Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (First Year)

Subject: Botany

Paper Code: BOC 102

Paper Title: BIODIVERSITY II (Vascular Plants)

Unit: 02

Module Name: Reproduction of *Pinus* II

Module No: 33

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Notes

Gametophyte of *Pinus*

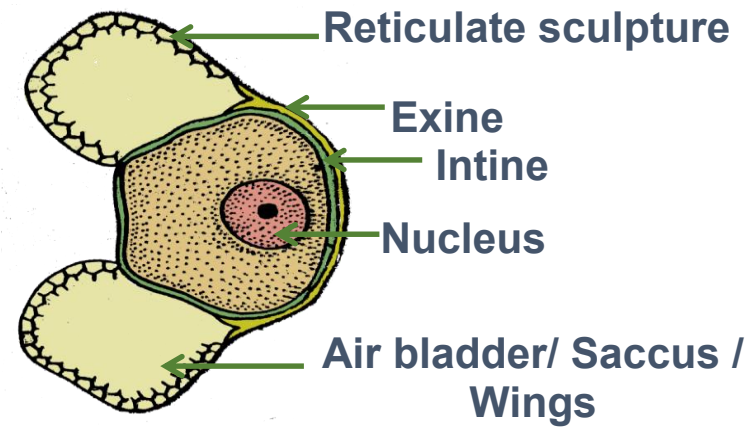
- Plant is heterosporous.
- It bears both microspores (pollen grain) and megaspores (embryo sac) which develop in microsporangium and megasporangium respectively.
- Both microspores (pollen grain) and megaspores (embryo sac) act as the last stage of the sporophytic generation.

- The spore after reduction division is the first phase of gametophytic generation.

- The microspore or pollen grain represents the male gametophyte, while the megaspore represents the first stage of female gametophyte.

A) Male gametophytes:-

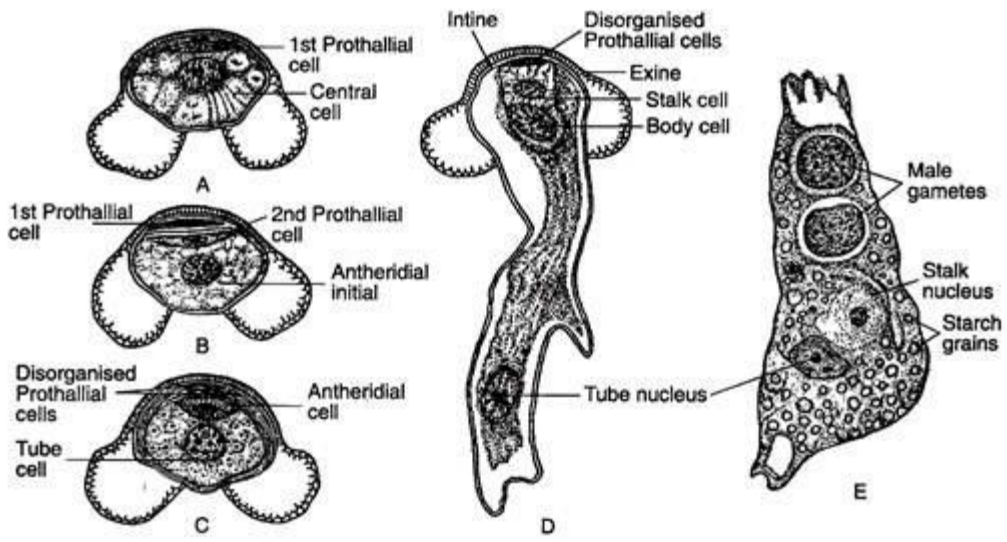
- The microspore (pollen grain) is the basic unit of male gametophytes.
- It is an uninucleate structure with two asymmetrically placed air bladders.
- The air bladder is also known as wings or saccus and arises on the lateral side of microspore.
- Each pollen grain has a circularized outer layer called exine and an inner thin layer called intine.
- The outer wall of the wings has a reticulate sculpture.
- Male gametophytes develop partially in the microsporangium and partially in the ovule.



Pollen Grain

Mature microspore

- Each pollen grain is composed of two ear-like air sacs on the outside, a large tube cell, a small generative cell, and two tiny prothallial cells.

