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**Topic: Pinus: Internal morphology & Reproductive structure**

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### **Internal Morphology of Pinus:**

**Stem:** A young stem in cross section resembles a dicotyledonous stem in many respects. It is wavy in outline. The general arrangement of various tissues from the periphery to the center is as follows:

**Epidermis:** It is the outer surface layer of the stem. It consists of a single layer of tubular close compact parenchymatous cells with a thick cuticle.

**Hypodermis:** Below the epidermis, a hypodermis layer is present. It consists of a few layers of lignified sclerenchymatous cells.

**Cortex:** It consists of several layers of parenchymatous cells with copious resin ducts. A single layer of resin secreting glandular epithelial cells surrounds the resin duct.

**Endodermis:** Outside of the pericycle, endodermis is present. It consists of a single layer of parenchymatous cells.

**Pericycle:** It consists of several layers of parenchymatous cells which are located outer to the ring of vascular bundles.

**Vascular bundles:** They are conjoint, collateral, open, arranged in ring and endarch. In this case, protoxylem is directed towards the pith. Between xylem and phloem, a narrow strip of cambium is present. The xylem is composed of

tracheids with bordered pits and xylem rays, without vessels. The phloem is composed of sieve tubes and phloem parenchyma without companion cells.

**Pith:** It is composed of a mass of parenchymatous cells.

**Pith rays:** It is composed by a narrow strip of cells running from the pith outwards between the vascular bundles.



Fig: Stem of *Pinus* (Cross section)

**Leaf:** A transverse section of foliage leaf shows the following structure under the microscope. It is semi-circular in outline (centric type of leaf).

(i) **Epidermis:** It consists of a single layer of thick walled cells with a heavy sheet of cuticle and sunken stomata.

(ii) **Hypodermis:** It consists of two or three layers of very thick walled sclerenchymatous cells with resin ducts, which are broken up by stomata. It is placed just underneath the epidermis. It strengthens the tissue of the leaf.

(iii) **Mesophyll:** It consists of a few layer of chloroplast containing parenchyma cells with peg-like projections. In this case, wall projecting occurs inside the cell cavity which is known as arm palisade.

(iv) **Endodermis:** It consists of a single layer of barrel shaped cells which is present outside of the pericycle.

(v) **Vascular bundles:** They are collateral, closed and two in number.

(vi) **Pericycle:** It consists of albuminous cells and tracheidal cells. In this case, albuminous cells lie close to the phloem while tracheidal cells lie adjacent to the xylem. Albuminous and tracheidal cells together form the transfusion tissue which helps to flow of nutrients. The xylem is surrounded by pericycle.

**Root:** The internal organization of tissues in the root of *Pinus* is almost similar to that in a dicotyledonous root. A cross section of young root shows an epiblema (piliferous layer) with root hairs, a multilayered cortex and a diarch to pentrarch vascular cylinder and Y-shaped xylem bundles. 2-3 layered pericycles surround the vascular bundles while the cortex consists of a few layers of thin walled parenchymatous cells. A single layered endodermis is present which is followed by a pericycle. The root is mycorrhizal because fungus grows on the surface of the root.

### **Reproductive Structures of *Pinus***

The *Pinus* is monoecious plant which shows the sporophytic generation. The microsporophyll (male) and megasporophyll (female) are formed on the same plant but these two types of sporophylls appear usually in separate cones or strobilli.

The male and female cones are known as staminate strobilus and carpellate strobilus, respectively. The *Pinus* does not show vegetative reproduction. The flowers are unisexual. They always occur on the shoots of the current and a little away from the apex.

#### ***Male cone (staminate strobilus)***

The male cones are simple, compact, oval structures and about 2-3 cm long. They are found to occur in clusters, near the tip of the long shoots.

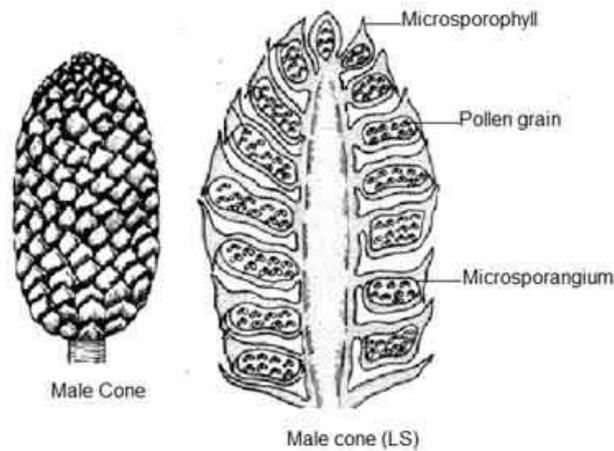


Fig: Male cones of *Pinus pinaster*

Each male cone bears a short and elongated central axis upon which a large number of microsporophylls or stamens are arranged spirally. The microsporophylls are scaly and their number varies from 60 to 135 in each cone.

