CONIFEROPSIDA

GENERAL CHARACTERISTICS

- Mostly evergreen with branched stems, rarely shrubs.
- LEAVES- needle or scale-like/ flattened/spirally arranged.
- The leaves possess xerophytic characters.
- Wood is pycnoxylic.
- Wood without vessels consisting of long tracheids which show bordered pits.
- Resin canals are present.
- The flowers are monoecious or dioecious.
- The female flowers are terminal or lateral surrounded by supporting bracts.
- The male flowers consist of a number of stamens arranged in strobili. The stamens are many, each with 2 to 20 pollen sacs.
- Pollen grains may be winged, e.g : *Pinus*.
- The female flowers are arranged in cones or catkins with the exception of Taxaceae, Cephalotaxaceae and Podocarpaceae.
- Each female flower consists of a bract (sterile) and a scale (fertile).
- The ovules develop on the upper surface of ovuliferous scales.
- The seeds - winged, nut like and with a leathery or woody testa.
- The cotyledons are epigeal and 2-16 in number.
- Polyembryony is quite common.
- They produce non-motile sperms at the time of fertilization.

ENTRI

PINUS

Class: Coniferopsida

Order: Coniferales

Family: Pinaceae

Genus: *Pinus*

MORPHOLOGY

- Indian species are *P. excelsa, P. longifolia, P. gerardiana, P. insularis, P. armandi*.
- Perennial, xerophytic plants appearing pyramidal or conical due to radial branching.
- Branches are dimorphic – long shoots and dwarf shoots (spurs)
- Leaves are dimorphic – Scale leaves and green acicular leaves.
- Male and female cones present on the same plant, hence monoecious

ROOTS

- Plant possesses tap root
- Ectotrophic mycorrhiza is present.
- It is symbiotic association of fungal mycelium on the root's surface
- Helps in absorption of nutrients & protection from pathogens

- Fungal species identified are *Rhizopogon*, *Amanita, Boletus, Entoloma*, etc. – mostly members of Basidiomycetes

STEM

- Erect, tall, cylindrical, woody and branched
- Monopodial branching
- Lower branches longer and horizontal giving the conical shape to the plant
- Branches of unlimited growth are the long shoots
- Arranged spirally around the main trunk

LEAVES

- Scale leaves - thin, brown ,small
- Main function is to protect young buds & conserve water around the branches
- Foliage leaves - long & acicular (needle like)
- Remains green for a number of years (3-10 yrs) hence plants are evergreen

ANATOMY OF ROOT

- Root Resembles typical dicotyledonous root
- Piliferous epiblema bear unicellular root hair (seen only in young roots)
- Broad parenchymatous cortex follows
- Endodermis and pericycle layers seen next
- Vascular tissue is radially arranged in 2-6 groups of xylem and phloem

- This tissue lacks true vessels and companion cells
- Resin canals present in xylem patch making it Y-shaped
- Old roots show secondary growth

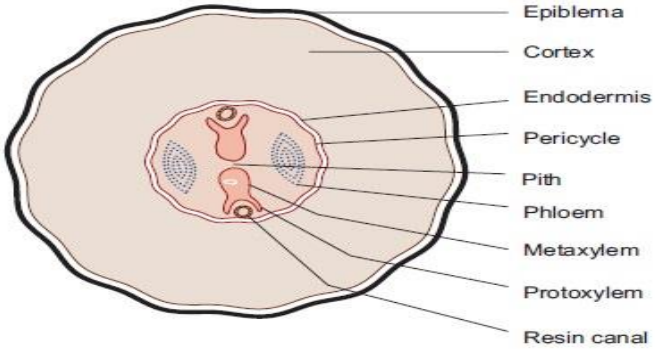


Figure 2.49: T.S. of *Pinus* root

ANATOMY OF STEM

- Stem Typically dicotyledonous stem
- Cuticularized epidermis encloses the lignified sclerenchymatous hypodermal layer below
- Inner cortex is thin walled parenchyma containing chloroplasts and resin canals
- Vascular bundles are conjoint, collateral, endarch , open and form a ring
- Medullary rays are narrow
- Vessels in xylem and companion cells in phloem are absent

