1. ABSTRACT

One important feature distinguishing plants from other complex multicellular organisms is that plants are sessile and thus environmental stresses such as drought, high salinity and temperature extremes pose danger for many of them and cause significant crop losses. Many of the environmental stresses cause osmotic stress. Upon exposure to this stress, plants exhibit a wide range of responses at the molecular, cellular and whole-plant levels. These include, for example, morphological and developmental changes (e.g. life cycle changes, shoot growth inhibition etc.), adjustment in ion transport and metabolic changes, e.g. in carbon metabolism, and synthesis of compatible solutes. These metabolites include nitrogen-containing compounds (e.g. proline, other amino acids) and polyhydroxyl compounds (sucrose, sugar alcohols, cyclitols and oligosaccharides) with potential to protect proteins, membranes and metabolic machinery against damage. One of the most important compounds is sucrose, which is transported by plants for a long distance and accumulated under stress conditions. Sucrose is ubiquitous in the plant kingdom. The ability of sucrose to protect membranes and macromolecules is well documented. Certain plants produce beside sucrose also other important carbohydrates which are involved in stress protection - sugar alcohols or raffinose family oligosaccharides (RFO). Contribution of the particular saccharides in stress response and their cooperation or protection specificity under stress in plants with high diversity of photosynthetic products, however, is still far from being elucidated. The present study is focused on stress response in plants producing beside sucrose also sugar alcohol mannitol (*Apium graveolens*) or mannitol along with RFO (*Olea europaea*). In vitro cultivation of tissue cultures derived from celery or plants derived from apical or nodal segment in olive was used as an experimental system. It enables to apply exogenous carbohydrates, thus disconnect the stress response at the level of carbohydrate accumulation and other stress affected physiological processes (mainly photosynthesis) changing plant carbohydrate status. Using this technique we found that mannitol is accumulated in celery under osmotic stress probably as the result of strict down regulation of its degradation. The olive amasses mannitol under osmotic stress as well, but the down regulation of its degradation is lesser as mannitol is partly used as C and energy source even under severe stress. Accumulation of RFO in olive proved to be specific to low temperature stress. The results obtained with in vitro cultivated plants were compared to those gained using tissue cultures. The possibility to make use of organised and unorganised in vitro plant cultures for abiotic stress response evaluation is discussed. The tissue cultures were derived from lamina and petiole of celery and the influence of the type of primary explant to stress response was studied.