Physiological Changes and Osmoregulation in Several Romanian Spruce Populations Exposed to Salt and Drought Stress

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Bulletin UASVM Horticulture 71(2) / 2014
Print ISSN 1843-5254, Electronic ISSN 1843-5394
DOI:10.15835/buasvmcn-hort:10616

Abstract . Due to global warming and anthropogenic activities, drought and salinity are becoming two of the major abiotic stresses affecting coniferous forests in Romania. Seedlings from several Romanian populations of *Picea abies* were subjected to drought and salt stress treatments and the responses of each of them were analysed in terms of changes in dry mass percentages and proline levels. The highest fluctuations were recorded in the population from Valea Mare and the lowest in those from Sudrigiu and Gioriştea-Călimănuţ.

Keywords: *conifers, drought, P. abies, salt stress.*

Introduction. Norway spruce (*Picea abies* (L.) Karst.) is the commonest coniferous species in Romania, covering approximately 1.43 million hectares (Şofletea and Curtu, 2001). Salinity and drought are considered to be the most important limiting factors in the plants' biological cycle, hindering seed germination, and reducing vegetative growth and reproductive success. The species is known for its sensitivity to soil water supply and salt stress, like the majority of conifers (Karlsson *et al.*, 1997). Furthermore, in the next decades the climate change will likely cause drought periods in Europe's forested areas (Ježík *et al.*, 2014). Yet no comparative studies on stress responses have been carried out on different populations, which could be adapted to distinct environmental conditions.

Aims and objectives. The aim of this study was to analyse the physiological and biochemical responses of several Romanian spruce populations to drought and salt stress on one-year-old seedlings, to obtain preliminary data for spruce reforestation in areas potentially affected by these abiotic stresses.

Materials and methods. Seedlings from seven Romanian populations of Norway spruce were grown on peat substrate. One-year-old seedlings were treated with increasing salt concentrations (control, 75 mM, 150 mM and 300 mM NaCl) or subjected to drought stress (no watering at all), under controlled conditions in the greenhouse; watering was performed twice a week using approximately 1.5 l of distilled water (control) supplemented with NaCl (salt treatments). After 6-week treatments, the seedlings were harvested for dry mass and proline measurements. The statistical analysis was carried out using the Statgraphics Centurion XVI programme.

Results and Discussion. Drought and salt treatments caused an increase in relative dry weight (that is, a decrease in water content in plant tissues) in all the studied populations. However, the differences were not homogenous. In water stress treatments, the smallest increase was recorded in the populations Gioriştea-Călimănuţ and Sudrigiu, while after salt treatments the population from Valea Mare showed the largest increase in dry mass (Fig. 1).

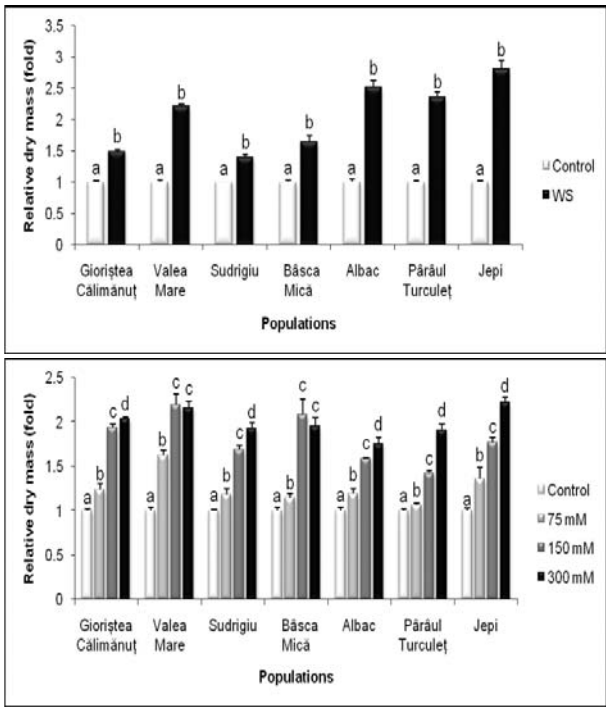

Fig. 1. Relative dry mass (fold) after water stress (left) and salt stress (right) treatments

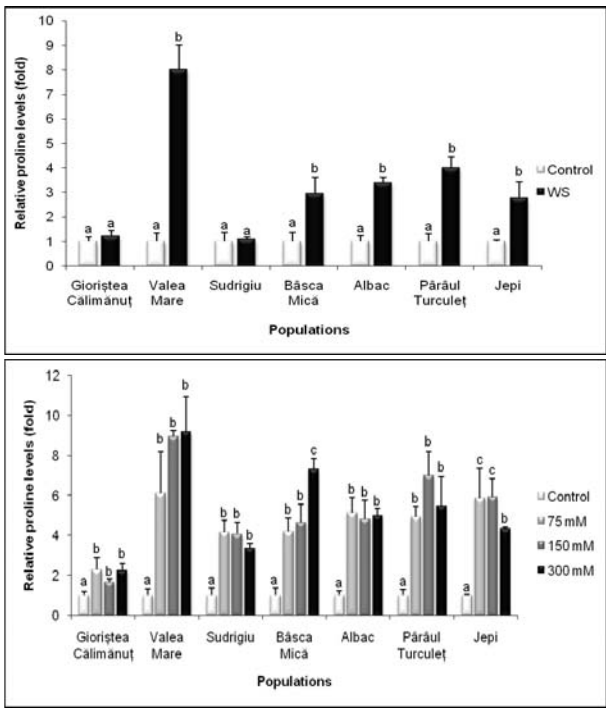

Fig. 2. Relative proline levels (fold) after water stress (left) and salt stress (right) treatments

Proline levels increased with stress; the largest differences to the controls were recorded in the population Valea Mare, while the smallest ones were found in populations Gioriştea-Călimănuţ and Sudrigiu (Fig. 2), which corresponded to the dry weight variation patterns.

Conclusion. This study indicates that in re-forestation programmes some provenances can substitute others more affected by drought and salt stress, to minimize the negative effects of water deficit in summer and salt spraying in winter on the spruce shelterbelts located nearby mountain roads.

Acknowledgements. This paper was published under the frame of European Social Found, Human Resources Development Operational Programme 2007-2013, project no. POSDRU/159/1.5/S/132765.

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