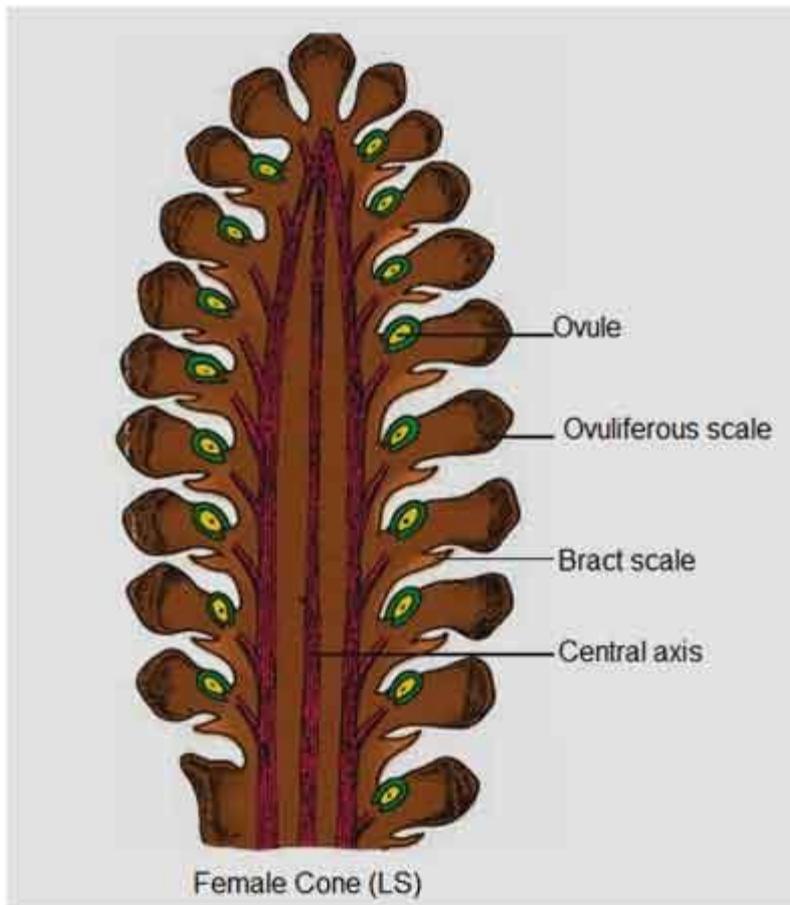
A microsporophyll consists of a short filament or stalk and a terminal leaf-like expanded structure while the apex is slightly bent upwards. Each microsporophyll bears two pouch-like microsporangia (anthers or pollen sacs) on its ventral surface. A microsporangium is sessile and oblong which is supported with a jacket of several layers of cells.

Each microsporangium produces a several microspores (pollen grains). The wall of each microspore is covered by inner intine and an outer exine. The microspores are winged and yellow in color. In this case, wings help in the dispersal of spores by wind.

### **Female Cone (ovulate strobilus)**

The female cones are larger and compound in nature. They are formed in clusters of 1-4 in the axils of scale leaves of long shoots. Initially, they are green but ultimately become brownish red in color. It starts to produce in winter and become ready for pollination during the spring. It is hard woody and dry

structure. It bears a central axis upon which a large number of megasporophylls are arranged spirally.



Each megasporophyll has short stalk with a large ovuliferous scale on the upper surface and a small bract scale on the lower surface. Each ovuliferous scale bears two inverted megasporangia on its upper surface towards the base.

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Each megasporangium consists of a massive tissue which is called the nucellus and an envelope which is known as the integument. At the basal region, the integument is fused with the nucellus and open at the top by forming micropyle.

A single megaspore mother cell is differentiated within the nucellar tissue, which divides meiotically to form four megaspores. Of these four megaspores, only the lower most one is functional while others degenerate. The only functional megaspore increases in size and takes part in the development of the female gametophyte.

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