

RECLAIMED MUNICIPAL WASTEWATER USED FOR IRRIGATION OF GREENHOUSE TOMATOES: EFFECTS ON PHYSIOLOGICAL PLANT PERFORMANCE AND FRUIT QUALITY

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i) Problem identified. In the Mediterranean area, agriculture consumes over 80% of water resources, and it is estimated that by 2030 due to the climatic change, the availability of water will be reduced by more than 30%. Faced with this situation, irrigation with reclaimed municipal wastewater is a promising option to reduce pressure on freshwater sources in the Mediterranean semi-arid regions. However, the lack of specific knowledge on crops performance, especially on yield and quality, is one of the cause of rejection by growers to use this alternative water source for irrigation. In the present study we have evaluated water quality parameters considering the current Spanish regulation on the use of reclaimed water for agricultural irrigation. Also, we have compared physiological parameters and mineral content in xylem sap and fruits from tomato plants irrigated with reclaimed municipal wastewater (RW) or fresh local water (FW).

ii) Methodology used. The study was developed in Algarrobo municipality, province of Málaga (Spain). Samples of reclaimed water (RW) were collected weekly from the Bioazul system effluent (technology to regenerate wastewater is specified in RichWater project , FTIPilot-1-2015 GA number 691402, EC, Horizon2020). Fresh local water (FW) was pumped from the dam of La Viñuela, which supplies a large part of the water used by Community of growers of the municipality of Algarrobo. Tomato seedlings (*Solanum lycopersicum*, cv. Eliseo) were grown under natural greenhouse conditions, in 16-L polyethylene pots filled with vermiculite. The nutrient solution for irrigation was prepared considering the nutrient load that contained each type of water. The irrigation solution contained: 5.94 mM N, 1 mM P, 6.6 mM K, , 4.5 mM Ca, 2 mM S y 2 mM Mg, EC=2.93 dSm⁻¹ and pH=6.3) plus a solid mixture of chelated micronutrients (Fe, Zn, Mn, Cu, B and Mo). Mineral contents in the RW, FW, irrigation solution after adding the fertilizers, xylem sap, and tomato juice were determined by an inductively coupled plasma mass spectrometer (ICP-ICAP 6500 DUO Thermo). The physiological performance of plants was evaluated by periodically recording photosynthesis (A, $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) and transpiration (E, $\text{mol H}_2\text{O m}^{-2} \text{ s}^{-1}$) rates with a portable infrared gas analyzer system (LI-6400; LI-COR Inc., Lincoln, NE, USA). Leaf water potential (ψ_w) was measured on the same leaves sampled for A and E, with a water status console (Soil Moisture Equip. model 3000). For the analysis of fruits, 2-3 mature tomatoes were crushed and the pulp obtained was subsequently submitted to 3000 rpm, then samples of the supernatant were stored at -20 °C until analysis.

iii) Main results obtained. Water quality was evaluated taken as reference the Spanish

legislation (RD 1620/2007, Annex II, type of water 2.3). Over time, FW presented constant values of electrical conductivity (EC, 500 $\mu\text{S}/\text{cm}$). Values of EC recorded in the RW were more variable along the time, being maximum values recorded around 2300 $\mu\text{S}/\text{cm}$, which are below 3000 $\mu\text{S}/\text{cm}$ considered by the Spanish legislation as the threshold EC value suitable for irrigation. Overall, RW showed higher content of major nutrients (NO_3^- , PO_4^{3-} , K^+) than FW. Recorded data show no differences in net photosynthesis and transpiration rates, neither in leaf water potential, as result of irrigation with LW or RW. No differences were found in major minerals and heavy metals content of fruits from plants irrigated with LW or RW. Content of heavy metals in the irrigation water and fruits were below the threshold limit stated by the European Food Security Authority.

iv) Most relevant conclusions. Considering data recorded in the present study, it can be concluded that the RW from municipal wastewater treatment plant of Algarrobo municipality should be considered as a secure alternative water-source to cope with water needs for greenhouse tomato production. By other hand, considering that RW contain high contents of essential nutrients for plant growth, the use of this alternative source of water to prepare the nutrient irrigation solutions provide between 30- 50 % of major nutrients requirements, consequently reducing the needs of standard commercial fertilizers and its associated costs.