Course: B.Sc Botany
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TOPIC: *Pinus*
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Taxonomic position of *Pinus*

Gymnospermae
Coniferophyta
Coniferopsida
Coniferales
Pinaceae
Pinus

Occurrence & Distribution

Widely distributed in the Northern Hemisphere, have about 75 species out of which 6 species are Indian like *P. excelsa, P. longifolia, P. gerardiana, P. insularis, P. armandi* . Forms dense evergreen forests in hilly regions (Himalayas)

Sporophytic Plant Body

- Adult plants are tall trees up to 200 feet in height
- 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

External Morphology of Stem

They are erect, tall, cylindrical, woody and branched, branching monopodial and lower branches are longer and horizontal giving the conical shape to the trunk. Branches of unlimited growth are the long shoots, arranged spirally around the main trunk, bear scale leaves and dwarf shoots in axils of scale leaves. Branches of limited growth or dwarf shoot lacks apical bud , possess 8-10 spirally arranged scale leaves terminating into 1-5 needle like foliage leaves at apex

External Morphology of Leaves

Scale leaves are thin, brown and small. Main function is to protect young buds & conserve water around the branches Foliage leaves are long & acicular (needle like). Remains green for a number of years (3-10 yrs) hence plants are evergreen. Number of needles per spur varies from 1-5 with species (monofoliar to pentafoliar)

External Morphology of Root

Plant possesses tap root. Elongated structure with strong lateral branches. Root-hairs is scant.There function is taken up by ectotrophic mycorrhiza (fungus roots). It is symbiotic association of fungal mycelium on the root's surface. Helps in absorption of nutrients & protection from pathogens.

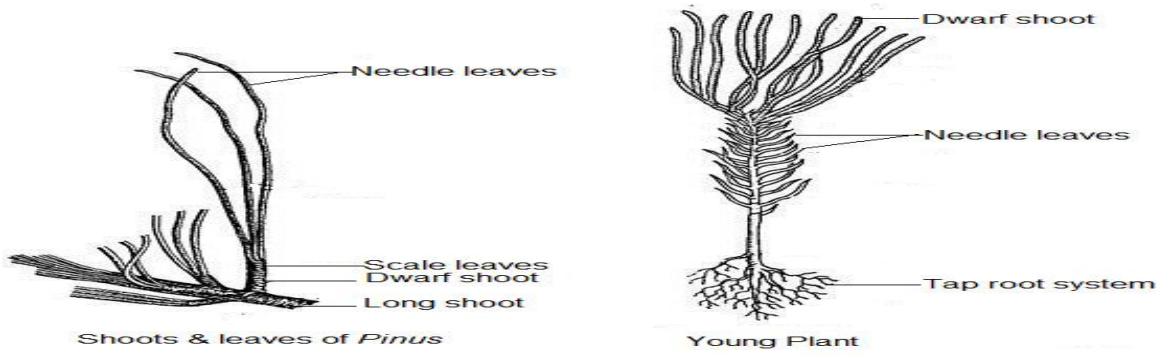
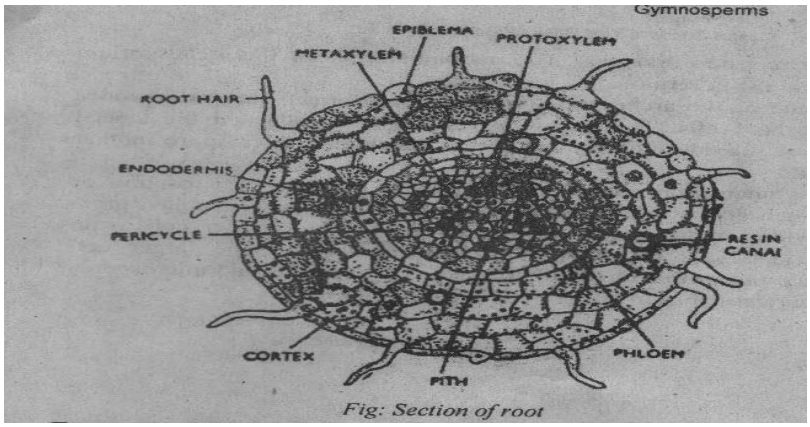


