PHLOEM

The term is coined by Nageli and is derived from a Greek word '*Phlois'* meaning bark.
It is one of the main complex tissue involved in translocation of food materials in plant body.
Phloem tissue based on their origin can be studied as primary phloem and secondary phloem. Primary phloem develops from the procambium whereas secondary phloem develops from that of vascular cambium. Also based on the sequence of formation, phloem can be divided as protophlem which is formed first with narrow sieve tubes and metaphloem which is formed later showing larger sieve tubes.

Phloem is composed of more than one type of cells and has four main elements :

1. Sieve elements
2. Comapanion cells
3. Phloem fibres
4. Phloem parenchyma

1. Sieve elements

The conducting elements of the phloem are collectively termed as sieve elements and consist of less specialised sieve cells and the more specialised sieve tubes or sieve tube elements.

a. Sieve cells

Primitive conducting cells found in pteridophytes and gymnosperms.
Sieve cells are elongated and narrow cells and has sieve areas throughout the cells. It always remains associated with the albuminous cell present adjacent to it.

b. Sieve tube elements

Advanced actual conducting cells found in angiosperms.
The cells are short, elongated and slightly cylindrical tube like structures. They form long tubes long sieve tubes.
In general, the cell wall is cellulosic and is thin with central vacuole and characteristically no nucleus. The companion cell nucleus controls the functioning of sieve tube elements. Sieve tube element and the companion cell develop from the same mother cell and remain together throughout.
The end walls of the sieve tube elements are oblique and have sieve plates with sieve pores. The sieve plates are modifications of their protoplast. The sieve areas are depressed wall areas with cluster of perforations through which the protoplast of the adjacent sieve elements are interconnected by connecting strands. In sieve areas, each connecting strand remains encased in a cylinder of callose. The wall in a sieve area is a double structure consisting of two layers of primary wall, one belonging to one cell and the other of another cell cemented together by intercellular substance. Sieve areas varies in number and are variously distributed in sieve elements of different plants. The wall parts bearing highly specialised sieve areas are called sieve plates (Esau, 1950).If the sieve plate consist of a single sieve area, it is called a simple sieve plate. Many sieve areas arranged in scalariform, reticulate or in any other manner constitute a compound sieve plate. Apart from the end walls, sieve areas are also present on side walls referred to as lateral sieves.
In mature sieve tube, there is a thin layer of parietal cytoplasm, a large central vacuole and a large group of longitudinally running transcellular strands. Transcellular strands are aggregates of tubules made up of P protein (Phloem protein). Esau (1971) reported that phloem protein promote movement of materials through the cell.

Function : Sieve tubes are chief elements helping in longitudinal translocation of prepared food materials.

Sieve cells and sieve elements differ from one another in few cases. Firstly sieve cells are having the sieve areas distributed throughout the cells and do not possess sieve plated in the end walls unlike sieve tube elements. Also the sieve pores are comparatively smaller in sieve cells. Sieve tube elements remain associated with companion cell, which is originating from the same mother cell whereas sieve cell remain associated with albuminous cell which originates from a different mother cell.

2. Companion cell

It is characteristic of angiosperms. It remains associated with the sieve tube elements and are connected through plasmodesmata.

In T. S. cell is usually a small triangular, rounded or rectangular cell present adjacent to sieve tubes. These have granular cytoplasm with large number of ribosomes and mitochondria and a prominent elongated nucleus. Starch grains are absent.

Function : Helps in controlling the functioning of sieve tube elements and also provide energy for translocation of food materials in the sieve tubes.

3. Phloem parenchyma

These are parenchyma cells associated with the phloem and are present in primary as well as secondary phloem.

Cells show the presence of dense cytoplasm and a prominent nucleus and are having cellulosic thin cell wall with pits. The parenchyma cell are elongated and oriented like sieve tubes. There are two systems of parenchyma found in secondary phloem, the vertical and horizontal parenchyma. The vertical system is known as phloem parenchyma and horizontal is composed of phloem rays.

These are present in pteridophytes, gymnosperms and dicots, and are not present in monocots and herbaceous stems.

Function : Parenchyma store food materials and other substances like resin, latex, mucilage etc. and the main function is radial conduction.

4. Phloem fibres

Sclerenchyma fibres associated with phloem. These are also called bast fibres, and are mainly found in secondary phloem.

The fibres comprises of dead cells. The cells are much elongated and unbranched with tapering ends. The cell wall is lignified and has narrow lumen and has the presence of simple pits.

Function : Provide mechanical support to the plant as well as protect the phloem tissue.