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Safe and High Quality Food Production using Low Quality Waters and Improved Irrigation Systems and Management (SAFIR)

L. Cary (1), W. Kloppmann (1), A. Battilani (2), M. Bertaki (3), S. Blagojevic (4), K. Chartzoulakis (3), A. Dalsgaard (5), A Forslund (5), Z. Jovanovic (4), I. Kasapakis (3), and the Cary Team

(1) BRGM, Water division, 3 Avenue C. Guillemin - BP 36009, 45060 Orleans, France (l.cary@brgm.fr), (2) Consorzio Emilliano Romagnolo (CER), Via E Masi, 8 - 40137 Bologna, Italy, (3) National Agricultural Research Foundation (NAGREF), Agrokipio, 731 00, Chania, Greece, (4) Faculty of Agriculture, University of Belgrade, 6 Nemanjina Str., 11080 Zemun, Belgrade, Serbia, (5) Royal Veterinary and Agricultural University Department:Department of Veterinary Pathobiology, Grønnegårdsvej 15, Frederksberg C, DK-1870, Denmark, (6) China Agricultural University (CAU), College of Resources and Environment, Haidian District, 100094 Beijing, China, (7) Chinese Academy of Agricultural Sciences (CAAS), South Street Zhong Guan Cun 12, 100081 Beijing, China, (8) Stazione Sperimentale Industria Conserve Alimentari (SSICA), Viale Tanara, 31/a 43100 Parma, Italy

The safe use of treated domestic wastewater for irrigation needs to address the risks for humans (workers, exposed via contact with irrigation water, soil, crops and food, consumers, exposed via ingestion of fresh and processed food), for animals (via ingestion of crops an soil), for the crops and agricultural productivity (via salinity and trace element uptake), for soil (via accumulation or release of pollutants) as well as for surface, groundwaters and the associated ecosystems (via runoff and infiltration, Kass et al., 2005, Bouwer, 2000). A work package in the EU FP5 project SAFIR is dedicated to study the impact of wastewater irrigation on the soil-water-plant-product system. Its monitoring program comprises pathogens and inorganic pollutants, including both geogenic and potentially anthropogenic trace elements in the aim to better understand soil-irrigation water interactions. The SAFIR field study sites are found in China, Italy, Crete, and Serbia.
A performance evaluation of SAFIR-specific treatment technology through the monitoring of waste water and irrigation water quality was made through waste water chemical and microbiological qualities, which were investigated upstream and downstream of the SAFIR specific treatment three times per season.
Irrigation water transits through the uppermost soil decimetres to the crop roots. The latter will become, in the course of the irrigation season, the major sink of percolating water, together with evaporation. The water saving irrigation techniques used in SAFIR are surface and subsurface drip irrigation. The investigation of the solid soil phase concentrates on the root zone as main transit and storage compartment for pollutants and, eventually, pathogens. The initial soil quality was assessed through a sampling campaign before the onset of the first year irrigation; the soil quality has been monitored throughout three years under cultivation of tomatoes or potatoes.
The plot layout for each of the study sites allows comparing different combinations of (1) water quality, including tap water as a reference, (2) irrigation techniques, and (3) irrigation strategies (including full irrigation, partial root drying, RDI). The replication of each of the combinations on three different plots takes into account the local variations of soil properties and allows a proper statistical treatment.
Reactions of the infiltrating water with the soil solid phase are important for the solute cycling, temporary fixation and remobilisation of trace pollutants. The type of reaction (sorption, co-precipitation…) and the reactive mineral phases will also determine the availability of trace elements for the plant and determine the passage towards crops and products. Therefore it is important to assess the soil water quality, directly or indirectly. Direct measurements of soil water imply soil water sampling through an appropriate system; porous cups were installed on the Cretan, Italian and Chinese sites. Indirect evaluation of water-soil interactions can be obtained through sequential extractions. The combination of a variable input function (through diffuse pollution, irrigation, fertigation) and of variable MTE mobility in soils can be expected to lead to short term variations in soil metal concentrations even if such short term variations have been rarely investigated (Féder, 2001; Cary and Trolard, 2008).
The sampling focused upon the fully irrigated plots given that the potential impact of irrigation water quality on soil and plant quality can be expected higher for fully irrigated soils compared to other irrigation strategies.

Samples were taken within the soil volume of potential influence around each of the drip emitters. This volume varies depending on the nature of the soil and the irrigation system so that each site adopted a specific protocol.
For all experiments, three sampling campaigns were scheduled for each irrigation season: at pre-planting, at the end of irrigation, at harvest. The geochemical evolution of soil properties over the 3 years shows significant variations in major and minor elements, especially trace metallic elements. It implies the role of the cultivated plant as a sink of elements which leads to direct loss of elements in the soil system.

Bouwer, H., 2000. Groundwater problems caused by irrigation with sewage effluent. Journal of Environmental Health 63, 17-20.
Cary L., Trolard F. (2008). Metal mobility in the ground water of a paddy field in Camargue (South eastern France). Journal of Geochemical Exploration 96/2-3 : 132-143.
Féder, 2001. Dynamique des processus d
óxydo-reduction dans les sols hydromorphes, These de l
Úniversite Aix Marseille III.
Kass, A. Gavrieli, I. Yechieli, Y. Vengosh A.and Starinsky, A., 2005. The impact of freshwater and wastewater irrigation on the chemistry of shallow groundwater: a case study from the Israeli Coastal Aquifer, Journal of Hydrology, 300, 314-331.