Fig: *Pinus* external feature of root, stem and leaf

Anatomy of Root

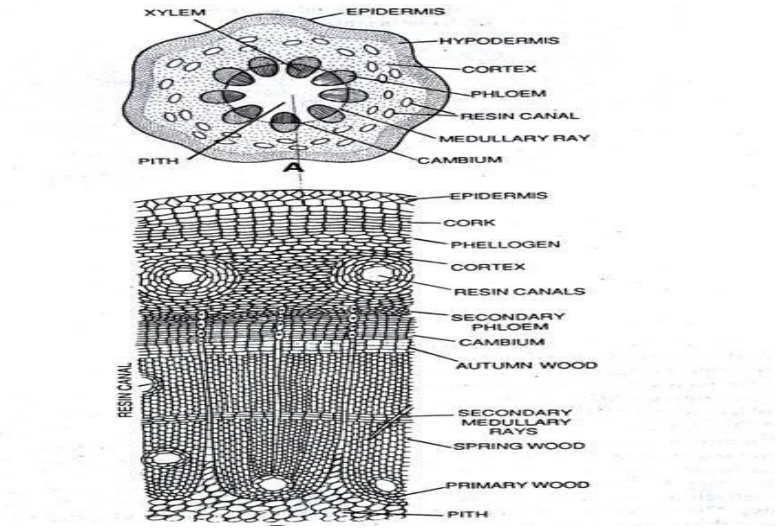
Resembles typical dicotyledonous root. Piliferous epiblema bear unicellular root hair (seen only in young roots) Broad parenchymatous cortex is present. Endodermis and pericycle layers seen next Vascular tissue is radially arranged in 2-6 groups of xylem and phloem. This tissue lacks true vessels and companion cells. Resin canals present in xylem patch making it Y-shaped. Old roots show secondary growth.



Pinus **T.S of Root**

Anatomy of Stem

Typically dicotyledonous stem. Cuticularized epidermis encloses the lignified sclerechymatous hypodermal layer. 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.



T.S of Stem *Pinus*

Secondary growth in stem

Ring of vascular cambium develops. They remains active each year forming spring wood & autumn wood – annual rings. It is 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

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. Mesophyll not differentiated further. These cells have peg-like infoldings of cellulose projecting in their cavities Have a large number of chloroplasts & starch grains. Resin canals with secretory tissue present. Two vascular bundles with conjoint tissue present in the middle.

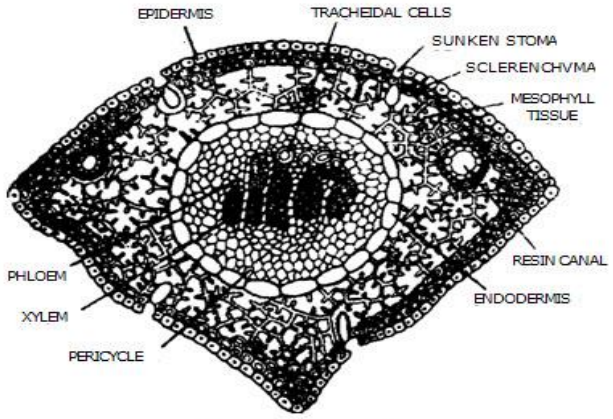


Fig: Section of leaf

***Pinus* T.S of Leaf**

REPRODUCTION

Takes place by means of spores –microspores (male) and megaspores (female).The plants are therefore heterosporous .The male and female cones occur on the same plant, but different branches i.e. monoecious.

Male cones (Staminate cones)

Borne on the lower branches in the axils of scale leaves. Appear in the month of January (in plains) and March (in hills) reaching maturity within 2-3 months. Can be seen in clusters just behind the shoot – apex. Each cone has 60-100 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. On maturation the spores germinate in situ. Hence, early gametophytic development is precocious. At the time of dehiscence, huge quantities of microspores form yellow clouds around the pine forests. It's called the "Shower of sulphur dust" Pollen grains 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. Female cones are seen in february and get pollinated within 3-4 months. Complete maturation and seed dispersal takes place in the 3 rd year of development.

