## General morphology of Pinus and anatomy of stem, root and leaf of Pinus

Family: Pinaceae

Order: Coniferales

Division: Coniferophyta of Gymnospermae

### A. PINUS

*Pinus* belongs to the family Pinaceae, order Coniferales and the division Coniferophyta of Gymnospermae.

**Distribution** —*Pinus*, the most dominate genus of the order Coniferales is represented by about 90 species. The genus *Pinus* is widely distributed throughout the temperate and sub-alpine regions of the Northern hemisphere, and forms an evergreen forest-belt. It is widely distributed in the hills and is an important source of resin and timber. In India, 6 species of *Pinus* are found to occur in the North-West and North-East Himalayas (Raizada and Sahni, 1960).

(1) *Pinus gerardiana* Wall. (the Chilgoza Pine)—A tree (upto 22.0 m), found in the North-Western Himalayas at altitudes ranging from 1,800 to 3,500 m.

(2) *P. insularis* (syn. *P. khasya*), the Khasi pine —A tall tree (upto 45.0 m.), found in Eastern Himalayas, specially in the Khasia and Jaintia hills at an altitude of 1,000 to 2,500 m.

(3) *P. roxburghii Sarg.* (syn. *P. longifolia*), the Chir pine —A tall tree (upto 30.5 m), found in the Western and Eastern Himalayas between the altitude of 450 and 2,250 m.

(4) *P. wallichiana Jacks.* (syn. *P. excelsa, P. griffithii*), the Blue pine —A tree (upto 45.5 m), found in both the Western and Eastern Himalayas between an altitude of 1,800 and 3,000 m.

(5) *P. armandi Franch*, Armand's pine—A medium sized tall tree (upto 15 m), found in the NEFA above an altitude of 1500 m.

(6) *P. merkusii Jung.* (the Tenasserim Pine)—A small tree, hardly reaches a height of 3 m. Found to grow profusely on hillocks in Eastern India, Bangladesh; often

coming down to an altitude of 150 metres.

**Structure of the Sporophyte**

1. EXTERNAL MORPHOLOGY —A tall, evergreen and lofty tree with strong tap root system. The tree takes a pyramidal form (*excurrent*) due to development of racemose branching.

*Stem* —The stem is erect, stout, cylindrical and branched. The stem is covered with bark which is characteristic of different species. Branching is monopodial. Branches are of two kinds, viz. (a) short branches of limited growth (dwarf or spur shoots) and (b) long lateral branches of unlimited growth (long shoots). The dwarf shoots develop in the axils of scale leaves and are devoid of apical buds. These dwarf shoots possess scale leaves below and needle-like foliage leaves at their apices.

*Root—Pinus* has a strong tap root system, which may persist or may be associated with stronger adventitious roots. Root hairs are scanty and ectotrophic mycorrhiza occurs.

