**Unit 3: Translocation in phloem** **LL (6 lectures)**

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

**Translocation**

Movement of organic and inorganic solutes from one part of plant to another is considered as translocation or transport. These terms are applied generally to the movement of solute in some conducting tissues. In simple words, transport of sugar in sieve tubes is called translocation.

Translocation of organic solutes is essential in higher plants because-

1. In higher palnts, only the green parts can manufacture the food and it must be supplied to other non-green parts for consumption and also for storage.
2. During the germination of seeds, the insoluble reserve food material of the seed is converted into soluble form and is supplied to the growing regions of young seedlings till it has developed its own photosynthetic system i.e. leaves.

Translocation of organic solutes always takes place from the region of higher concentration of soluble from i.e. the supply end (source) to the region of lower concentration of its soluble form i.e. the consumption end (sink).

**Directions of translocations**

Translocation of organic solutes may takes place in the following directions-

1. **Downward translocation**

Mostly organic food materials are manufactured by leaves and is translocated downward in the stem and the roots for consumption and storage.

1. **Upward translocation**

It takes place mainly during germination of seeds, tubers etc. when stored food after being converted into soluble form is supplied to the upper growing parts of the young seedling till it have developed green leaves.

Upward translocation of solutes takes place through stem

1. To buds which resume growth during spring
2. To developing leaves situated closer to its apex
3. To opening flowers and developing fruits which are situated near the ends of the branches
4. **Radial translocation**

It takes place in plants from the cells of the pith to cortex.

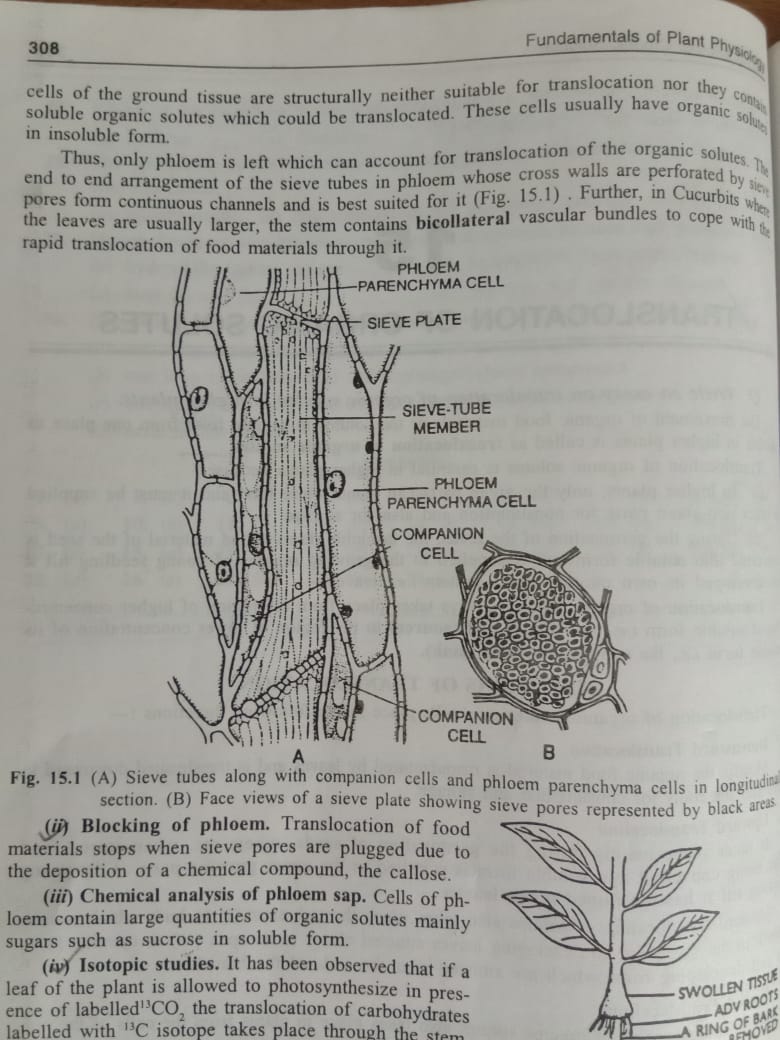
**Path of translocation of organic solutes**

