Study on Salinity Tolerance in a Seagrass (*Zostera marina*)

Toshiyuki FUKUHARA (Tokyo University of Agriculture and Technology)
Shingo TAKAGI (Osaka University)
Yoshinari OHWAKI (National Agriculture Research Center)
JunYong PAK (Korea University)

Summary

The majority of higher plants are sensitive to a high-salt environment. However, a few species of monocotyledonous angiosperms, namely, seagrasses, have acquired salt-tolerance mechanisms that allow them to thrive in seawater. Ability to thrive in seawater is one of the most prominent examples of adaptation in higher plants. Such adaptation must be accompanied by morphological and physiological changes in seagrass plants, and these changes must be genetically regulated.

The epidermal cells of mature leaves of a seagrass (*Zostera marina*) change morphologically and physiologically in response to salinity; cells isolated from immature-leaf tissues are sensitive to salinity, while mature leaf cells with the morphological characteristics of transfer cells are resistant to salinity. It is generally accepted that transfer cells are highly active in transporting various ions and nutrients and the invaginated plasma membranes of typical transfer cells are associated with high levels of ATPase activity. Plasma membrane H^+-ATPases are responsible for creating an electrochemical proton gradient (proton-motive force) which is used for the transport of ions and nutrients that is mediated by specific carriers and channels (secondary transport). The high degree of invagination of the plasma membrane of transfer cells increases the surface area of the membrane and the number of these H^+-ATPases, carriers and channels.

We characterized biochemical properties of the plasma membrane fraction from a seagrass (*Z. marina*) to compare with those from a freshwater grass (*Vallisneria gigantea*) and a land plant (rice, *Oryza sativa*). Amounts of the H^+-ATPase protein in the plasma membrane fraction of these three plants that were detected by a polyclonal antibody against the rice H^+-ATPase protein were similar. The proton pumping activity in the plasma membrane fraction of the seagrass was confirmed by quenching of acridine orange absorbance. The ATPase activity in the plasma membrane fraction from the seagrass was resistant to high-salt buffer, but the ATPase activities in those from the freshwater-grass and rice were sensitive. Therefore, the differentiation of the transfer cell-like structures, accompanied by the salt-resistant plasma membrane ATPase activity, in the epidermal cells of mature leaves may be important for the excretion of various ions by these cells. These specifically differentiated epidermal cells may play a crucial role in the survival of the seagrass in seawater.