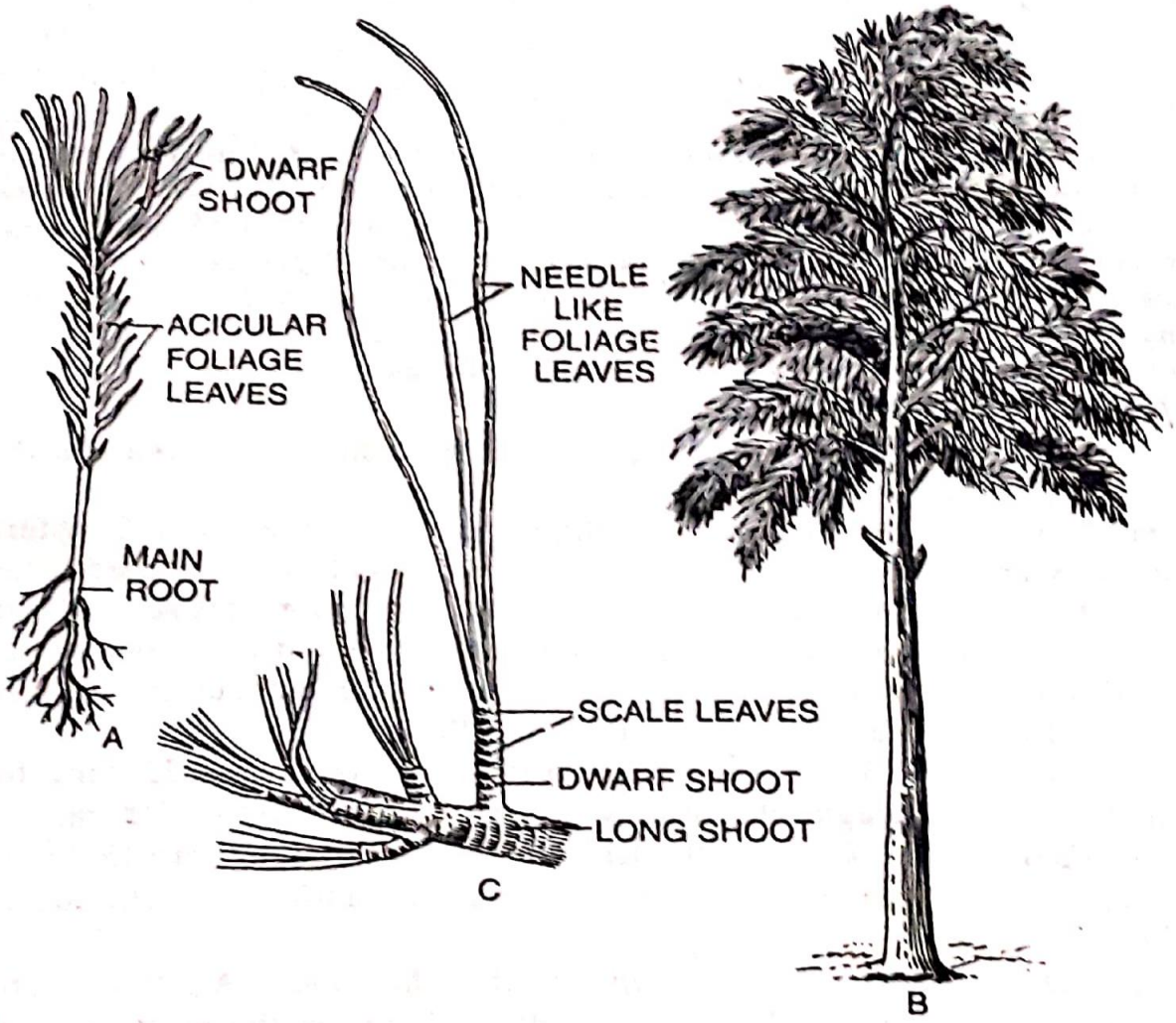


Fig. 3.10—*Pinus* sp. A. A young plant. A–Structure of a tree. B–Dwarf shoots bearing foliage leaves and scale leaves (only one shoot bears entire foliage leaves).

*Leaves*—Leaves are dimorphic i.e. (i) brown, small, thin scale leaves and (ii) needle-like green simple, foliage leaves developing in cluster at the apex of dwarf shoot. The number of mature needle-like foliage leaves varies from 1 to 5 in different species. Scale leaves occur on long and as well as on dwarf shoots and fall off as the branches attains maturity. But needle like foliage leaves are borne only on dwarf shoots. The main photosynthetic function is performed by the needle-like leaves.

## 2. INTERNAL MORPHOLOGY

*Stem*—In transverse section the stem shows a *thin cortex, a large zone of vascular tissues and a small pith* (Fig. 3.11).

