# Phloem Loading and Unloading in Plants

The below mentioned article provides an useful note on the phloem loading and unloading in plants.

Translocation of organic solutes such as sucrose (i.e., photosynthetic) takes place through sieve tube elements of phloem from supply end (or source) to consumption end (or sink). But, before this translocation of sugars could proceed, the soluble sugars must be transferred from mesophyll cells to sieve tube elements of the respective leaves.

This transfer of sugars (photosynthetic) from mesophyll cells to sieve tube elements in the leaf is called as phloem loading. On the other hand, the transfer of sugars (photosynthetic) from sieve tube elements to the receiver cells of consumption end (i.e., sink or-gans) is called as phloem unloading. Both are energy requiring processes.

Phloem Loading:

As a result of photosynthesis, the sugars such as sucrose produced in mesophyll cells move to the sieve tubes of smallest veins of the leaf either directly or through only 2-3 cells depending upon the leaf anatomy. Consequently, the concentration of sugars increases in sieve tubes in comparison to the surrounding mesophyll cells.

The movement of sugars from mesophyll cells to sieve tubes of phloem may occur either through symplast (i.e., cell to cell through plasmodesmata, remaining in the cytoplasm) or the sugars may enter the apoplast (i.e., cell walls outside the protoplasts) at some point en route to phloem sieve tubes.

In the latter case, the sugars are actively loaded from apoplast to sieve tubes by an energy driven transport located in the plasma membrane of these cells. The mechanism of phloem loading in such case has been called as sucrose-H+ symport or cotransport mechanism.

According to this mechanism (Fig. 15.5 ) protons (H+) are pumped out through the plasma membrane using the energy from ATP and an ATPase carrier en-zyme, so that concentration of H+ becomes higher outside (in the apoplast) than inside the cell. Spontaneous tendency toward equilibrium causes protons to diffuse back into the cyto-plasm through plasma membrane coupled with transport of sucrose from apoplast to cyto-plasm through sucrose -H+ symporter located in the plasma membrane.

The mechanism of the transfer of sugars (sucrose) from mesophyll cells to apoplast is however, not known.

Phloem loading is specific and selective for transport sugars. Both symplastic and apoplastic pathways of phloem loading are used in plants but in different species. In some species however, phloem loading may occur through both the path-ways in the same sieve tube element or in different sieve tube elements of the same vein or in sieve tubes in veins of different sizes.

Experimental findings have revealed certain patterns in apoplastic and symplastic load-ing of sugars in phloem (Table 15.1), which appears to be related with the type of sugar transported to phloem, type of companion cells (ordinary, transfer or intermediary) and num-ber of plasmodesmata (few or abundant ) connecting the sieve tubes (including the com-panion cells) to surrounding cells in smaller veins.

To some extent, phloem loading is also correlated with the family of plant, its habit (trees, shrubs, vines or herbs) and climate such as temperate, tropical or arid climate.

Phloem Unloading:

It occurs in the consumption end or sinks organs (such as developing roots, tubers, reproductive structures etc.)

Sugars move from sieve tubes to receiver cells in the sink in-volving following steps:

(i) Sieve element unloading:

In this process, sugars (imported from the source) leave sieve elements of sink tissues.

(ii) Short distance transport:

The sugars are now transported to cells in sink by a short distance pathway which has also been called as post-sieve element transport.

(iii) Storage and metabolism:

Finally, sugars are stored or metabolized in the cells of the sink.

As with the phloem loading process, sucrose unloading also occurs through symplat.