

Complex permanent tissues

1- Xylem

The vascular system of the plant is composed of xylem. The principal of water – conducting tissue, & phloem, the food conducting tissue.

Vascular system occur in higher plants and absent in lower plants therefor it is called vascular plants. The origin of xylem in primary growth stage in procambium, the resulting xylem elements at first called protoxylem, & the xylem elements mature after that called metaxylem which large in diameter than the protoxylem. Plant which get in secondary growth such as dicotyledon&gemnosperm have secondary xylem initiated from vascular cambium.

Xylem elements:

1. The vessels.
2. The tracheid.
3. Fibers.
4. Xylem parenchyma.

1. The vessels:

A series of vessel members joined end to end, length about 2-15 ft, thickened with legnine differ in length, thickening way, diameter depending on spaces, age, time of vessel formation in plant. The secondary thickening of tracheary elements are:
pitted , stalariform , reticulate , spiral , annular

There are two types of vessels end:

a. Perforated:

- 1- Simple perforation plates (uniperforate)
- 2- Compound perforation plates (multiperforation)
 - foraminate
 - reticulate
 - scalariform

b. Non-perforated: in this kind the ends of the vessels solute:

The Tracheid:

Dead cells at maturation more narrow than the vessels with a thickened wall with the lignen, imperforated, ends attenuated, contain so many border pits, tracheids similar to vessels but it have thin cell wall & wide inner cavity. Vessels occurrence is characteristic of Angiospermae in contrast tracheid is the transportation element in Gymnospermae & lower plants xylem.

Xylem & phloem units in monocots vascular bundle are less than in dicots, arranged as the letter(V/Y) and also contain tracheid, protoxylem have a large intercellular space called (protoxylem cavity) vascular bundle in monocots covered with a layer or more of fibers forms (bundle sheath) in some monocots plants vascular bundle as concentric bundles.

Monocotyledonae	Dicotyledonae
1. Does not differentiate	1. ground tissue differentiate to cortex, pith, medullary rays.
2. Does not found	2. Pericycle found
3. diffused in ground tissue	3. Vascular bundle arranged in one –

	two cycles
4. Closed collateral vascular bundle does not contain vascular cambium	4. Open collateral vascular bundle contain vascular cambium
5. xylem vessels arranged in form Y or V.	5. Xylem vessels arranged in strips
6. vascular bundle covered with bundle sheath (fibers)	6. Vascular bundle does not covered with sheath
7. no secondary thickening	7. secondary thickening occur

Primary & secondary xylem

Primary xylem originate from the procambium during the primary growth period, and differentiate to protoxylem & metaxylem, while the secondary xylem originate from the vascular cambium & composed of vessels, tracheids, fibers, parynchmaxylem, & contain vertical system & horizontal system.

Xylem parenchyma:

Consist of two kinds:

1. Axial parenchyma: derived from fisiform cambial initials, living tall cells divided into shorter cells.
2. Ray parenchyma: derived from ray initials of the cambium tall with thickened wall contain simple & border & half border pits.

Tylosis

In many plants, the axial and the ray parenchyma cells develop protrusions that enter tracheary cells when these become inactive or the xylem tissue is injured, such outgrowth from parenchyma cells, Tylose

development occur through the pit – pairs connecting the parenchyma cells with the tracheary elements. Tyloses have bladder shape & completely fill the lumen of the tracheid or vessel element, the nucleus of the originating parenchyma cell & part of the cytoplasm appear in the cytoplasm.

Annual Rings (Growth Rings)

Cambium activity in plants is seasonally because of the weather change therefore growth cycle appear and consist of:

Spring wood / Early wood: wide elements, thin cell wall, most of them are vessels.

Summer wood/ Late wood: narrow elements thickened cell wall most of them are fibers, few vessels.

Heart wood & Sapwood:

Heart wood: no active cells, cell walls thickened Low water ratio, colour dark, cells saturated with oils, gums resin, pigments. important, economical.

Sap wood: leaving cells, high water ratio, thin cell walls, light colour, function is transportation and mechanical.

Secondary Xylem in Gymnospermae

- 1) Simpler than Angiosperm xylem composed of tracheds, fibers, parenchyma. Vessels only occur in one order (Gnelales).
- 2) In some of gemnospermae contain (Grassulae) up and down border pit.

- 3) Xylem ray contain homocellular ray composed of parenchyma & Heterocellular ray composed of parenchyma + tracheids.

Resin Ducts

Occur in gymnospermae xylem, derived in schizogenous intercellular space among parenchyma cells which produce resin after that convert to epithelial cells. Sometimes resin duct may become closed by enlarging epithelial cells. These tylosis – like intrusions are called tylosoids they differ from tyloses in that they do not grow through pits.