1. **Path of downward translocation**

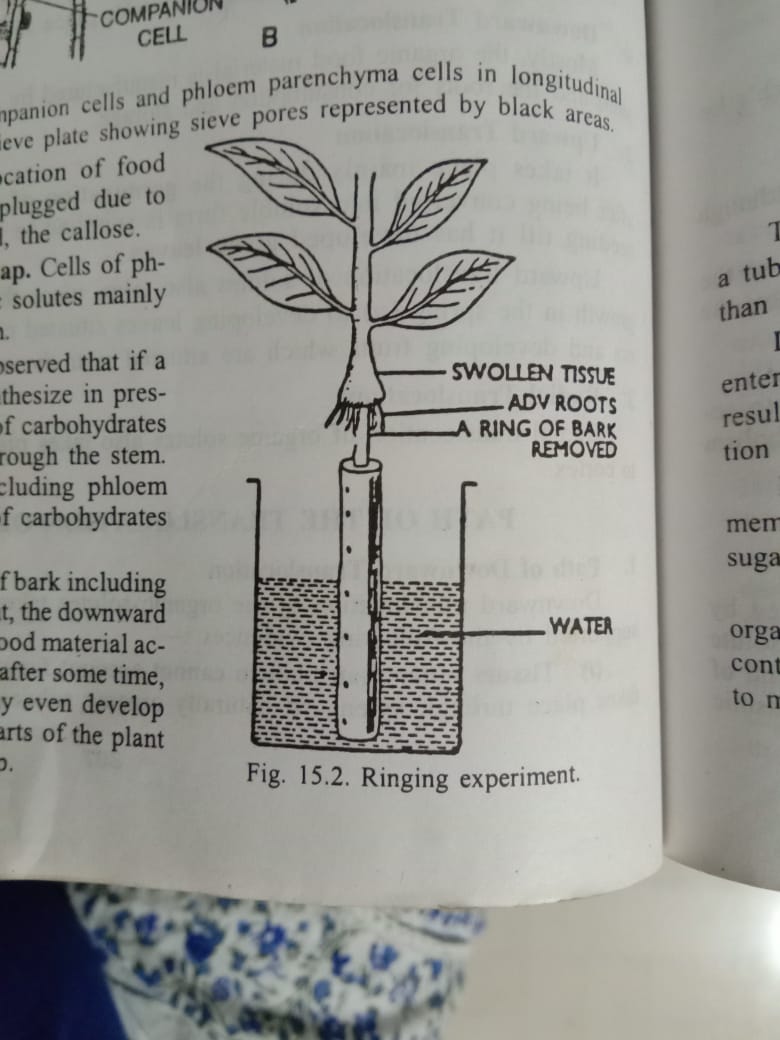
Downward translocation of organic solutes takes place through phloem. This view is supported by following evidences-

1. **Tissues other than phloem cannot account for downward translocation**. Ascent of sap takes place through xylem, so naturally organic solutes are not translocated through it. The cells of ground tissue are structurally neither suitable for translocation nor they contain soluble organic solutes which could be translocated. These cells usually have organic solutes in insoluble form.

Thus, only phloem is left which can account for translocation of the organic solutes. The end to end arrangement of the sieve tubes in phloem whose cross walls are perforated by sieve pores form continuous channels and is best suited for it. Further, in Cucurbits where the leaves are usually larger, the stem contains **bicollateral** vascular bundles to cope with the rapid translocation of food materials through it.



1. **Blocking of phloem** – Translocation of food materials stops when sieve pores are plugged due to deposition of a chemical compound, the callose.
2. **Chemical analysis of phloem sap** – Cells of phloem contain large quantities of organic solutes mainly sugars such as sucrose in soluble form.
3. **Isotopic studies** – It has been observed that if a leaf of the plant is allowed to photosynthesize in presence of labelled 12CO2 the translocation of carbohydrates labelled 13C isotope takes place through the stem. But, if some segments of the stem including phloem were killed by hot wax, no movement of carbohydrates could be detected.
4. **Ringing experiment** – If a ring of bark including phloem is removed from the stem of a plant, the downward translocation of food material accumulates just above the ring. As a result after some time, the tissue above the ring swells and may even develop adventitious roots while the lower parts of the plant below the ringed portion gradually dry up.



1. **Path of upward translocations**-

There has been controversy regarding the path of upward translocation of organic solutes in plants. Although translocation of organic solutes takes place through phloem, but under certain conditions it may take place through xylem.

1. **Path of radial translocation** –

Radial translocation of organic solutes from pith to cortex takes place medullary rays.