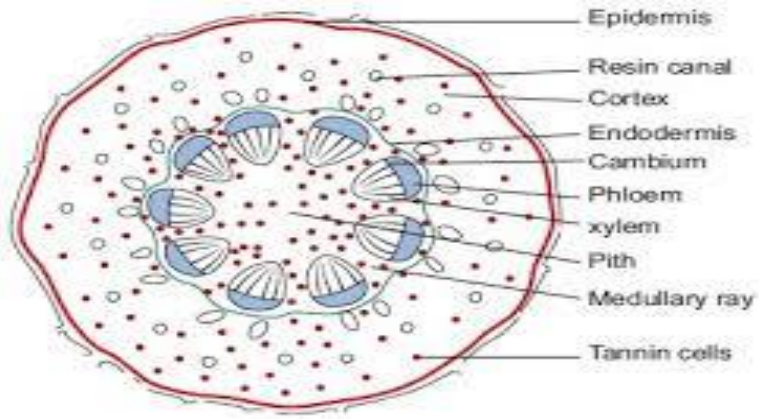
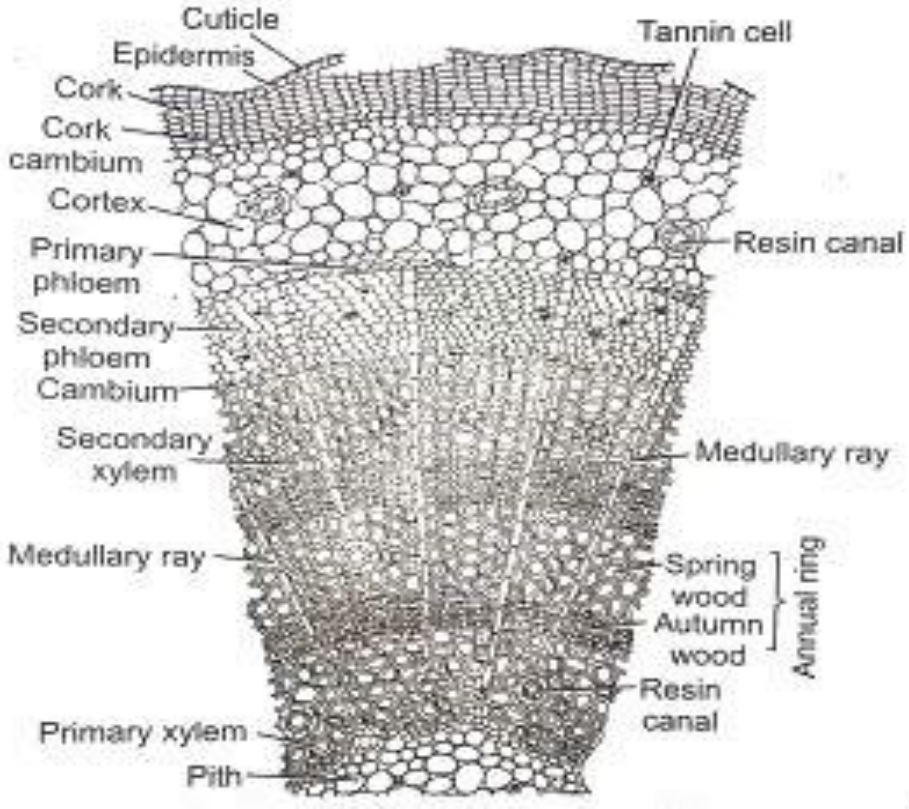


