XYLEM

The term is derived from a Greek word '*Xylon*' meaning Wood and is coined by Nageli.

Xylem is one of the main conduction tissues of the plants and help in conduction of water and minerals in upward direction.

During the primary growth, plant comprises of primary xylem derived from procambium and later during the secondary growth, secondary xylem develops from vascular cambium. During the development, two types of xylary elements can be recognized based on difference in size and are categorized on the basis of their sequence of formation, the first formed xylem vessels having the presence of smaller vessels are referred to as protoxylem and the xylem vessels formed later showing the presence of larger vessels are referred to as the metaxylem.

Xylem is a complex tissue made up of different types of cells and is composed of four elements:

A. Xylem tracheids
B. Xylem vessels
C. Xylem parenchyma
D. Xylem fibres

Xylem tracheids and vessels together are referred to as tracheary elements. Except the xylem parenchyma, all the other elements devoid of living protoplast and are dead.

A. Xylem Tracheids

It is a primitive conducting tissue, mainly found in gymnosperms. In angiosperms, it is found in 5%.

Tracheids are elongated, having tapering ends (chisel like), possess thick lignified cell wall and a narrow lumen. The cells are devoid of protoplast and are dead.

The cells appear polygonal in cross section. The secondary wall possess various types of thickenings :

1. Annular : Lignin deposited in the form of rings all along the walls almost at regular intervals.
2. Spiral : Lignin is deposited in a manner that appears spiral shaped.
3. Reticulate : The lignin is deposited in a manner that it looks network like thickening.
4. Scalariform : Lignin deposition is in the form of closely arranged transverse bands which gives an appearance of ladder.
5. Pitted : Thsese are the most common types. In this case, the entire inner surface of the cell wall is thickened except for certain unthickened circular areas which looks like pits. Through these pits, tracheids establish communication with the neighnouring cell elements which may be living or non living. The nature of the pits may be variable. In lower vascular plants, these are elongated, giving them scalariform appearance. In gymnosperms and angiosperms, these are circular, in which two types are recognised, i.e. simple and bordered.

Simple pits are the areas with only primary wall without any secondary thickening. In bordered pits, the secondary wall partially outgrows the pit to form a dome shaped structure with a small perforation in the middle. The primary wall develops a thickening in its central part which is known as torus.

Functions: Tracheids are mainly helping in conduction of water and are also providing mechanical support.

B. Xylem Vessel

It is characteristic to angiosperms and is also found present in gnetophyta.

Vessel member is short, cylindrical, tube like structure with lignified walls and a wide central lumen. The cells are dead as these do not have protoplast. The vessel members are arranged in longitudinal series, so that the entire structure looks like a pipeline and is referred to as Vessel. The partition walls (end walls) are perforated. If the perforation plate contains one large pore, it is called simple perforation plate and if there are several pores in it, it is called multiple perforation plate. In multiple perforation plate, the pores are found arranged in several ways. When the pores are arranged in a reticulate manner, it is called reticulate type and if the pores are elongated and are arranged in parallel series, it is called scalariform type. Sometimes perforations are circular and grouped together, then, the perforation plate is called foraminate type.

Besides, the secondary wall layers are deposited in a manner similar to tracheids and commonly the vessels show the presence of bordered pits.

Functions: Vessels are more efficient in conduction of water than tracheids which is mainly facilitated by the presence of wider lumen and perforation plates. It is also providing mechanical support.

C. Xylem Fibres

Xylem fibres are sclerenchymatous cells with pointed ends and narrow central lumen. These are dead cells. Fibres are mainly of two types - fibre tracheids and libriform fibres. It provides mechanical support.

Tracheid differ from sclerenchymatous fibre in having the cell wall that is comparatively less lignified. Tracheids show large number of pits. It mainly has bordered pits in the secondary wall and has a larger lumen.

D. Xylem Parenchyma

Xylem parenchyma is the only living tissue in xylem and is composed of cellulosic thin walled cells. These are found in primary and secondary xylem but are commonly found in primary xylem. In secondary xylem, the xylem parenchyma may often have thick, lignified pitted cell wall. The parenchyma found in secondary xylem are classified into two types:

a. Axial or wood parenchyma – These are derived from fusiform initials of cambium together with tracheary elements and fibres. These are elongated and lie in vertical series.
b. Ray parenchyma – These originate from ray initials of fusiform cambium and occur in radial transverse series.

Functions: Xylem parenchyma store food reserves in the form of starch or fats. Sometimes, tannins, crystals and other substances may be found. Ray parenchyma helps in radial conduction of water.

Some parenchymatous cells are structurally modified for intensive transfer of solutes. These are characterised by wall ingrowths of unlignified secondary wall, to which the plasma membrane remains intimately appressed, increasing its area to several times. These are referred to as transfer cells.