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. Female cones are seen in february and get pollinated within 3-4 months. Complete maturation and seed dispersal takes place in the 3 rd year of development. Each cone consists of central axis bearing spirally arranged ovuliferous scales (60-70). 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 and 15-20cms in length.

Megasporophyll

The ovuliferous scale is thick, large, woody & brownish structure. More or less triangular in outline – broad. 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.

Female Gametophyte

The inner most functional megaspore further gives rise to the haploid female gametophyte tissue wherein the archegonia develop. The venter of the archegonia contains the upper ventral canal cell and the larger egg cell.

Male Gametophyte

Early development takes place inside the microsporangium. Pollen grains are released at the 4-celled stage (2 prothalial, 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 Time gap of 12-14 months is seen between pollination and fertilization.

Young Sporophyte

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 Seed Structure. 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.

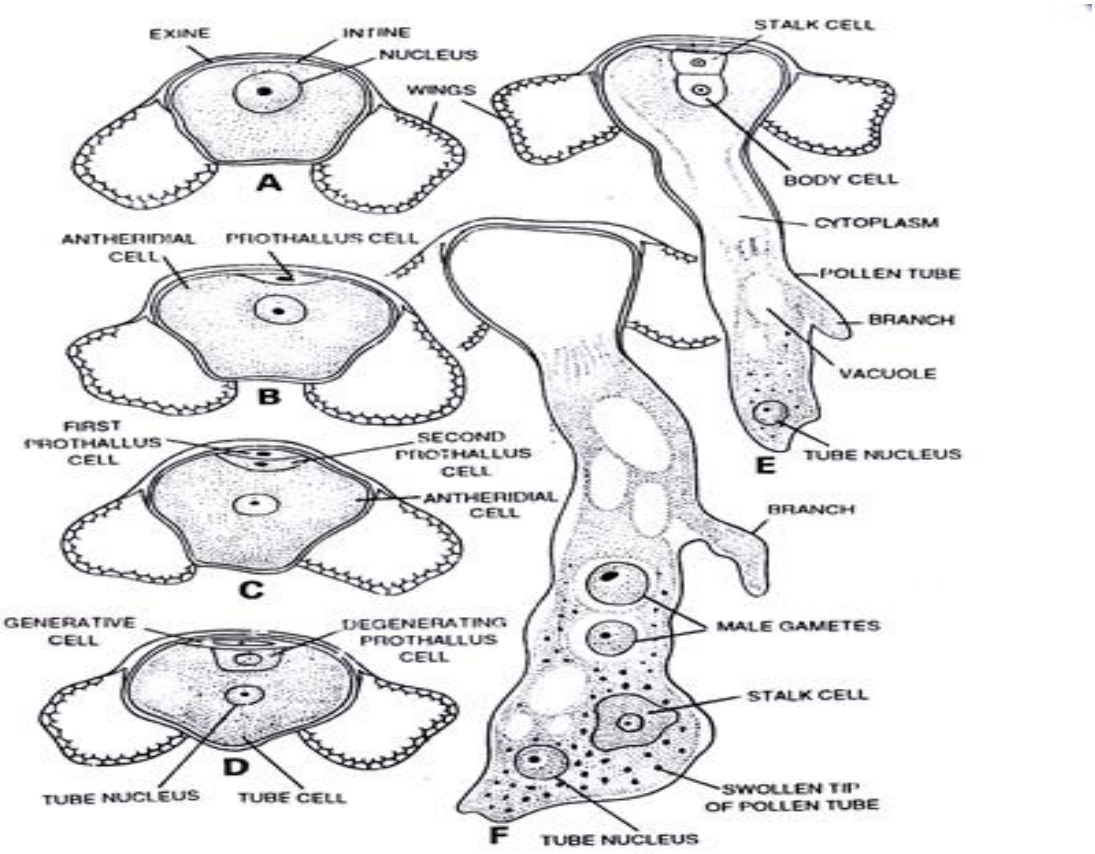


Fig. *Pinus* spp. Development of male gametophyte. A, a pollen grain; B-D, successive stages in the development; E, pollen tube with nucleus; F, two unequal male gametes, stalk nucleus, tube within pollen tube.