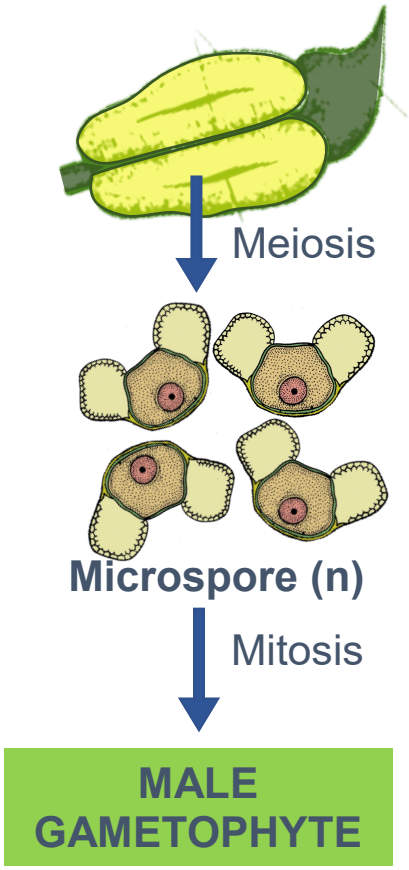


Stage in the development of male gametophytes photo by Bi Joy G retrieved from https://www.biologydiscussion.com/essay/gymnosperms/essay-on-the-life-cycle-of-pinus-class-coniferopsida-gymnosperms-botany/76971 from open free repository

DEVELOPMENT OF MALE GAMETOPHYTE

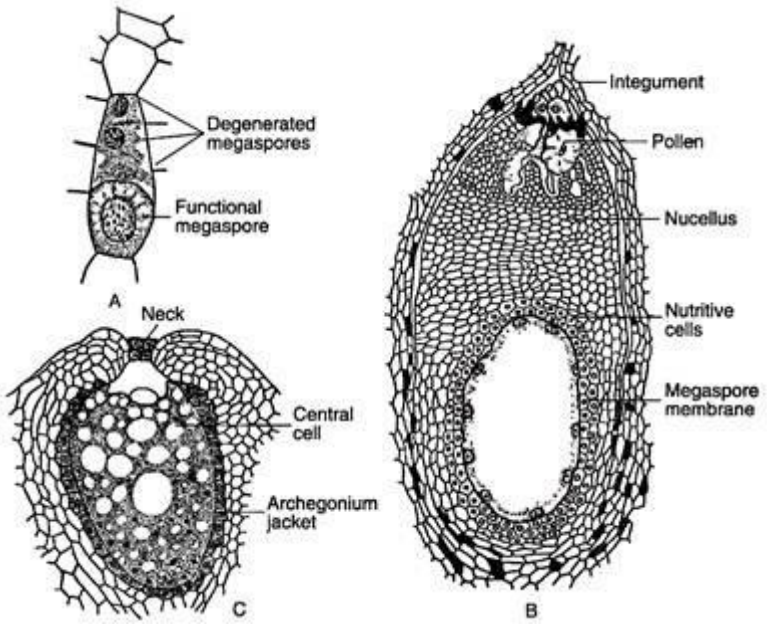
- The microspores develop in microsporangium.
- Within the microsporangium, microsporocytes cells divide by meiosis to produce four haploid microspores.
- Further mitosis of the microspore produces two nuclei: the generative & the tube nucleus.
- Male gametophyte is developed.
- Upon maturity, the male gametophyte is released from the male cones and it reaches the ovule due to pollination for further development. A number of microspores reach the ovule where they are attached with sticky mucillagenous substance from the micropyle. When mucillagenous substance dries up, some of the microspores are drawn inside on to the apex of the nucellus. Later on, the spore coats split between the wings.
- Then the tube cell protrudes and grows to form the pollen tube. Ultimately, the pollen tube penetrates the nucellus.

- The generative cell then divides to form a sterile stalk cell and a fertile body cell (spermatogenous cell).
- The body cell further divides to form two non-motile unequal male gametes (sperms).