Figure 2.50: T.S. of *Pinus* stem

SECONDARY GROWTH IN STEM

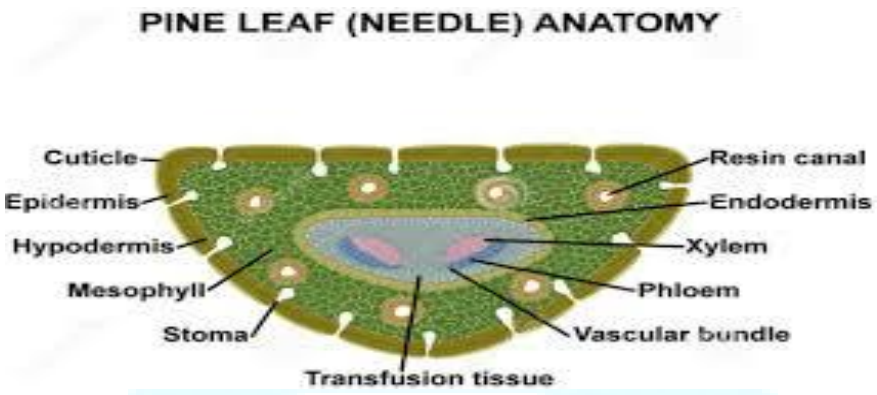
- Ring of vascular cambium develops
- Remains active each year forming spring wood & autumn wood – annual rings
- Important in dendrology for estimation of the age of the plant
- Secondary medullary rays usually uniseriate
- Pinus wood is dense and massive with few parenchyma cells – pycnoxylic
- Cork cambium (phellogen) formed in outer cortical layer
- Forms secondary cortical cells (phelloderm) towards inner side and cork (phellem) on outer side.



ANATOMY OF LEAF

- Leaf Xeromorphic
- *P. longifolia* is trifoliar; so the needle shows triangular outline

- Outermost epidermal layer has thick-walled cells which are cuticularized
- Stomata are sunken
- Hypodermis is sclerenchymatous



REPRODUCTION

- Takes place by means of spores –microspores (male) and megaspores (female).
- Heterosporous
- Monoecious

MALE CONE/STAMINATE CONE

- Borne on the lower branches in the axils of scale leaves.
- Can be seen in clusters just behind the shoot – apex.
- Each cone has spirally arranged microsporophylls
- Two microsporangia are present on the underside of each microsporophyll
- Development of microsporangium is eusporangiate type

- Within the microsporangium, the microspore mother cells undergo meiotic divisions to form haploid microspores

MICROSPORE/POLLEN GRAIN

- It is surrounded by a 3-layered wall
- Exine heavily cuticularized on one side of the microspore
- Middle layer -Exo-intine projected outwards into two large balloon-like air sacs or wings
- Inner layer- Intine is very thin
- Spore germination is in situ
- At the time of dehiscence, huge quantities of microspores form yellow clouds around the pine forests.
- It's called the "Shower of sulphur dust"

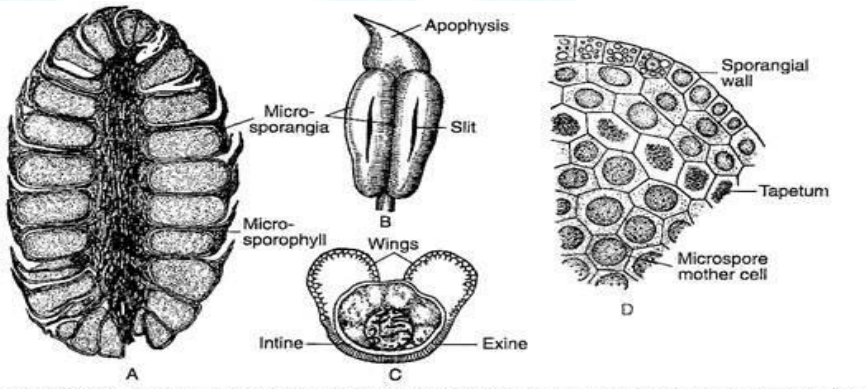
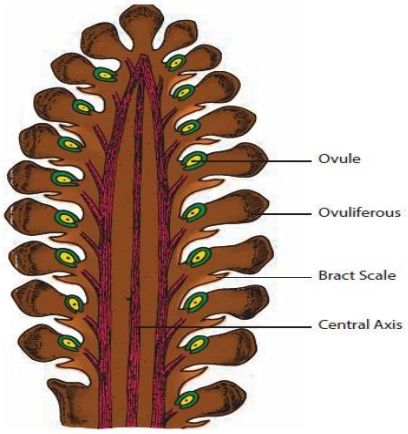


