



Abstract

Exogenous antioxidant applications enable salt-stressed plants to successfully cope with different environmental stresses. The objectives of this investigation were to study the effects of sequential treatments of proline (Pro), ascorbic acid (AsA), and/or glutathione (GSH) on 100 mM NaCl-stressed cucumber transplant's physio-biochemical and growth traits as well as systems of antioxidant defense. Under salinity stress, different treatment of AsA, Pro, or/and GSH improved growth characteristics, stomatal conductance (gs), enhanced the activities of glutathione reductase (GR), superoxide dismutase (SOD), ascorbate peroxidase (APX), and catalase (CAT) as well as increased contents of AsA, Pro, and GSH. However, sequential application of antioxidants (GSH-Pro-AsA) significantly exceeded all individual applications, reducing leaf and root Cd^{2+} and Na^+ contents in comparison to the control. In plants grown under NaCl-salt stress, growth characteristics, photosynthetic efficiency, membrane stability index (MSI), relative water content (RWC), contents of root and leaf K^+ and Ca^{2+} , and ratios of K^+/Na^+ and Ca^{2+}/Na^+ were notably reduced, while leaf contents of non-enzymatic and enzymatic antioxidants, as well as root and leaf Cd^{2+} and Na^+ concentrations were remarkably increased. However, AsA, Pro, or/and GSH treatments significantly improved all investigated growth characteristics, photosynthetic efficiency, RWC and MSI, as well as AsA, Pro, and GSH, and enzymatic activity, leaf and root K^+ and Ca^{2+} contents and their ratios to Na^+ , while significantly reduced leaf and root Cd^{2+} and Na^+ contents.