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The Multiple Effects of Salinity and Drought Stresses on Physiological Parameters and Transpiration Rate of Quinoa

Fatemeh Razzaghi[1], Seyed Hamid Ahmadi[2], Verena Isabelle Adolf[3], Christian R. Jensen[3], Sven-Erik Jacobsen[3], Mathias N. Andersen[1]

[1] *Aarhus University, Department of Agroecology and Environment, Denmark*
[2] *University of Copenhagen, Department of Basic Sciences and Environment, Denmark*
[3] *University of Copenhagen, Department of Agricultural Sciences, Denmark*

Abstract

Lack of precipitation, high rate of evapotranspiration and un-sustainable use of water resources cause drought and salinity problems in agriculture in semi-arid and arid regions. Therefore, introducing crops, which could cope with such environmental situations, is essential. Quinoa is a facultative halophyte, which is known to tolerate abiotic stresses (such as drought and salinity). Greenhouse experiment was conducted to study the response of physiological parameters of quinoa (cv. Titicaca or Q 52) under the combination of full irrigation (FI) and progressive drought (PD) coupled with five irrigation salinity levels (0, 10, 20, 30 and 40 dS m^{-1}). Stomatal conductance (gs), photosynthesis (An), leaf water potential (LWP), and soil water potential (ΨT) were measured during the drought period. The result showed that the gs and An decreased by increasing the salt levels in FI0–5 plants and under the combined effect of drought and salinity (PD0–5). The minimum gs value was found in the droughted plants under lowest (PD0) and highest (PD40) salinity levels. However, the lowest values of An and LWP were observed in FI40. Total soil water potential decreased due to reduction in both soil water osmotic and matric potential. Reduction in total soil water potential caused the transpiration rate to decrease. The study indicated that salt accumulation at the root surfaces and lack of contact between root and soil solution due to reduction in soil water content in drought treatments contributed to the observed increase in the apparent resistance of the soil-root pathway for water transport and thereby decreased the leaf water potential, shoot ABA and transpiration.

Keywords: Drought stress, photosynthesis rate, Quinoa, salinity stress, stomatal conductance, transpiration rate

Contact Address: Fatemeh Razzaghi, Aarhus University, Department of Agroecology and Environment, Blichers Alle 20- P.O.Box 20, 8830 Tjele, Denmark, e-mail: razzaghi.f@gmail.com