

Lecture. 6

Theoretical plant anatomy

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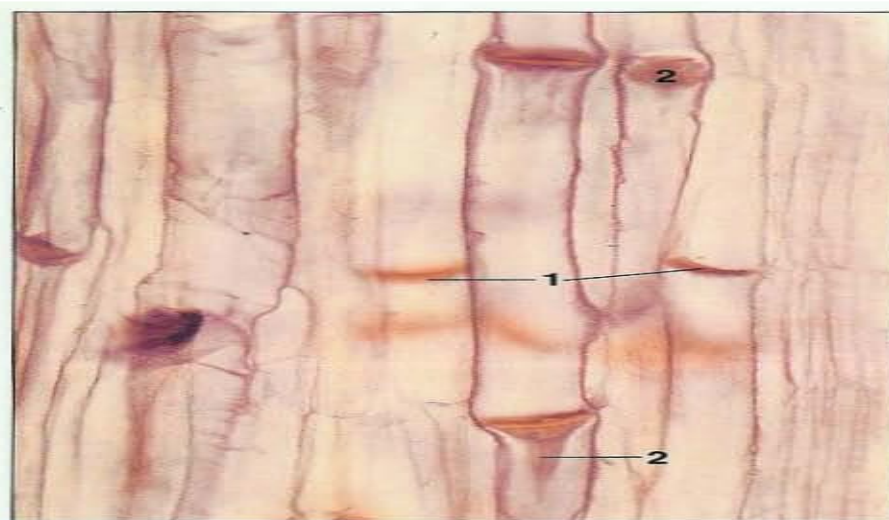
Phloem:

It is the vascular tissue which is responsible for the transport of sugars from source tissues (ex. Photosynthetic leaf cells) to flowers. The main components of phloem are:

1-Sieve tube elements:

It is the principal conducting cells of the phloem in angiosperm and characterized by:

- a) The presence of sieve plates. The protoplasts of sieve-tube elements contain **P-protein** (phloem protein, formerly called slime).



3.39 LS of the phloem of the dicotyledon *Cucurbita* showing numerous large-diametered sieve tubes in the stem. These are interrupted periodically by transverse or slightly oblique sieve plates (1). The P-protein fibrils coagulated when the specimen was excised and now form plugs (2) at the sieve plates. (LM x 335.)

1 Sieve plates

2 P-protein plugs

- b) The walls of sieve-tube elements commonly are described as primary with cellulose and pectin.

- c) In the leaves of grasses, sieve tubes typically have relatively thick cell walls, in some species—*Triticum aestivum*, these walls are lignified.
- d) Some sieve plates bear only a single sieve area are called simple sieve plate, while others bear two or more are called compound sieve plate. The sieve pores typically are lined with the wall constituent callose.

2- Companion cells:

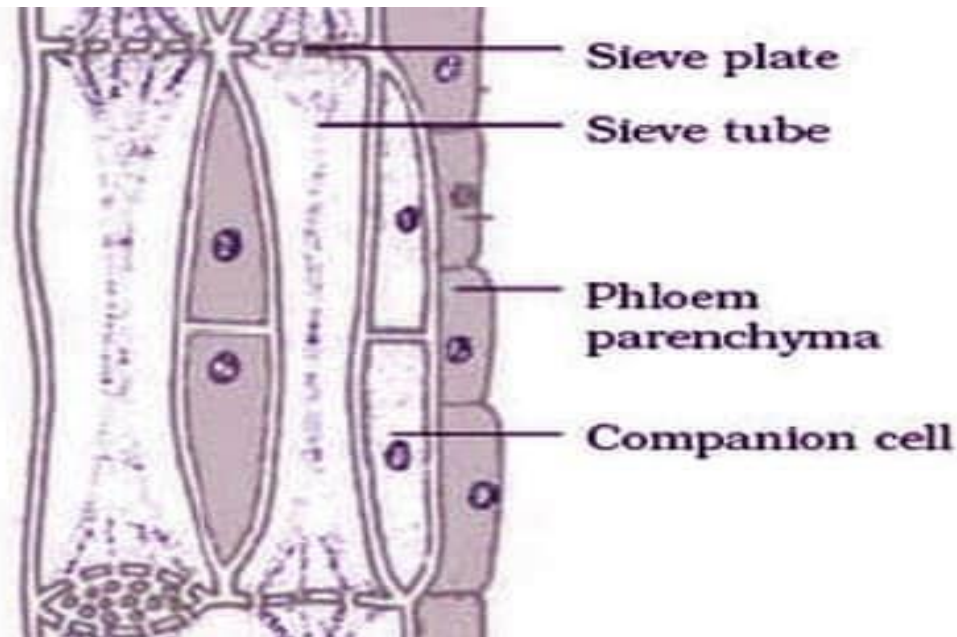
They are specialized parenchyma cells associated with sieve-tube elements. Typically, companion cells are derived from the same mother cell as their associated sieve-tube elements, so that that the two kinds of cells are closely related ontogenetically. Companion cells are nucleate whilst sieve tube members are not. One or more companion cells may be associated with a single sieve-tube element. The walls of companion cells are neither sclerified nor lignified, and commonly the companion cells collapse when their associated sieve-tube elements die. The function of the companion cells seems in part to be regulation of the physiological activities of the sieve elements.