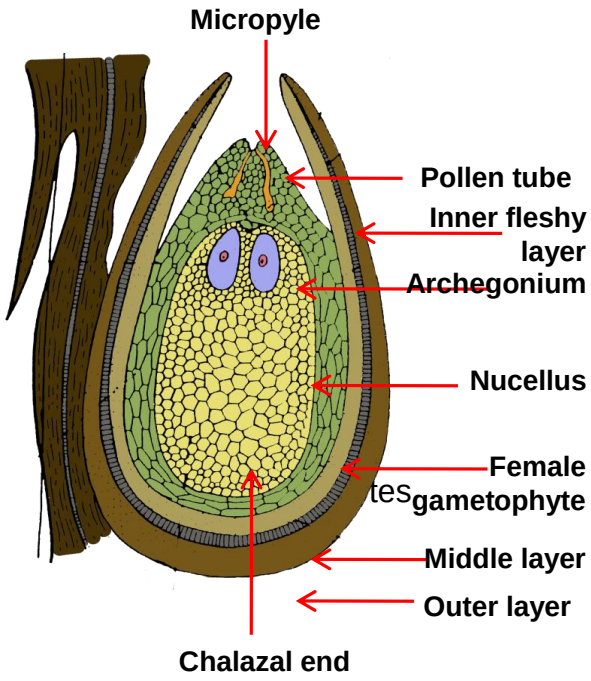


B) Female gametophyte

- The haploid megaspore is the first cell of female gametophyte.
- It is never shed and retained permanently within the nucellus.
- The functional megaspore is the basic unit of female gametophyte. It develops inside the nucellus. The functional megaspore enlarges in size and develops vacuole in its centre. Megaspore undergoes 11 successive free nuclear divisions and produces nearly 2000 small nuclei. This stage is called as the nuclear stage.
- The nuclei come to lie towards the periphery due to enlargement of the central vacuole which later disappears.
- Wall formation starts in centripetal fashion from the periphery.
- Multinucleated radially elongated open tubes known as alveoli are portioned by cross wall and form a multicellular structure known as female prothallus or endosperm.
- This is haploid and pre-fertilized tissue. This stage is known as cellular stage. Two or four layers nutritive tissue is present around it.



Linear tetrad structure and female gametophytes, an archegonium photo by Bi Joy G retrieved from https://www.biologydiscussion.com/essay/gymnosperms/essay-on-the-life-cycle-of-pinus-class-coniferopsida-gymnosperms-botany/76971 from open free repository



Pollination:-

Pinus is wind-pollinated (anemophilous). The pale-yellow pollen grains are released into the air in a large quantity, so that a pine forest appears yellow at the time of pollination. This is popularly called ‘sulphur showers’ which occurs specially in the spring when pine trees are shaken by strong winds.

At the same time, the nucellar beak in the ovule disorganises forming a viscous sugary liquid containing glucose, fructose and sucrose. This fluid comes out in a cyclic phenomenon (24 hour cycle) through the micropyle in the form of a pollination drop either at night or in the early hours of morning. The pollen grains are caught in the pollination drop and are collected in the pollen chamber as a result of drying off the fluid. The mouth of the micropyle is then sealed from the outer environment

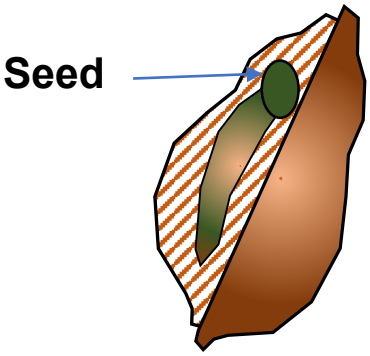
Fertilisation:

The fertilisation takes place after one year of pollination. The pollen tube enters the tip of the archegonium by forcing itself between the cells of the nucellus. The pollen tube wall is disintegrated by the enzymes

secreted from the egg and eventually two male nuclei are released. One of the male nuclei fuses with the egg cell and thus a zygote is formed.