Fig. 1.62 : *Pinus* : A. Median L.S. of male cone, B. A microsporophyll, C. A pollen, D. T.S. of a microsporangium

FEMALE CONE/OVULATE CONE

- Borne on the upper branches of the tree, in axils of scale leaves either singly or in groups of 2-4.
- Each cone consists of central axis bearing spirally arranged ovuliferous scales.

- On young cones a small thin & leathery bract scale can be below the ovuliferous scale.
- Each ovuliferous scale has two ovules on its upper surface.
- Cone on maturity is usually cylindrical.



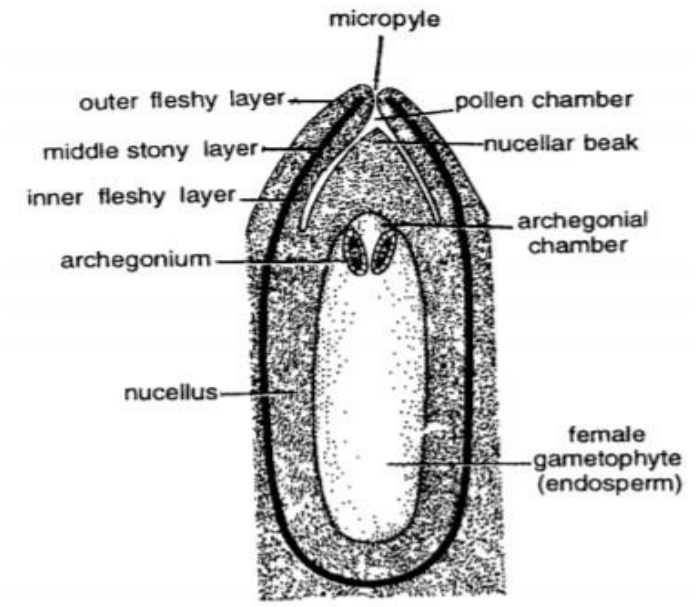
e) L.S. of female cone

MEGASPOROPHYLL

- The ovuliferous scale is thick, large, woody & brownish structure
- More or less triangular in outline – broad, terminal portion is apophysis with its centrally projected area
- Basal portion is narrow and bears two naked, sessile anatropous ovules on its upper surface

OVULE STRUCTURE

- Micropyle of the ovule faces the central axis of the cone
- The single integument is fused to the nucleus except for a short distance near the micropyle
- Embedded in the nucellus ,the archesporial cell divides meiotically to form four megaspores



Pinus. L.s. of ovule.

MALE GAMETOPHYTE

- Early development takes place inside the microsporangium
- Pollen grains are released at the 4-celled stage (2 prothallial, a generative cell and tube cell)
- Pollination is anemophilous and pollen reach the pollen chamber of the ovule through micropyle
- Further development here, results in the formation of pollen tube which carries the two unequal male gametes to the neck of the archegonium
- The released male gametes will fertilize the egg cell resulting in zygote formation

SPOROPHYTE DEVELOPMENT

- Embryo development is meroblastic

- In early stages the embryonal tier of the proembryo splits apart forming 4 apical segments each with its suspensor
- Each of these terminal embryonal cell give rise to a mature embryo, thus Cleavage polyembryony is observed

SEED STRUCTURE

- Seeds are naked (not enclosed in fruit)
- Seeds are winged – the latter being derived from portion of upper surface of the ovuliferous scale
- Outer fleshy layer of ovule disintegrates
- Testa formed from the middle stony layer
- Tegmen is the inner fleshy layer of the ovule
- Nucellus is almost consumed during embryo development.
- Remnants of nucellus , at micropylar end can be seen as reddish papery structure – the perisperm
- The haploid female gametophyte surrounding the embryo forms the oily white kernel (edible part).
- Mature embryo has the radicle towards the micropyle and plumule away from it.
- Plumule is surrounded by 8-14 cotyledons, which are green in colour.
- Germination is epigeal.

