Salt stress effects on growth, pigments, proteins and lipid peroxidation in *Salicornia persica* and *S. europaea*

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Abstract

The effects of NaCl stress on growth, water status, contents of protein, proline, malondialdehyde (MDA), various sugars and photosynthetic pigments were investigated in seedlings of *Salicornia persica* and *S. europaea* grown *in vitro*. Seeds were germinated under NaCl (0, 100, 200, 300, 400, 500 and 600 mM) on Murashige and Skoog medium for 45 d. The shoot growth of both species increased under low NaCl concentration (100 mM) and then decreased with increasing NaCl concentrations. In contrast to *S. persica*, root length in *S. europaea* reduced steadily with an increase in salinity. Proline content in *S. persica* was higher than in *S. europaea* at most NaCl concentrations. Proline, reducing saccharide, oligosaccharide and soluble saccharide contents increased under salinity in both species. In contrast, contents of proteins and polysaccharides reduced in both species under salt stress. MDA content remained close to control at moderate NaCl concentrations (100 and 200 mM) and increased at higher salinities. MDA content in *S. europaea* was significantly higher than *S. persica* at higher salinities. Salt treatments decreased K^+ and P contents in seedlings of both species. Significant reduction in contents of chlorophylls and carotenoids due to NaCl stress was also observed in seedlings of both species. Some differences appeared between *S. persica* and *S. europaea* concerning proteins profile. On the basis of the data obtained, *S. persica* is more salt-tolerant than *S. europaea*.

Additional key words: halophyte, *in vitro* culture, free proline, MDA, photosynthetic pigment, RWC, salinity, saccharides.

Introduction

Halophytes are known for their ability to adapt to salinity by altering their energy metabolism (Winicov and Bastola 1997). These plants provide viable organisms for studying the mechanisms they use to handle high salt concentrations (Moghaieb *et al.* 2004). The elucidation of physiological and biochemical mechanisms are critical before trying to introduce genetic and environmental improvements to salt stress (Meloni *et al*. 2003). Salinity affects numerous physiological or biochemical processes, many of which are seen at the cellular level. *In vitro* culture techniques provide controlled, uniform environments to study the salt-stress response of seedlings and undifferentiated callus, thus eliminating complications arising from genetic and morphological variability associated with tissues of whole and mature plants even within the same species (McCoy 1987, Niknam *et al.* 2006). Adaptation of halophytes to salinity is associated with osmotic adjustment that leads to the accumulation of several organic solutes, such as free proline and sugars (Bohnert *et al*. 1995). Plants that are subjected to environmental stress often suffer oxidative damage (Scandalios 1993). Plants protect cells and subcellular systems from the effects of reactive oxygen species (ROS) by enzymes such as superoxide dismutase, catalase, peroxidase, glutathione reductase, polyphenol oxidase and non-enzymic antioxidants such as ascorbate and glutathione (Agarwal and Pandey 2004). Malondialdehyde (MDA) content, a product of lipid peroxidation, has been considered as an indicator of oxidative damage. Thus cell membrane stability has widely been utilized to differentiated sat-tolerant and salt-sensitive plants (Shalata *et al*. 2001, Hernandez and Almansa 2002,

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Abbreviations: Car - carotenoid; Chl - chlorophyll; MDA - malondialdehyde; MS medium - Murashige and Skoog medium; RWC - relative water content; WC - water content.
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