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* I

Module No: 32

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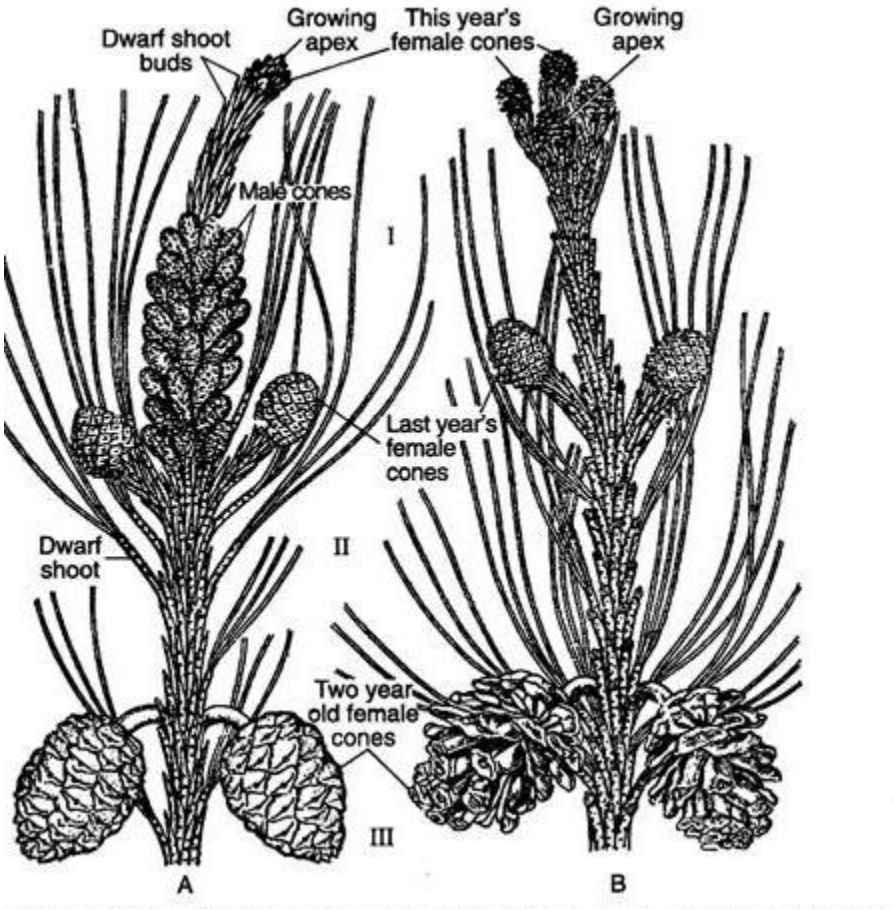
- *Pinus* reproduces sexually.
- Plant body is sporophytic.
- *Pinus* is monoecious i.e. both male and female strobili (cones) are produced on the same plant, but the branches are usually dioecious i.e. the male and the female cones are produced on separate / different branches of the same plant.
- *Pinus* is heterosporous and produces two types of spores - Microspores (pollen grains) and Megaspore (embryo sac).
- They are produced in specialised structures called microsporangia (pollen sac) and megasporangia (ovule without their coats).
- The sporangia are borne on sporophyll which are organised to form cones or strobili.
- The cones are of two kinds - one containing only microsporangia and other megasporangia.
- Microsporangia are also called as male cone / strobili/ microsporangiate strobili/ staminate strobili.
- Megasporangia are also called as female cone or megasporangiate strobili / carpellate or ovulate cone.

The male cones develop on the lower branches, while the female cones are formed on the upper branches. The male cones, which replace the dwarf shoots, develop in clusters on the base of the current year's long shoot at early spring. The number of male cones in a cluster varies considerably from 15 (*P. wallichiana*) to 140 (*P.*

roxburghii). At the onset of spring, the male cones fall off and simultaneously the young female cones are borne in pairs or in clusters round the tip of the long shoot The female cones grow very slowly and the growth may persist for several years. Thus, the female cones of different ages may be seen in acropetal succession in the long shoot.