LIFE CYCLE

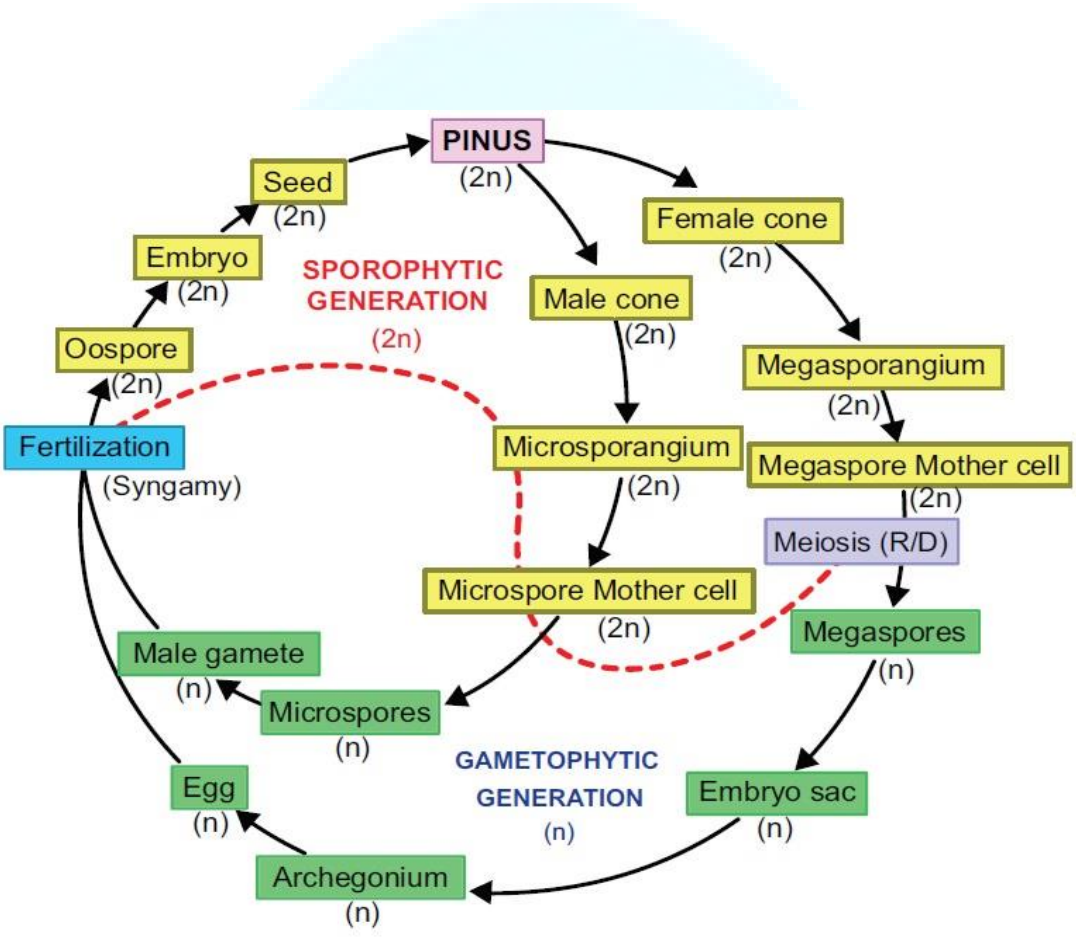


Figure 2.53: Life cycle of *Pinus*