Lisianthus response to salinity stress

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Abstract

The effect of salinity on some morpho-physiological characteristics in lisianthus cultivars was investigated. Cultivars namely, Blue Picotee (C_1), Champagne (C_2), Lime Green (C_3), and Pure White (C_4), were subjected to salt stress (0–60 mM NaCl) in a sand culture and their responses were measured. Our results showed that as a salinity level increased, growth parameters, relative water content, photosynthetic pigments, and gas-exchange characteristics decreased in all cultivars, while root fresh mass, root/shoot length ratio, electrolyte leakage, and a malondialdehyde content increased. However, the changes were less pronounced in C_3 and C_4 compared to C_1 and C_2. The regression analysis of the relationship between salinity levels and seedling height or root/shoot length ratio defined two groups with different slope coefficients: C_1 and C_2 as salt-sensitive cultivars and C_3 and C_4 as salt-tolerant cultivars. Shoot dry mass and leaf area tolerance indices were less affected by salinity in C_3 and C_4 compared to those in C_1 and C_2. Further, C_3 and C_4 showed higher photosynthetic rates, greater stomatal conductances, and accumulated greater K^+ and Ca^{2+} contents and K^+/Na^+ ratios in roots and shoots compared to those in C_1 and C_2. The results suggests that C_3 and C_4 could be recommended as resistant cultivars due to maintaining higher growth, water balance, leaf gas exchange, ion compartmentalization, and lower lipid peroxidation in response to salinity compared to C_1 and C_2.

Additional key words: cultivar; gas exchange; NaCl-salinity; tolerance index.

Introduction

Currently, one third of all irrigated lands is affected by salinity worldwide and salinity stress remains one of the most serious environmental problems limiting crop production (Munns 2005, Turhan and Şeniz 2010). Irrigation with saline water introduces salt into the soil, resulting in a decrease of osmotic potential in root environment, thus making it difficult for roots to extract water from soils (Rengasamy 2006). Plant growth and productivity decline with increasing salinity due to interruption of certain morphological and physiological processes and certain types of ionic toxicity and nutritional imbalances (Morales *et al.* 1998, Valdez-Aguilar *et al.* 2014). Also, salinity reduces plant quality and marketability, and represents a significant challenge to ornamental horticultural production systems.

There are several strategies to cope with salinity problem in plant production, including improvements of irrigation methods, such as drip and subsurface irrigation system, reclamation of salinized lands, and other special horticultural techniques. However, these techniques are expensive, difficult to apply, and take a very long time to have an effect (Turhan and Şeniz 2010). While improvement of soil and water management can help to solve the problem, obtaining salt-tolerant cultivars is one of the most effective strategies to cope with salinity (Flowers and Yeo 1995, Essa 2002, Ruiz-Carrasco *et al.* 2011). Therefore screening salt tolerance in plants, particularly for landscaping projects and cut flowers production, is crucial for recommendations of suitable plants (Navarro *et al.* 2008). A number of studies have been conducted to investigate the degree of salt tolerance and the associated mechanisms in different crops, such as sunflower (Akram *et al.* 2009, Shahbaz *et al.* 2011), olive (Chartzoulakis *et al.* 2002), and ornamental shrubs (Cassaniti *et al.* 2009).

Lisianthus (*Eustoma grandiflorum*), native to the arid zones of the southern United States and northern Mexico, (Gómez-Pérez *et al.* 2014), is an ornamental plant of increasing demand. Lisianthus has become a consumer favorite in the cut flower market because of its exceptional

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Abbreviations: C_1 – Blue Picotee; C_2 – Champagne; C_3 – Lime Green; C_4 – Pure White; Chl – chlorophyll; DM – dry mass; EL – electrolyte leakage; E – transpiration rate; FM – fresh mass; g_s – stomatal conductance; LA – leaf area; MDA – malondialdehyde; P_N – net photosynthetic rate; RWC – relative water content; TI – tolerance index.