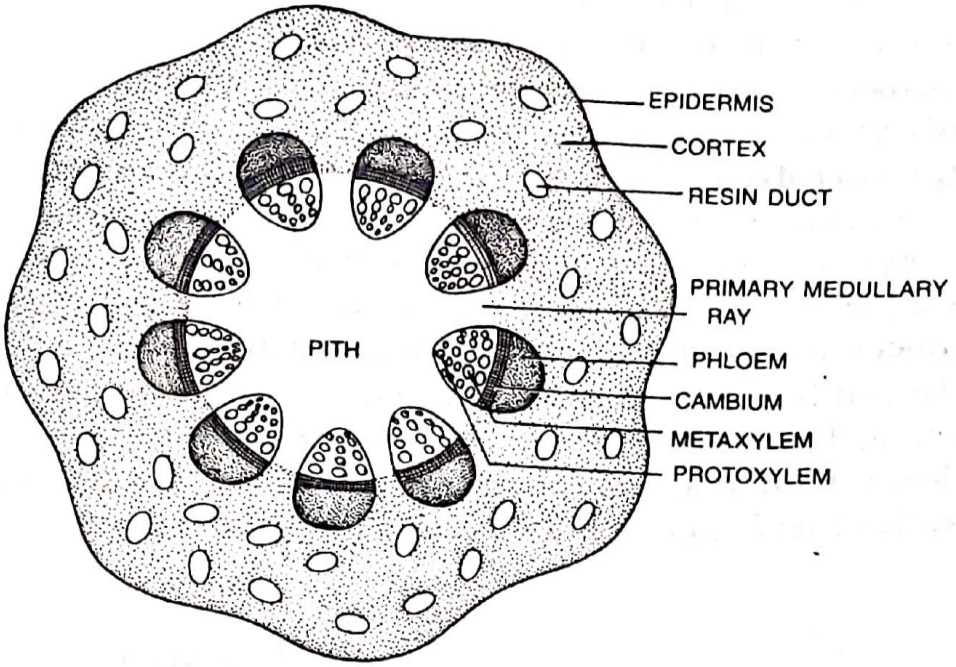


Fig. 3.11—*Pinus* sp. T.s. of young stem (diagrammatic).

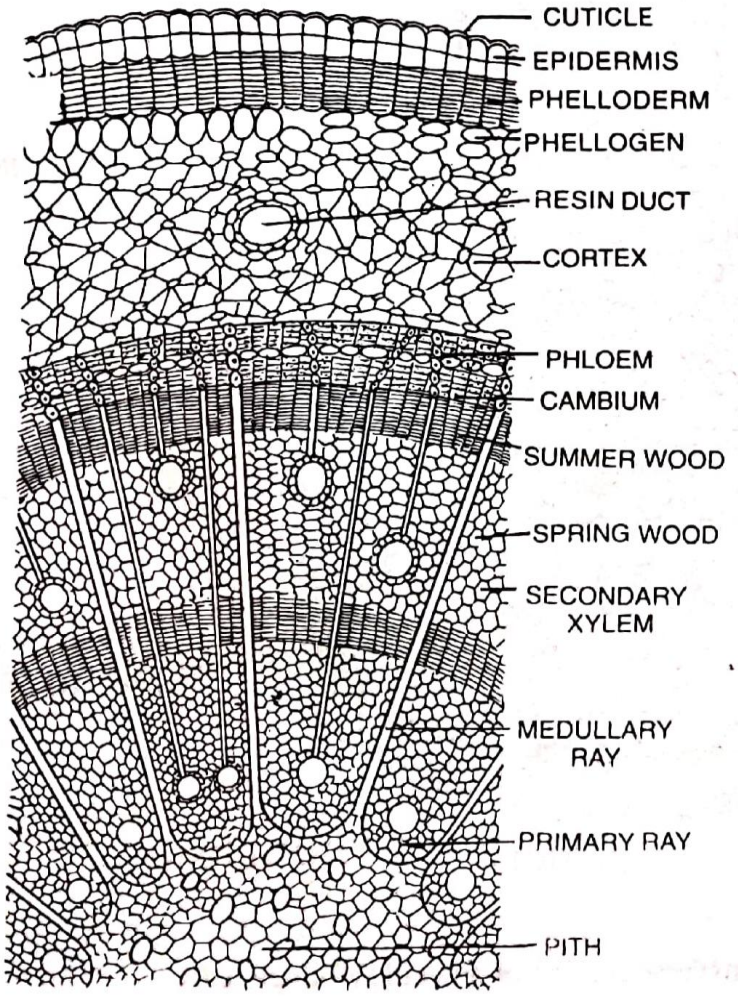


Fig. 3.12 —*Pinus* sp. A portion of a stem (two years old) in transverse section.

