



Temporal impact of treated wastewater irrigation on field hydraulic conductivity

Lin Wang¹, Tim De Cuypere², Sabien Pollet², Sarah Garré³, and Wim Corneils¹

¹Department of Environment – UNESCO Chair on Eremology, Ghent University, Ghent, Belgium (lin.wang@ugent.be)

²Department of Outdoor Horticulture and Precision Agriculture, Research and Advice Centre for Agriculture and Horticulture (Inagro vzw), Beitem, Belgium

³Flanders Research Institute for Agriculture, Fisheries and Food (ILVO), Melle, Belgium

Hydraulic properties of agricultural soils exhibit dynamic temporal variations influenced by field management practices, such as tillage and irrigation, as well as climatic factors, particularly changes in precipitation and temperature. With the emergence of using treated wastewater (TWW) in irrigation as a solution to alleviate increased pressure on available water resources, but characterized by elevated salt and solute concentrations, understanding its potential impact on soil hydraulic properties is crucial. In this study, we aimed to discern the influences of field management practices and irrigation water sources on the temporal variability of soil hydraulic conductivity.

Mini disk infiltrometers were employed to assess near-saturated hydraulic conductivity K_h and associated soil indicators (including soil's electrical conductivity EC_e , sodium adsorption ratio SAR, water repellency WR, bulk density BD, aggregate stability AS, and air permeability Ka) in the top 20 cm of a Retisol soil in Beitem (50°91'N, 3°12'E), Belgium. A comparative analysis was conducted to evaluate the effects of irrigation using treated wastewater (from households, from vegetable industry and from potato industry) and rainwater, relative to those under rainwater irrigation conditions. All treatments significantly affected EC_e and SAR. Across four replicated plots per treatment, K_h was measured at distinct matric potentials on various dates, spanning a wet (2021) and a dry (2022) year, during a crop rotation of cauliflower (*Brassica oleracea* L.) and spinach (*Spinacia oleracea* L.). The plots were tilled with a rotary harrow till 30 cm depth to prepare the seedbeds.

Our findings highlighted tillage as the predominant factor influencing K_h . Irrespective of the irrigation type, K_h increased post-tillage and subsequently decreased throughout the growing season. Yearly weather differences also played a significant role, with the dry, warm year resulting in a higher average K_h at each matric potential. Surprisingly, there were no significant differences in K_h between irrigation treatments over two crop cycles.

Despite the elevation of soil salinity (EC_e) and sodicity (SAR) with TWW irrigation, it did not detrimentally impact or other soil attributes (WR, BD, AS, and Ka) in this study. Our results underscore the importance of considering the interplay of tillage, weather conditions, the

timing/frequency of irrigation/rain events, and matric potential when evaluating the effects of different irrigation sources on soil hydraulic properties.