Abstract

Abiotic stress factors, primarily those which disturb plant water balance, cause extensive crop losses. With regard to sessile lifestyle, many mechanisms how to cope with these unfavourable conditions were developed during evolution of plants. As common impact of many of these stresses like drought, salinity or low temperatures is of osmotic nature, the osmotic adjustment represents important part of plant stress response. Mostly, this component of stress reaction is provided by organic compounds, which are referred to as compatible solutes, including polyhydroxyl compounds (sucrose, sugar alcohols, cyclitols, and oligosacharides) and nitrogen-containing compounds (mainly proline). The effect of these solutes is not only osmotic, but also osmoprotective as they are able to preserve integrity of membranes and macromolecules by mimicking their water envelope. The compatible solutes also contribute to quenching of reactive oxygen species overproduced under these stress conditions. This study is focused on apple (*Malus domestica*) producing, beside sucrose, sugar alcohol sorbitol as primary photosynthetic product and transporting these carbohydrates along with raffinose family oligosaccharides (RFO) for a long distance. In vitro tissue cultures derived from leaves of two apple cultivars differing in stress sensitivity (cv. Šampion Red and cv. Idared) were used to investigate possible connection between differences in stress tolerance and particular soluble carbohydrate accumulation. Salinity caused an increase of total soluble carbohydrate content in more tolerant cv. Šampion Red, whilst the same stress cause opposite reaction in less tolerant cv. Idared. For the observed increase of soluble carbohydrates in this case hexoses were preferentially responsible. More severe growth inhibition of cv. Idared under this treatment was observed as well. Osmotic stress induced by nonpermeable osmoticum - PEG - caused the decrease of soluble carbohydrate content in contrast with the case of permeable osmoticum - mannitol, where the increase of soluble carbohydrate content was observed, although accumulation of the osmoticum itself was mainly responsible for this change. Interestingly, significant accumulation of sorbitol was not observed under any stress treatment in both cultivars. The content of raffinose, in raffinose-supported cultures, increased substantially under low temperature treatment in both cultivars indicating a role of these oligosaccharides in response to this specific stress. The results proved the value of the use of plant tissue cultures in the studies of stress response as it enables to distinguish the stress responses at the cell level from those requiring organ or whole plant organisation.