Pinus male and female cone at early stage and at the end of spring 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

i. Male Cone:

The male strobili / cones are produced earlier than the female strobili

The male cones, develop in clusters on the branches of unlimited growth (long shoot) replacing the branches of limited growth (dwarf shoots/ spur shoot).

- They appear in the month of March-April in hills and in January in plains.
- The male cone is small (2-4 cm in length and 5-6mm in diameter) and oval in shape that develops in the axil of scale leaves. It is pale yellow in color.

Male cone is shortly stalked and consist of elongated central axis, bearing on which 60-150 number of small spirally arranged and closely fitting scale like microsporophyll

Male cone author by Walter Siegmund retrieved from https://commons.wikimedia.org/wiki/File:Pinus_contorta_8021.jpg is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported

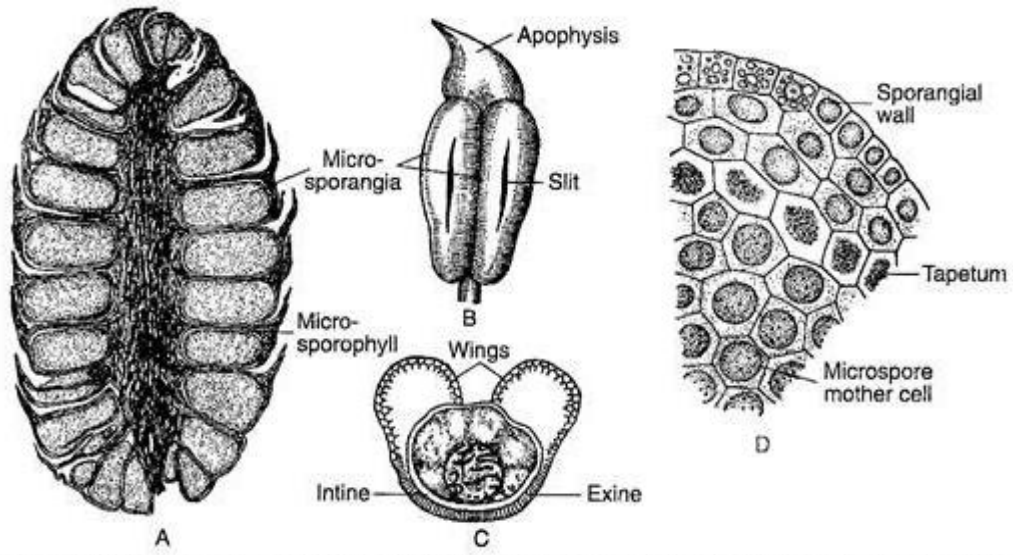
Each microsporophyll is brown, small, scaly and triangular in structure. It takes its origin from the central axis, runs out horizontally. It consist of short stalk (filament) and leaf like expansion which bears two sac-like microsporangia on the (lower) abaxial surface. To the end of microsporophyll roughly triangular flattered sterile part is present called an apophysis. It extends upward and overlaps the above lying microsporophyll and cover the microsporangia downward. Microsporophyll arises at right angle to the central axis of male cones. Some of the basal microsporophylls are sterile while remaining upper one are fertile.

A mature microsporangium: - consists of a multi-layered wall-tapetum and microspore mother cells. Each microspore mother cell — by meiotic division — produces four microspores or pollen grains.

A mature microsporangium

Each microsporophyll on the (lower) abaxial surface which bears pair of microsporangia, each microsporangium is small, sessile and elongated sac like. Thus, at maturity, a single microsporangium contains numerous pale yellow two winged microspore (pollen grains). The dehiscence of sporangia takes place by longitudinal slit in dry and warm environment.

The pollen grains are boat-shaped with monosulcate apertures and are bounded by two concentric wall layers: The outer thick exine and the inner thin intine. The exine on the lateral sides of the pollen is expanded to form two wings (sacci).



Pinus L. S. male cone, a microsporophyll, a pollen, T.S. Sporangium 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

ii. Female Cone:

The female cones of *Pinus* are also called ovulate strobili.

They appear in the months of February in plains and May in the hills.

Female cones are produced in pairs or in clusters in the axil of the scale leaves.

Each female cone arises in the place of dwarf shoot.