The stem is differentiated into outer cortex and stele i.e. central cylinder. Epidermis and pericycle are not very distinct. The pith is parenchymatous.

The epidermis is one-cell layer thick and consists of tubular, close compact cell— the outer walls are cutinised. The cortex is composed of parenchyma cells, Resin ducts are present in the cortex. The vascular bundles are conjoint, collateral, open and endarch (i.e., the protoxylem is directed towards the pith). The primary permanent tissue and secondary tiissues are developed in the same way as in dicotyledons of angiosperms.

The vascular bundles are composed of phloem, fascicular cambium and xylem. The xylem exclusively consists of tracheids with bordered pits and xylem rays. No vessels and wood fibres occur. Phloem consists of sieve tubes and phloem parenchyma; companion cells are absent. The stele is ectophloic dissected siphonostele. Cambium is present in between xylem and phloem.

The secondary wood contains special tracheidal rays *i.e.* the medullary rays. Secondary wood also contains tracheids; the medullary rays in the secondary bast or phloem consist of starch-containing cells and albuminous matter containing cells. Resin ducts are also present in the secondary wood. Cork cambium appears successively in the cortex and in the outer part of the phloem (Fig. 3.12).

*Root*—The root in transverse section shows an outermost piliferous layer (epiblema), a multilayered cortex composed of parenchyma and a diarch to tetrarch vascular cylinder. There is a single-layered endodermis which is followed by a pericycle; pericycle is several-layers thick sometimes. Protoxylem is exarch, it is slightly forked in the form of 'Y'. Resin canals, opposite to each protoxylem group often occur. *Pinus* root is mycorrhizal because of the presence of a fungus on the surface of the root forming ectotrophic mycorrhiza. Root hairs airse in young root but disappear ultimately.

*Leaf*—The leaf is needle-shaped *i.e.* acicular, the anatomical structure (Fig. 3.13) is peculiar. The anatomy of leaf shows xerophytic structure. In transverse section the leaf is somewhat semi-circular in out-line i.e. the leaf is *centric* type. The outer walls of leaf-epidermis are heavily cuticularised.

