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Up-regulation of antioxidative defense systems by glycine betaine foliar application in onion plants confer tolerance to salinity stress
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Abstract

Plants face a lot of abiotic stresses, during their life cycle, including salinity that greatly influences their growth and entire metabolism. Osmoprotectants have to enable plant to beat such stress. Two-season field experiments were conducted consecutively in 2015/16 and 2016/17 to study the effect of glycine betaine (GB) foliar application at three levels (0; a control, 25 and 50 mM) on onion growth, physio-biochemical attributes and antioxidant defense system activity was investigated under 4.80 dS m⁻¹ salt stress. Under saline soil conditions, GB treatment significantly increased growth indices (e.g., shoot length, leaves area of plant⁻¹, shoot fresh and dry weights), bulb yields and water use efficiency (WUE), leaf chlorophylls contents and their efficiency, stomatal conductance and tissue health measured as relative water content and membrane stability index. Additionally, endogenous osmoprotectants (e.g., GB and choline) contents, non-enzymatic antioxidants (e.g., glutathione and ascorbic acid) contents and enzymatic antioxidants (e.g., catalase, superoxide dismutase, and ascorbate peroxidase) were significantly increased with exogenous GB application under salt stress. In contrast, glutathione reductase activity was reduced, while free proline and soluble sugars contents were not affected. A level of 50 mM GB was more effective to be the better treatment by which this study recommends to use for growing onion plants under moderate salt stress.