Lettuce irrigation with wastewater from pistachios processing. Effect on soil properties

P. Kostopoulos[1], A. Papadopoulos[1], Y. Troyanos[1], Ch. Kolovos[1], S. Kosmidis[1], M. Psychogiou[2], M.K.Doula[1]

[1]Laboratory of Non Parasitic Diseases, Department of Phytopathology, Benaki Phytopathological Institute, 8 Stef. Delta str, Kifissia, 14561, Greece
[2]Agricultural University of Athens, 75 Iera Odos Str., 11855, Athens, Greece
Keywords: pistachio wastewater, soil, irrigation with wastewater, lettuce.
Presenting author email: mdoula@otenet.gr

Introduction

Provided that benefit to agriculture (or ecological improvement) can be demonstrated, landspreading of wastes is considered preferable to other management practices as proposed in the Waste Framework Directive issued by the EU.

So far little is known regarding the fate of pistachio's waste in Greece and in other Mediterranean countries. It is known, however, that, on average, $2m^3/h$ of water are required for dehulling 1tn fresh nuts, while the processing of 1tn of pistachios produces almost 2.5tn of sludge, which consists of hulls, nuts and water.

In the framework of the LIFE project entitled "Sustainable strategies for intensively cultivated areas in the Mediterranean-AgroStrat" (http://www.agrostrat.gr), it was revealed that pistachio waste (wastewater and solid) is either discharged on soil, mainly where pistachio trees or vegetables are cultivated, or is disposed in wells and streams. In some cases, disposal lagoons are used for the disposal, however these are poorly constructed (i.e. simple soil excavation without using protective materials to prevent leaching) and of high depth (up to 5 m) that, apart from adverse impacts on soil quality, inhibit the evaporation process (Doula et al., 2018).

The development of an environmental friendly methodology for the reuse of pistachio wastewater for irrigating Mediterranean crops is considered, important for many reasons, e.g. soil protection, rational use of fresh water and fertilizers, water sources conservation under the pressure of the Mediterranean climatic conditions, etc. The aim of this study was to investigate the appropriateness of pistachio wastewater to be used for vegetable irrigation, focusing on the impacts of such practice on soil properties.

Materials and Methods

A pot experiment (Kostopoulos et al., 2017) was conducted under greenhouse conditions during which lettuce seedlings were irrigated with 5 wastewater/water ratios-treatments, i.e. 1:10, 1:6: 1:2, no dilution and fresh water. Each treatment was composed of 5 replicates in a Latin square experimental design. Plants were irrigated twice a week by adding 100ml of liquid while leachates were collected at a weekly basis. Leachates were further analyzed for electrical conductivity, pH, NO_3^-, Cl^-, Na, K, polyphenols, Cu, Zn, Mn, and Fe. After experiment completion, the substrates were collected and analyzed for pH, electrical conductivity, organic matter, polyphenols, total nitrogen, available phosphorus, exchangeable cations (potassium, sodium, calcium, magnesium), boron and available metals in order to assess potential impacts on soil properties after harvesting.

Results and Discussion

The most important impact was recorded for soil electrical conductivity (EC) and exchangeable potassium (K) concentration. However, compared to the increase caused by fertilization, the increase in EC and K from the use of wastewater was less significant. Changes were also recorded for pH, exchangeable magnesium and polyphenols, which were increased with the decrease in wastewater dilution factor. The effect of dilution was recorded also in yield parameters. As it can be seen in Fig. 1 there was a significant effect on lettuce growth as the dilution factor was decreased. No significant changes were recorded for available metals, i.e. Cu, Fe, Mn, and Zn.

Fig. 1 Increase in wastewater salts content causes negative effects on lettuce growth.

Conclusions

Considering soil parameters after experimentation and also soil quality thresholds (Doula et al., 2013), it can be proposed that the use of pistachio wastewater for irrigation after 1:10 (and also 1:6 after specific preconditions) could provide the anticipated and well known advantages of wastewater reusing on soils, while at the same time protects soils from overloading with salts and nutrients.

References

Doula, M.K., Kolovos, Ch., Papadopoulos, A. (2018). Irrigation water use in Mediterranean islands-Fresh water or wastewater reuse. 6th International Conference on Sustainable Solid Waste Management, 13-16 June, Naxos, Greece.

Doula, M.K., Kavvadias, V. Elaiopoulos, K. (2013). Proposed soil indicators for Olive Mill Waste (OMW) disposal areas. Water, Air & Soil Pollution, 224,1621.

Kostopoulos, P., Trogianos, Y., Papadopoulos, A., Psychogiou, M., Diplarou, E., Doula, M.K. (2017). Lettuce irrigation with pistachio wastewater-Quality of leachates and risk for groundwater reservoirs. 6th International Conference on Environmental Management, Engineering, Planning an Economics-CEMEPE. 25-30 June 2017, Thessaloniki, Greece.