3- Parenchyma cells:

The phloem contains variable numbers of parenchyma cells other than companion cells. Parenchyma cells containing various substances, such as starch, tannins, and crystals are regular components of the phloem. Crystal-forming parenchyma cells may be subdivided into small cells, each containing a single crystal; such chambered crystalliferous cells are commonly associated with fibers or sclereids and have lignified walls with secondary thickenings.

4- Fibers:

They are common components of both primary and secondary phloem, in some plants, the fibers are typically lignified; in others, they are not. The pits in their walls are usually simple, but may be slightly bordered. The fibers may be septate or non-septate and may be living or nonliving at maturity. Living fibers serve as storage cells as they do in the xylem. Gelatinous fibers also occur in the phloem.



Primary phloem:

The primary phloem is classified into proto-phloem and meta-phloem on the same basis of xylem.

A- Proto-phloem:

Proto-phloem is the first-formed phloem in a plant and is found closest to the meristem, which is the growing tip of the plant. It is made up of elongated cells with thin walls and large pores, allowing for the easy movement of nutrients and sugars.

- 1- The sieve elements of angiosperms are usually narrow and inconspicuous but they are enucleate and have sieve areas with callose.
- 2- They may or may not have companion cells.
- 3- Fibers are found in the periphery of the phloem region in numerous dicot stems they also occur in roots.

B- Meta-phloem:

It is formed after the plant has matured. It is responsible for transporting sugars, amino acids, and other organic nutrients from the leaves to the rest of the plant. Meta-phloem cells are shorter and wider than proto-phloem cells and have thicker walls, providing more support and protection from external factors. They are also more developed than proto-phloem cells and are less susceptible to damage

The main characteristics of metaphloem are:

- 1- Sieve elements are wider than the protophloem.
- 2- Companion cells are regularly present in metaphloem.
- 3- Fibers usually absent.
- 4- Parenchyma cells are elongated and oriented, with their long axes parallel with the longitudinal extent of the vascular tissue. They may become sclerified after the phloem ceases to conduct.

Gymnosperm phloem:

- 1- The axial phloem consists of sieve cells and parenchyma cells, some of which become albuminous cells.
- 2- Some gymnosperms have fibers in the phloem.
- 3- There is often very little wall thickening but sclerification can take place.
- 4- The outermost phloem layers either become compacted, or are incorporated into the 'bark'.

Angiosperm phloem:

- 1- The **sieve areas** (which are areas of dense pitting in lateral walls of sieve cells) are a feature of the more primitive dicot.
- 2- **Well-organized sieve plates**, simple and transverse, situated at end of the sieve tube members are considered to be advanced
- 3- **Companion cells** usually **much narrower** than the sieve tube member, to whom they are adjacent, are a feature of dicot phloem.

Secondary phloem:

It is formed from vascular cambium just as secondary xylem, so it has axial and ray system. The axial system of secondary phloem often contains:

- 1- The axial parenchyma may occur in parenchyma strands or as single fusiform parenchyma cells, idioblastic cells, sclereids and fibers.

2- In some species, sclereids and fibers are absent from the functioning phloem, but differentiate at a later stage. Fibers often alternate, in bands, with conducting cells, for example in *Tilia* and various Malvaceae.

Periderm

Periderm is a protective tissue of corky (suberinized) cells that is produced either as a response to wounding or in the outer layers of the cortex of a stem or root that has increased in thickness. The periderm consists of up to three layers: phellogen, phellem and phelloderm. The phellogen is a uniseriate meristematic layer of thin-walled cells that produces phellem to the outside, and (in some cases) phelloderm to the inside. The phellem cells constitute the corky tissue. They are tightly-packed cells that lack contents at maturity. They possess deposits of suberin and sometimes lignin in their walls, and form an impervious layer to prevent water loss and protect against injury. Phelloderm cells are non-suberinized and parenchymatous, and contribute to the secondary cortex.

