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Lecture 7

:Xylem

It is the principal water-conducting tissue in a vascular plant. It is also involved in the transport of solutes, in support, and in food storage. Together with phloem forms continuous vascular system extending throughout the plant body . The vascular plants, also referred to as **tracheophytes**, the terms vascular plants and tracheophytes refer to the characteristic conducting .elements of the xylem, the **tracheary element**s

Cell types of the xylem

1- Tracheids

They are the conducting cells of the xylem which are **thin, long tubes** with **tapereing end walls** to allow the maximum number of pit-pairs between consecutive cells, thickened with lignin and **non-living at maturity**, found in all plants**.** They are **imperforate** cells having only pit-pairs on their common walls. In the most of tracheary elements, almost the entire inner surface of the primary walls is covered by secondary wall, except for **pits**. Water flowing from tracheid to tracheid must pass through the pit membranes of the pit-pairs in their overlapping walls.

2- Vessels:

They are contained from vessel members and connected end to end forming long vessels, vessel elements have **perforations** (which are areas lacking

both primary and secondary walls through which the vessel elements are interconnected).The part of the vessel element wall bearing the perforation or perforations is called the **perforation plate**. A perforation plate may have

1- **Simple perforation plate, it is** single perforation.

2- **Multiple perforation plate,** which are several perforations. The perforations in a multiple perforation plate may be:

A- Scalariform perforation plate, ladder which are elongated and arranged in a parallel series.

B- Reticulate perforation plate or in a reticulate manner.

C- Foraminate perforation or as a group of approximately circular holes . Multiple perforation plates are rarely found in woody species of low altitude tropical forests. They are more common in woody species of tropical high mountain floras and of temperate and mild-meso-thermic climates characterized by low temperatures during winter, whereas species with scalariform perforation plates tend to be restricted to relatively non-seasonal mesic habitats, such as tropical cloud forests, summer-wet temperate forests, or boreal habitats where the soil never dries.

Perforations generally occur on the **end walls**, may be present on the **lateral walls** too. Each vessel element of a vessel bears a perforation plate at each end, except for the **uppermost vessel** element and the **lowermost one**. A single vessel can consist of as **few as two vessel elements** (e.g., in the stem primary xylem of ***Scleria*, Cyperaceae** or of hundreds or even thousands of vessel elements. **Vessels are more efficient conduits of water than are tracheids** is due in part to the fact that water can flow relatively unimpeded from vessel element to vessel element through the perforations in their end walls.

3- Fibers:

The fibers are long cells with secondary, commonly lignified, walls. The walls vary in thickness but are usually thicker than the walls of tracheids in the same wood. Two principal types of xylem fiber are recognized:

1- Fiber-tracheids:

They have bordered pits with cavities smaller than the pit cavities of tracheids or vessels in the same wood. These pits have a pit canal with a circular outer aperture and an elongated or slit-like inner aperture.

2- Libriform fibers :

I t usually resemble phloem fiber, has thick walls, simple pits which have slit-like aperture toward the cell lumen, longer than fiber tracheids.

3- Gelatinous fibers:

Specialized or modified type of fibers which found in the secondary xylem of dicot. In these fibers, the innermost layer of the secondary wall contains much alpha cellulose and is poor in lignin, this layer termed as G-layer, absorbs much water and may swell so as to fill the entire lumen of the fiber. On drying, these layers shrink irreversibly. The G-layers were found to be relatively porous and less compact than the adjacent outer layers.

Fibers of tracheids and libriform may be **septate** (**which usually retain their protoplasts in the mature active wood and concerned with the storage of reserve materials**) widely distributed in eudicots and are quite common in tropical hardwoods. Thus the living fibers approach xylem

parenchyma cells in structure and function.

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4- Xylem parenchyma:

Cells which are responsible for most of the **storage function** of xylem, many of them have **secondary lignified walls**, particulary in wooden plants. In other cases, these cells have **thin primary walls** with areas of plasmodesmata called **primary pit fields**, through which cell to cell movement of water and mineral nutrients can take place. **Mature xylem parenchyma cells** in active xylem tissue **retain a functional protoplasm** and can store carbohydrates in the form of starch, these cells play an important role in **wound healing** by forming callus and can differentiate to regenerate functional xylem cells.

Primary Xylem

Developmentally the primary xylem usually consists of an earlier formed part, the **protoxylem** and a later formed part, the **metaxylem**.

1- Protoxylem :

It differentiates in the parts of the primary plant body that **have not completed their growth and differentiation** like in the **stem** and **leaf** but usually **matures before these organs undergo intensive elongation**. the mature non-living tracheary elements of the protoxylem are **stretched and eventually destroyed**. In the root the protoxylem elements frequently **mature beyond the region** of major elongation and hence persist longer than in the shoot. The protoxylem usually contains relatively **few tracheary elements** (tracheids or vessel elements) embedded in parenchyma. When the tracheary elements are **destroyed**, they may become **obliterated** by

surrounding parenchyma cells.

2- Metaxylem:

It commonly begins to differentiate **in the still growing primary plant body**, but **matures** largely after the **elongation is completed**. It is therefore less affected by the primary extension of the surrounding tissues than the protoxylem. When tracheary elements destroyed, they **remain thin walled** or **become lignified, with or without the deposition of secondary walls**. The metaxylem is, as a rule, a more complex tissue than the protoxylem. In plants lacking secondary growth the metaxylem remains functional in mature plant organs.

Characteristics of metaxylem:

1-Its tracheary elements are generally **wider** and **retaining their protoplasts** after primary growth is completed .

2- In addition to tracheary elements and parenchyma cells, the metaxylem may contain **fibers**.

3- The parenchyma cells may be **dispersed** among the tracheary elements or may occur in **radial rows**.