



Fourth Article (Shared with other inside the specialization – Published in international Journal).

Exogenously applied proline enhances growth and productivity of drought stressed onion by improving photosynthetic efficiency, water use efficiency and up-regulating smoprotectants
Scientia Horticulturae. 2020, 272, 109580

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Article status

Shared with other inside the specialization – Published in international Journal

Impact Factor: 2.769

Abstract

Drought and salinity are the main limiting factors negatively affect plant growth and productivity. Proline is recently reported to play a positive role in plants exposed to various abiotic stresses. A two year field experiment was implemented consecutively to assess the potential effect of exogenously applied proline (1 and 2 mM) under different irrigation water regimes (IWR) (120 %, 100 %, 80 % and 60 % of ET_c) on growth, plant defense system, physio-biochemical attributes, bulb yield and water use efficiency of onion cultivated in saline calcareous soil. Results showed that, exogenously-applied proline significantly enhanced growth as well as, plant water status, photosynthetic efficiency, and osmoprotectants of drought-stressed onion which consequently reflected in increased bulb yield. Treatments of 80 % and 60 % of ET_c had increased water use efficiency (WUE) by 32.0% and 26.5 % respectively, compared to full irrigation (100 % of ET_c). The effect of proline was negligible on unstressed plants, but when applied under deficit irrigation (DI) treatments (80 and 60 % of ET_c), WUE reached % 20 higher than control. These plants also had a higher content of total soluble sugars but a lower content of proline and amino acids. Exogenous proline application markedly enhanced onion growth traits compared to non-treated plants due to increased cell membrane integrity (MSI) and leaf water content (RWC), also improved photosynthetic efficiency and up-regulated osmoprotectants contents. Results revealed that proline foliar application on onion plants might attenuate drought stress by increasing their sugar content and via improving plant self-defense system. Consequently, combination of DI at 80 % and 1–2 mM proline is highly recommended to attain optimal yield with the opportunity of saving 20–40 % of irrigation water during onion growing season.