The female cones mature very slowly. Each female cone takes three years to get mature and set seeds.

Foliage and female cone author by Walter Siegmund retrived from https://commons.wikimedia.org/wiki/File: nus_contorta_8021.jpg is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported

In the first year, young cone is small (1-2 cm in length), soft, compact and red-green in colour.

In the second year, cone is comparatively large (5-8 cm in length), woody, compact and green in colour.

The fully matured cone, in the third year is much larger (15-60 cm in length), woody, loose and brown in colour. Here megasporophylls are separated from each other due to the elongation of the cone axis.

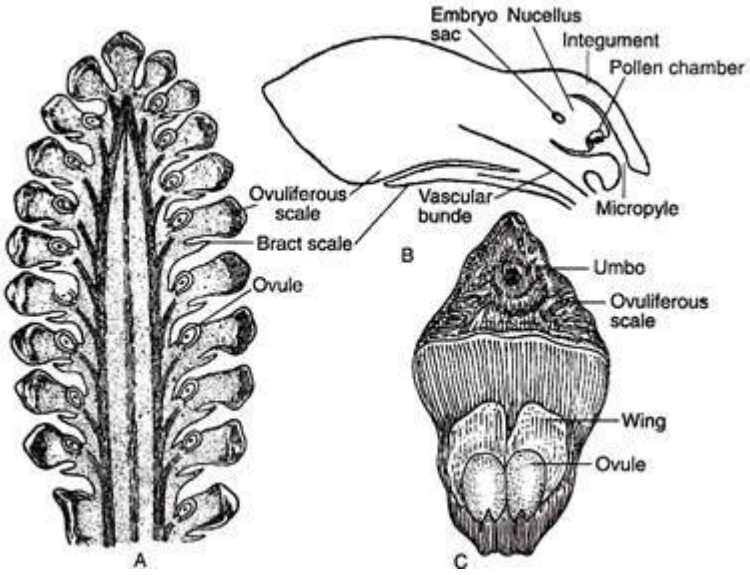
The female cone of *Pinus* represents a compound shoot; it is a complicated structure. It is an oval, elongated, cylindrical structure. The female cone is composed of a central axis on which 80-90 megasporophylls are arranged axillary to bract. Scale/ scale leaves are arranged spirally. Some of them lying at base are smaller and sterile. The bract scale and ovuliferous scale together form a seed-scale complex.

Megasporophyll -

A single megasporophyll consists of two types of scales:

(A) Bract scale (lower part) / cone scale: - It is lower part of megasporophyll. This is small dry and membranous structure. It is directly attached to the cone axis and occurs just below the ovuliferous scale.

(B) Ovuliferous scale (upper part):- The ovuliferous scale is a thick, large, woody, roughly triangular and brownish structure bearing two ovules on the adaxial surface. Its upper thick exposed part is known as apophysis. In the mature cone, the tip of the apophysis becomes the ‘umbo’. There are two separate vascular traces, one supply to the ovuliferous scale and the other to the bract scale. There is no separate vascular trace for ovule. Initially, the ovuliferous scale is much smaller than that of bract scale, but after pollination it becomes larger than the bract scale.



Pinus L.S. of female cone, V.L.S of an Ovuliferous scale, an Ovuliferous scale bearing two seeds 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

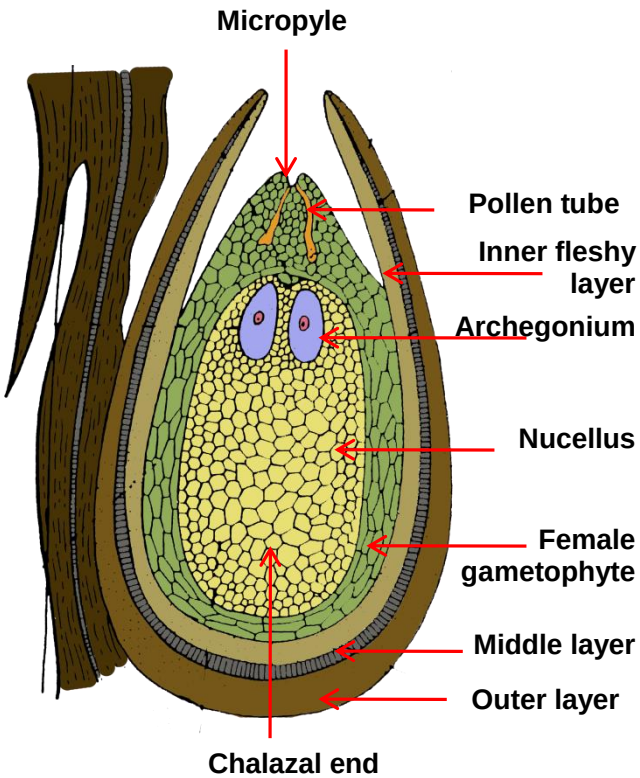
- The central part of ovule contains nucellus.
- The nucellus is covered by thick protective covering called integument.

