

ICID 26th Euro-Mediterranean conference on irrigation

11-16 October 2015, Montpellier - France

IRRIGATION OF HORTICULTURAL CROPS WITH RECLAIMED WATER: EFFECTS ON SOIL-PLANT SYSTEMS

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ABSTRACT

The study aims to investigate the effects on horticultural crops of reclaimed water treated by a constructed wetland (CW) combined with biological ponds (RW1) and a CW combined with ultraviolet disinfection. The experimental plants were located in San Michele di Ganzaria (37°17'0" N and 14°26'0" E), Sicily. The RW1 are effluents of a natural extensive tertiary urban wastewater treatment in which a CW, with a surface area of about 2,000 m², is followed in series by biological ponds (of about 150 m³) and sand filter plus a ring filter; the RW2 are effluents of a hybrid tertiary treatment, where CW is integrated by filtering systems and ultraviolet disinfection. Both RW1 and RW2 were used for irrigation of horticultural crops (i.e. tomato, eggplant, artichoke). Reuse effects were analysed on soil-plant systems in terms of physical-chemical modification and microbial contamination and to detect eventual changes on the main crops production features. RW irrigated soil-plant systems were compared with the analogous irrigated by conventional fresh water.

RW were supplied to the field by a micro-irrigation system, which alternates surface drip laterals with sub-surface ones. In the study, the characteristics of the biofilm growth, (i.e. a heterogeneous and functional aggregation containing microbial community) inside the pipelines, were explored in order to evaluate the emitters clogging risks and analysing the potential variability of the emission uniformity (EU) of the system (i.e. range of variation 95-70%).

RW coming from the two wastewater treatment plant (natural RW1 and hybrid RW2) revealed about 1 logarithm unit of differences in the *Escherichia coli* entering the irrigation system. RW1 generally did not match the Italian reuse standards (M.D. 185/2003) in terms of microbiological quality (*Escherichia coli* concentration), but both RWs were within the limits for reuse suggested by WHO (2006). Eggplant and artichoke crops irrigated with RWs showed an increase of the production features; tomato crops did not show significant differences on production features when irrigated with different water qualities. Microbial crops contamination resulted limited during the experimental campaign, whereas soil microbiological contamination resulted quite high and persistent.

The natural treatment system (RW1) seems more reliable to adequately treat reclaimed urban wastewater for agricultural irrigation scope; this system implies less operational and maintenance costs, resulting more affordable for small rural communities.