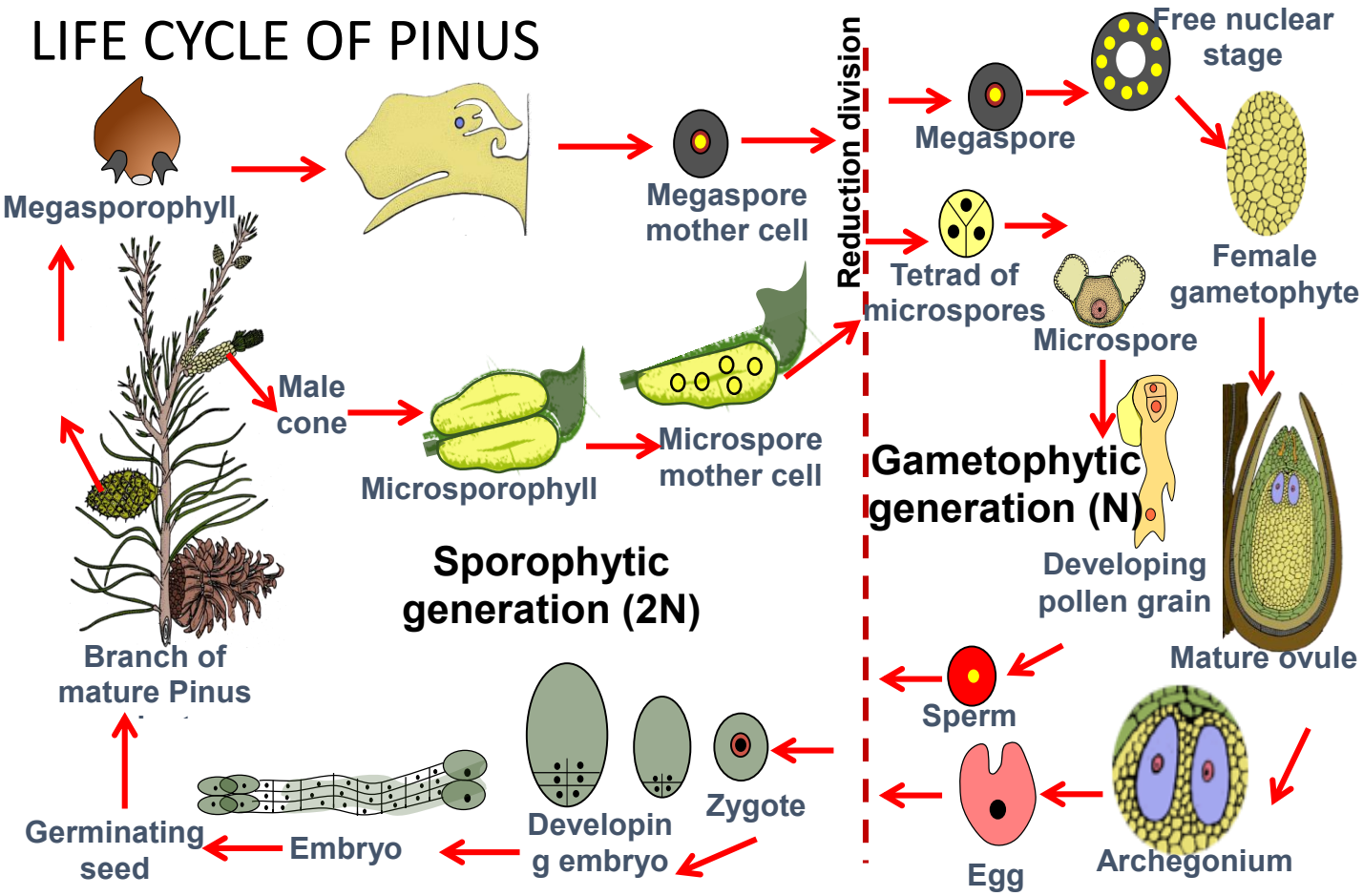
Seed:-

- It is formed from mature ovule. Winged seed escape from the cone are blown away by wind.
- Ex: Seed of *Pinus gerardiana* commonly known as chilgoza used as human food. Seed germination is **epigeal** (cotyledons comes above ground by the elongation of hypocotyl).



Germination of Seed:-

The radicle grows out. It splits the testa at the micropylar end. This radicle grows down into the soil and forms the primary root. The hypocotyl elongates to form a loop. Then it becomes straight. It carries with it the plumule and the cotyledons. The testa is also carried up with the cotyledons. Germination is epigeal.



Life cycle of ***pinus***

1. A pine tree- the mature sporophyte (2n).
2. It will produce both seed cones and pollen cones because it is monoecious. Seed cones will produce two megasporangia on each ovuliferous scale, each one surrounded by an integument.
3. Within the megasporangium, a megaspore mother cell (2n) undergoes meiosis to produce four megaspores (n).
4. Three die and one remains, developing by mitosis into the megagametophyte.
5. The megagametophyte produces two archegonia, each with an egg.
6. The **pollen cone**, microsporangia are produced on each microsporophyll of the pollen cone.

7. Initially, they are filled with microspore mother cells (2n) that then undergo meiosis to produce microspores (n).
8. These microspores grow by mitosis (though only two rounds) into 4-celled microgametophytes: pollen
9. Each pollen grain is composed of two ear-like air sacs on the outside, a large tube cell, a small generative cell, and two tiny prothallial cells.
10. The mature pollen grains are dispersed on the wind to seed cones where the tube cell will form a pollen tube into the megagametophyte by entering through a gap in the integument called the micropyle.
11. The generative cell divides to produce to sperm cells, which travel down the pollen tube to fertilize an egg.
12. Once fertilized, the integument closes, forming the seed coat.
13. The embryo develops within the seed, consuming the megagametophyte and the megasporangium (now called the nucellus) as it grows.
14. The seed is dispersed and, if in the right conditions, the embryo emerges from the seed coat and develops into a mature sporophyte.