Female cones

Year	Size in Length	Structure	Colou
First Year (Young)	Small (1-2 cm)	Soft, Compact	Red-g
Second Year	Large (5-8 cm)	Woody, Compact	Green
Third Year (Mature)	Larger (15-60 cm)	Woody, Loose	Brown

- The female cones mature very slowly.
- Each female cone takes three years to mature and set seeds.
- During third year megasporophylls are separated from each other due to the elongation of the cone axis.

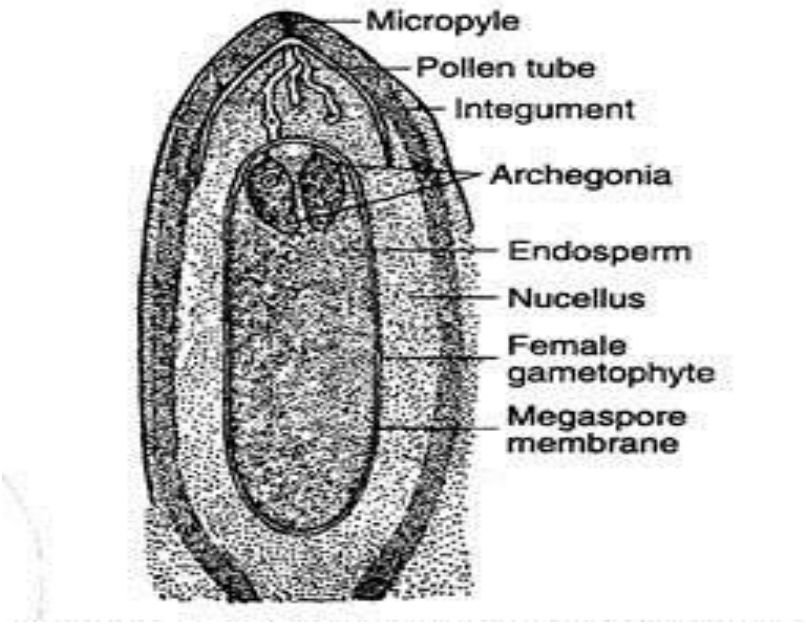
Ovule (megasporangium)



L.S. of Mature Ovule

The ovules of *Pinus* are oval, anatropous, unitegmic and crassinucellate shaped and attached laterally on the surface of ovuliferous scale. The single integument is free from the nucellus except at the chalazal end. There is a fairly broad micropylar tube which becomes inwardly curved during pre-pollination stages and becomes outwardly curved at the time of pollination.

The integument is three-layered, the outer fleshy, the middle stony and the inner fleshy. It is haploid. The micropylar end bears archegonia. Each archegonium has 8 neck cells arranged in 4 tiers of 2 cells each.



Pinus L.S. Ovule 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 called as **'Sulphur showers'** which occurs specially in the spring when pine trees are shaken by strong winds.

Male cones –sulphur shower by unknown author retrieved from https://seeds.ca/pollinator/bestpractices/wind_pollination.html is found under free repository

- The pollen grains are dispersed and remain suspended in the air for some time.
- The nucellar beak in the ovule forms a viscous sugary liquid containing glucose, fructose and sucrose.
- This fluid comes out in a cyclic phenomenon (24 hr. 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 of the fluid.
- The mouth of the micropyle is then sealed from the outer environment which completes pollination.