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Processing Tomatoes Irrigated With Treated Wastewater: the RIUSIAMO Project

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Introduction

The growing need for crop irrigation water and the shortage of fresh water due to increasing uses and climate changes are crucial issues leading to treating wastewater for crop irrigation (Hristov et al., 2021). The capability to use treated wastewater in a Southern Italy irrigation district has been assessed. The Consortium "Bonifica della Capitanata" of Foggia managed a large district with pressure and an on-demand irrigation scheme on 163 kha. In Capitanata plain, some plants of tertiary treatment (managed by Acquedotto Pugliese, AQP) of municipal wastewater allows obtaining an average of 6 Million m3/year that can be used for agricultural purposes.

The experiment aims to assess the effect of using tertiary treated wastewater for irrigation on processing tomato yield and quality compared to "conventional" water.

Materials and Methods

In the 2021 season, on a private farm in Trinitapoli (Capitanata plain, Southern Italy), an experiment with processing tomato (*Lycopersicon esculentum* Mill.) was set up. A strip plot design with elementary plots size of 9m x 30m, three replications, and two compared treatments, one with the irrigation with "conventional" water (CONV) and one with "treated wastewater" (TWW).

Weather stations and sensors were installed for monitoring agro-meteorological variables. Irrigation water, soil, and crop samples were taken to monitor the chemical-physical parameters, possible contaminants (heavy metals), and microbiological indicators (*Escherichia coli* and *Salmonella* spp.). Tomato hybrid "Taylor" was transplanted on 11 June 2021 and was harvested on 5 October 2021. From 21 July to 5 October 2021, with a biweekly frequency, plant height, percentage of land cover, Leaf Area Index (LAI), and plant biomass yield were collected. LAI was measured with the LAI-2200 Plant Canopy Analyzer 2200. For the biomass, four plants for each plot were sampled, removing one for each coupled row, on which the fresh weight and the dry weight, separately for plant and fruits, were measured after oven drying at 72°C until constant weight

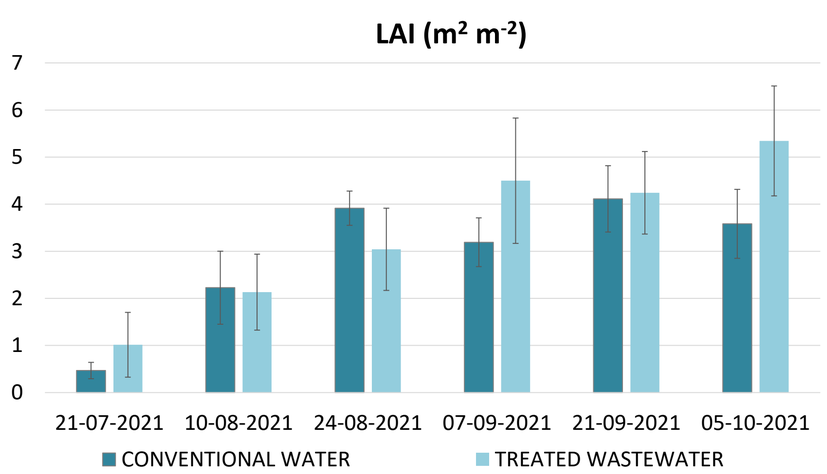

Fig. 1 Leaf Area Index of tomato in the two irrigation treatments. Bars indicate the standard deviations.

Results

Seasonal water irrigation volume was about 7,210 m^3 ha^{-1} (in 44 watering events), representing a high volume compared to the typical water requirements of processing tomato. This high volume is probably related to the climatic conditions observed during the crop cycle. In particular, the maximum air temperature detected (40-42 °C) both in June (transplanting) and in August (fruit formation stage) significantly increased the crop irrigation water demand. The crop development showed a LAI similar in the two treatments during the first phase of the growing cycle, while it resulted higher in TWW during the fruit maturity stage (Fig. 1). Total plant biomass at harvest (Tab. 1) was found to be greater in TWW than in CONV (125.92 *vs*. 92.45 t ha^{-1}), as well as the commercial fruit yield (105.34 *vs.* 75.42 t ha^{-1}). No difference of percentage of marketable fruit dry matter at harvest was observed for the two treatments (Tab.1), with a slight superiority in the conventional water (5.64% *vs*. 5.06%, respectively, for CONV and TWW).

Irrigation water	Total Plant Biomass (t ha^{-1})		Marketable Fruit Yield (t ha^{-1})		Total Plant dry matter (% on fresh weight)	Marketable Fruit dry matter (% on fresh weight)
	Dry	Fresh	Dry	Fresh		
CONV	7.90 b	92.45 b	4.19 b	75.42 b	8.63	5.64
TWW	9.82 a	125.92 a	5.37 a	105.34 a	7.72	5.06

Tab. 1 Tomato biomass and marketable fruit yield at harvest, in t ha^{-1} of fresh and dry weight. The different letter represents averages statistically different at $P<0.05$ (Student t-test).

Conclusions

Even if derived from only one year of experiment, some aspects can be highlighted:

I. positive effects on crop growth and marketable yield were likely due to the increased amounts of nutrients (i.e. N, P_2O_5, and K^+);
II. the microbiological quality of the marketable yields was similar between the two compared irrigation treatments (CONV and TWW).

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