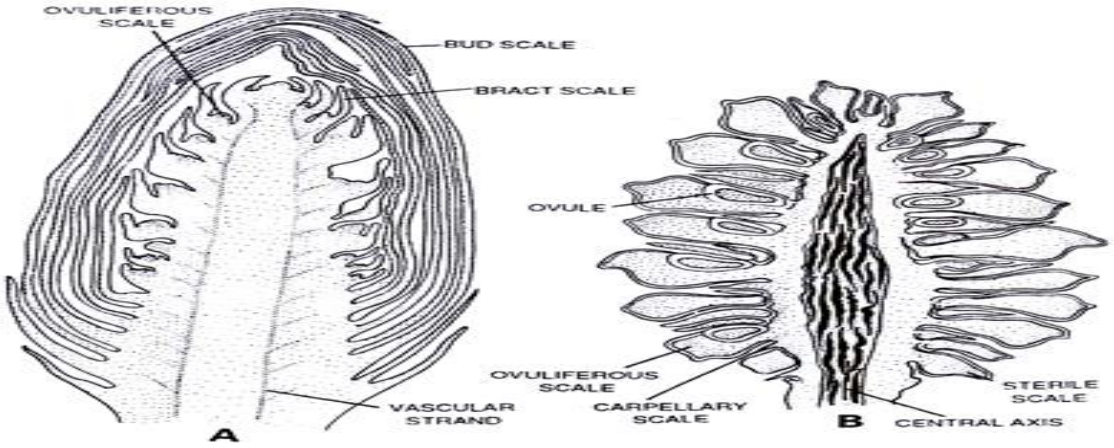


Fig: A)L.S of young female cone of *Pinus spp* showing well developed bract scale and developing ovuliferous section. **B)** V.S of mature female cone of *Pinus spp*.

