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Evaluating AquaCrop for simulating response of tomato to irrigation induced salinity

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AquaCrop is considered a reliable simulation model to predict crop yield. AquaCrop is supported by the FAO and seems to provide reasonable balance between accuracy and simplicity. While AquaCrop handles crop response to conditions of salinity, there have been few studies evaluating its accuracy to this parameter. We evaluated AquaCrop for its ability to simulate crop growth, transpiration and yield under conditions of irrigation-induced salinity using an experimental database of tomato grown during different meteorological conditions and demands under highly varied conditions of irrigation water salinity and irrigation amounts.

Field and lysimeter experiments were carried out in the Southern Arava Valley in Israel in fall and spring seasons. Tomato (Lycopersicon esculentum Mill. cultivar '5656') was grown. Irrigation in the field was managed with treatments of 30, 60, 100, and 130% of reference evapotranspiration (ET_0) of Class A pan with irrigation water salinity (EC_I = electrical conductivity of irrigation water) of 3 dS m^{-1}. Irrigation treatments in the lysimeters were six EC_I levels from 1 to 11 dS m^{-1} all at 130% of ET_0 and five irrigation levels of 30, 60, 100, 130 and 160 % of ET_0 all at EC_I of 3 dS m^{-1}. EC_I was regulated adding 1:1 Molar concentrations NaCl and $CaCl_2$. Irrigation was applied via drippers from soil surface covered with polyethylene mulch to reduce evaporative losses to a minimum. AquaCrop was run to calculate yield and transpiration in fall and spring. The datasets of meteorological, crop, management, and soil data were obtained from field-measured results.

Predicted biomass at the end of both growing periods agreed relatively well with measured biomass. Patterns of accumulated transpiration were different in the two seasons, with gradual increase to a stable maximum in the fall and continued increase in the spring. Irrigation level and salinity were found to effect biomass, transpiration and yield alternatively, with irrigation dominant at low EC_I levels and salinity dominant when irrigation application was relatively high. Transpiration was simulated well, showing similar trends of the measured data in lysimeters in both fall and spring. The biomass in fall and spring was predicted relatively well. Following these results, AquaCrop appears applicable for simulation of salinity effects on yield and transpiration, at least under conditions similar to those of the current study.