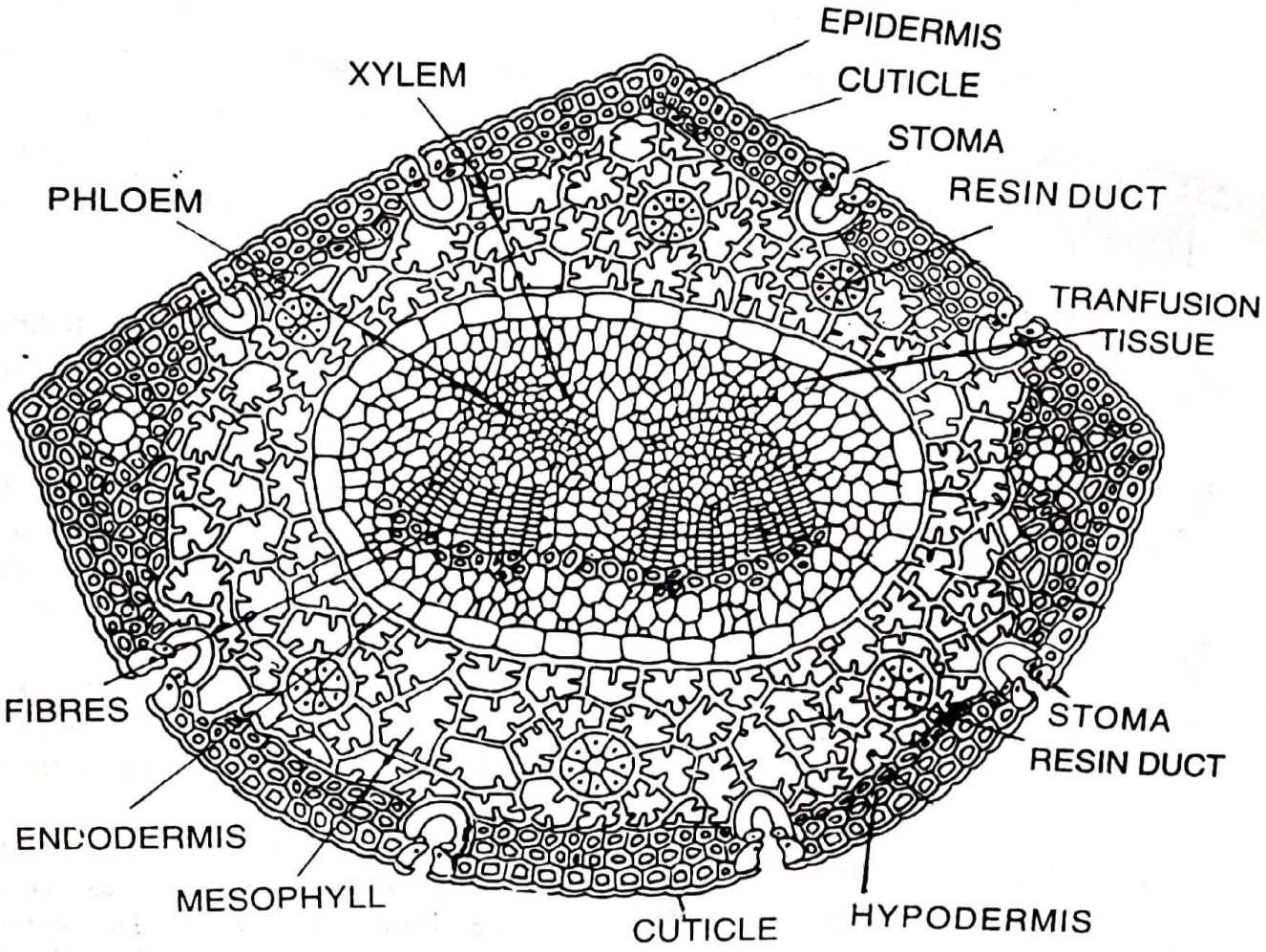


Fig. 3.13— *Pinus* sp. Transverse section of a needle (foliage leaf).

The stomata are sunken. The vascular bundles are 2 to 3 in number, they lie some what obliquely, the xylem facing towards the adaxial (upper) side and the phloem towards the abaxial (lower) side. The xylem is endarch and consists of crushed protoxylem and metaxylem composed of variously thickened tracheids. The entire xylem parenchyma

is more abundant. Some phloem parenchyma cells are rich in dense cytoplasm and such cells are known as *albuminous cells.*

The most conspicuous feature is the presence of transfusion tissue surrounding the vascular bundles. Here the pericycle-cells are collectively called transfusion tissue. The transfusioin tissue consists of two kinds of cells e.g., (1) thin-walled, non-living lignified tracheids (tracheidal cells) whose function is translocation of food from mesophyll to the phloem and (2) living, non-lignified parenchymatous cells with cellulose cell walls (albuminous cells) whose function is conduction of water and dissolved mineral salts from xylem to the mesophyll tissue. The parenchyma cells contain tannin, resin-like substances and starch. Towards the xylem the transfusion tracheids are elongated further away from the vascular bundle. They are short and parencyma-like. The transfusion cells lying very close to phloem are similar to albuminous cells. According to Huber (1930) the transfusion tracheids and transfusion parenchyma form continuous systems and these two systems interpenetrate each other. The transfusion cells are auxillary conducting system helping the vascular bundle in coming close to mesophyll for physiological purpose. The mesophyll tissue is not usually differentiated into palisade and spongy cells. The cells of mesophyll have ridges on the walls projecting inside the cell-cavities known as *arm palisade.*

The leaf shows xerophytic structure as the epidermis is heavily cuticularised with stomata having sunken guard cells which are overtopped by subsidiary cells. Below the epidermis lies the sclerenchymatous hypodermis having fibre-like thick-walled lignified cells.