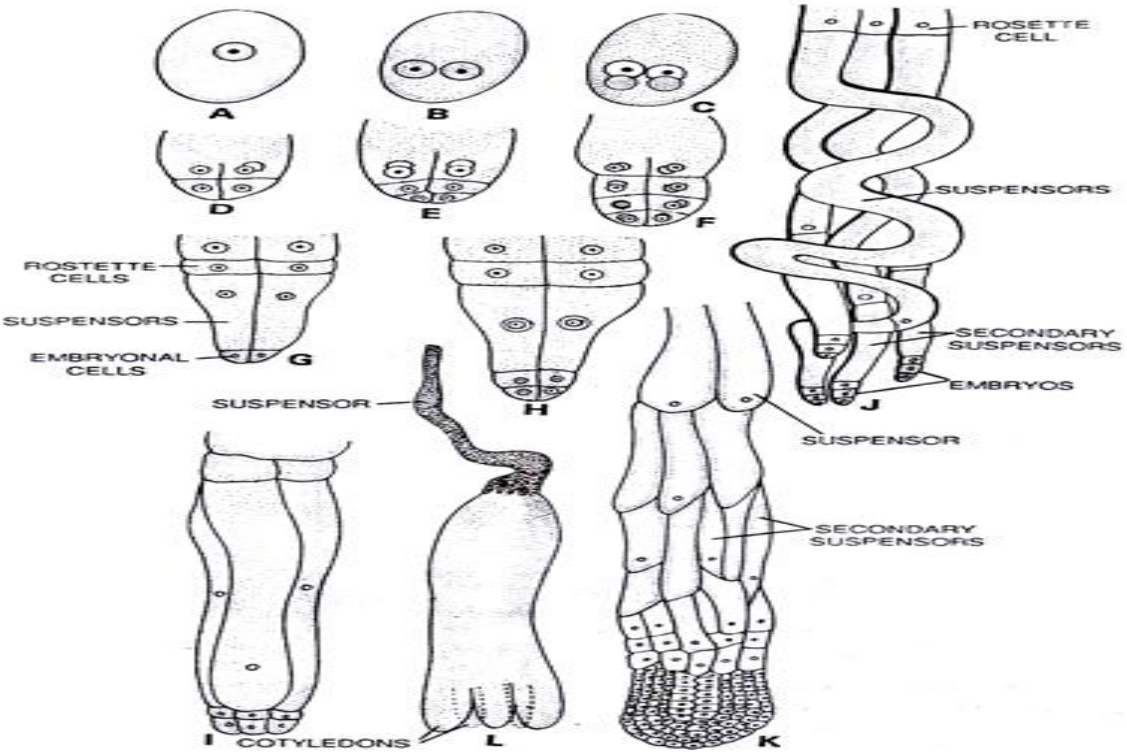


Fig: Pinus spp. Development of Embryo. **A)** Oospore **B-H)** Successive division of Oospore **I)** Primary Suspensor Elongated **J)** formation of secondary suspensor andf embryo **K)** formation of single embryo **L)**formation of Cotyledon

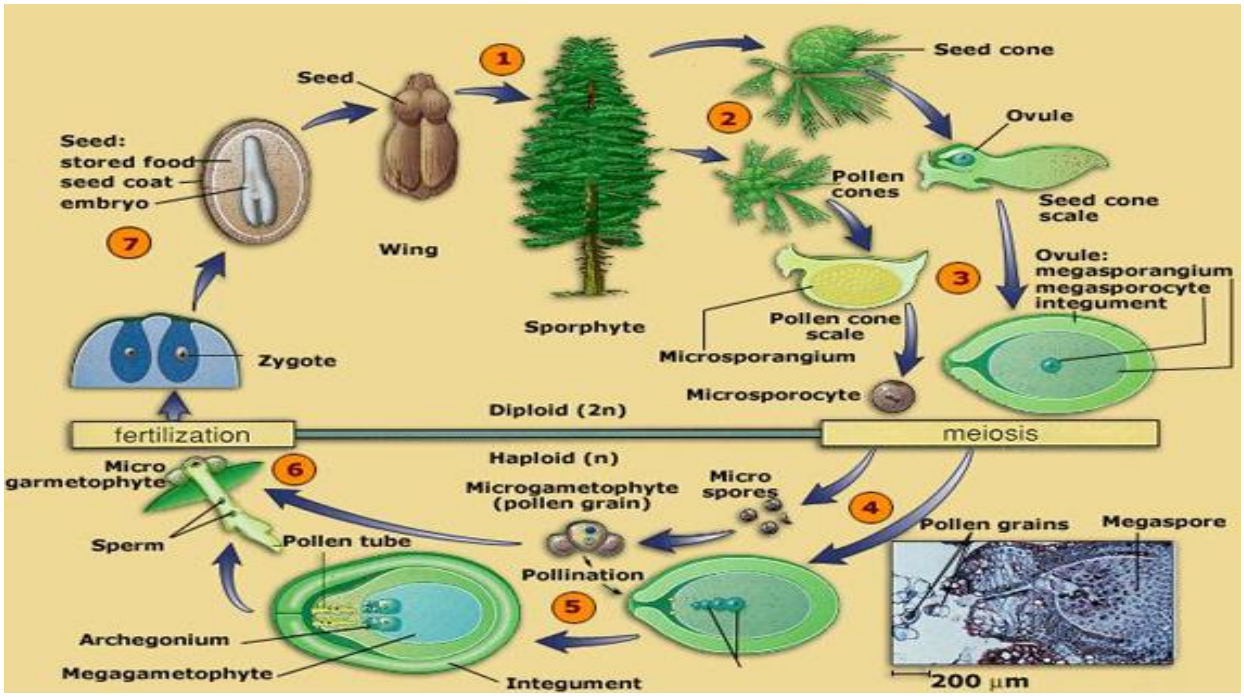


Fig: Showing Seed germination process