	2. It remains embeded permenantly in megasporangium.
3. Male gamete come out of pollen grain due to formation of pollen tube	3. Female gametophyte always remain inside and covered by megasporangium membrane
4. These are two phases of growth pre-pollination and post pollination	4. It has 7 cells 3 antipodal, 3 egg apparatus and one central cell.
5. It has 3 cells (1 tube cell + 2 male gamete).	5.
6. All 3 cells are functional as tube cells acts as carrier for male gamete	6. All 7 cells are non functional. Antipodal cells may or may not help in absorption out of 3 acts as receving of pollen grains
7. It will degenerate after fertilization	7. two new structure are formed after fertilization that is endosperm and oosphere

P.T.O.

Pollination:

It is transfer of pollen grains from anther (microsporophyll) to stigma of female (megasporophyll). It is of two types.
① Self pollination and II cross pollination.

Self pollination: (Note: microsporophyll: It is foliar structure specialised to bear microsporangia) It is transfer of pollen grains from anther to the stigma of same or genetically similar flower and is possible only when both matures simultaneously. It is of two types A. Autogamy and B. Geitonogamy. A. **Autogamy**. Gk. Auto = self, gamous = marriage. It is self pollination between anther and stigma of same flower. It takes place by following method (a) **Homogamy** when anther and stigma mature simultaneously or anther lies above stigma of same flower. on dehiscence pollen grains falls over stigma under influence of gravitational force.

(b) **Cleistogamy**: Gk. Kleisto = closed, gamous = marriage: The flower remains closed so only self pollination is possible Ex. Commelina bangalensis and Archis hypogea (Ground nut). Cleistogamy is accompained with geocarpy (formation of fruit inside the soil).

(c) **Bud pollination**: Anther and stigma of a flower mature before the opening of a flower. Thus self pollination occurs in bud condition before flower opens Ex. Rice, wheat, jute, tomato, etc.

(d) **No dehiscence of anther**: In some cases anther do not undergo dehiscence to shed pollen grains. Thus pollen grains undergoes germination. Later on pollen tube penetrate the anther wall to reach stigma for pollination E.g viola odorata.

e. **Fail safe device** In some plants Self pollination occurs when cross pollination fails E.g. In potato the stigma bends over anther whereas in sunflower stigma can curl back to receive pollen.

2 **Geitonogamy**: Gk. geiton = neighbour = gamos = marriage.
It is transfer of pollen grains from anther of one flower to stigma of another flower of either or same genetically similar plant i.e endogamy
It requir pollen transfer through pollinating agency.

Importance of self pollination: It eliminates some harmful traits ② There is no need of pollinating agencies ③ Flower do not under go modification to attarct pollinator ④ It will maintain pure line ⑤ Plants do not produce a large number of pollen grains thus avoids wastage.
⑥ It maintain purity of race. PTO.

Disadvantage.

① Adaptation decrease due to non modification of flower. ② Selfing decreases vigor and vitality. ③ Disease resistance decrease ④ Prolonged selfing leads to degenrating of superiorty and variety.

CROSS Pollination

Exserted = Protruded stigma

It is transfer of pollen grains from anther of one flower to the stigma of genetically disimilar flower. It is also called **xenogamy**.

Types of Cross pollination.

① **Anemophily**:- Gk, anemos = wind, Philein = to love.

Air current picks up pollen grains from dehiscing anther while receptive stigma picks up the pollen grains from air. Ex. grasses, Amaranthus, canabis chenopodium, coconut, Date, Mulbury popular willow. etc

Characters of Anemophilous flower.

① Flowers are small and inconspicuous. Non essential parts are reduced or absent.
② Flowers are usually colourless, nectarless and odourless
③ Flowers are developed above the foliage often hanging in spike or catkin
④ Male flowers are more abundant (enough), in case of unisexual flowers and bisexual flowers.
⑤ Anthers burst forcely and suddenly throw pollen grains in air. It is also called gunpowder mechanism.
⑥ Pollen grains are light. They may have air sacs or wings.
⑦ Pollen grains are small dusty and can travel in air upto distance of 1300km
⑧ Pollen grains are dry and unwetable.
⑨ Stigma are sticky hairy feathery and branched to capture pollen grains
⑩ A large number of pollen grains are produced e.g 5000/flower, 25M in maize and 135 m by mercurials canabis = 25 millions.
⑪ Pistals commonly possess single ovules.

Significance It is highly wasteful phenomenon because it is non directional
⑫ Rate of successful pollination is low.

Hydrophily = water loving :- It is pollination brought about by agency of water. It occur in aquatic plant e.g. Lemna, vallisneria and zostera. (Cronogecly upon aquatic plants)

Characters: Flowers are small inconspicuous and unwetable. (pollen grains)
II Flowers are without nectar and ordour. They may or may not have colours.
III Flowers have light and unwettable pollen grains and have long sticky and unwettable stigma. It is further of two types.
(a) hypohydrophily and (b) Epihydrophily. (PTO).

PTO.