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Response of photosynthesis, water relations and root growth of two tomato varieties (Lycopersion esculentum Mill.) to irrigation water salinity under arid conditions

Maik Veste[1,2], Siegmar W.-Breckle[2] and Alon Ben-Gal[3]

[1]CEBra – Centre for Energy Technology Brandenburg e.V., Friedlieb-Runge-Straße 3, 03046 Cottbus, Germany.
[2]University of Bielefeld, Wasserfuhr 24/25, 33501 Bielefeld, Germany.
[3]Agricultural Research Organization (ARO), Gilat Research Center, Gilat, Israel.
E-mail: maik.veste@me.com

In several arid and semi-arid regions vegetable production is attractive option but dependent upon the availability of large amounts of irrigation water. The Arava Valley in southern Israel is a typical area where vegetable production has increased steadily in recent years. Unfortunately, water resources in the Arava and other arid regions are limited and the salinity of available irrigation water tends to be high. Furthermore, high solar radiation and low air humidity are additional stress factors for plant growth. Tomatoes have been defined as moderately sensitive to soil water salinity.

The effects of salinity and water quantity were investigated for two tomato varieties (5656 and Daniela) in lysimeter and field experiments. Irrigation water was applied by a drip irrigation system. Salinity levels increased from 1 to 11 mS/cm. The irrigation amounts varied between 210 litres (30%) and 760 litres (130%) per plant and growing season. Pre-dawn leaf water potential was measured with a Scholander pressure probe. Maximum stomata opening were measured with a portable porometer CO_2/H_2O system. Diurnal CO_2 gas exchange was determined parallel with the transpiration. Chlorophyll fluorescence was used to determine the effects of salinity and temperature stress on the photosynthesis systems. Increasing salinity effects stomata opening and limits CO_2 uptake and photosynthesis by 40%. Irrigation amounts affecting the leaf gas exchange only at extreme drought stress at 30% relative irrigation. Stomata opening is regulated by the water uptake and therefore a relation between pre-dawn water and leaf conductance could be found. Furthermore, root growth was effected by soil salinity.