Pepper cultivation on a substrate consisting of soil, natural zeolite and olive mill waste sludge-Changes in soil properties

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Olive Mill Wastes (OMW) are still considered as a major problem in the Mediterranean region although many research works provide solutions for OMW treatment and production of clean or almost clean effluents that can be further used for irrigation or discharge. However, the issue that remains unanswered is the high cost for establishing such a treatment facility, which inhibits the adoption of these solutions.

On the other hand, OMW distribution on soil, under specific conditions and restrictions still seems to be an advantageous choice, considering that is a low cost method, it recycles nutrients on soil and returns organic carbon in soil, and is considered, therefore, as a practice that contribute to climate change mitigation.

Distribution of Olive Mill Wastewater on soil and exploitation for irrigation purposes have been extensively studied during the past years and it is believed that such practices could provide a sustainable alternative methodology for OMW management, supposed that all appropriate measures will be taken to avoid soil degradation.

The aim of this study was to investigate the potential of using the natural zeolite, namely clinoptilolite, as soil additive in order to make the addition of olive mill waste sludge more favorable for vegetable cultivation and eliminating the risk for soil and underground water degradation. For this reason, a pot experiment was conducted under greenhouse conditions during which pepper seedlings were transplanted and grown onto different substrates containing combinations of 0, 2.5%, and 5.0% zeolite and 0%, 2.5% and 5.0% of OMW sludge (v/v). Each treatment was composed of 12 replicates arranged in a split-plot design using zeolite as the main treatment (Photo 1).

Photo 1. (a) The pot experiment; (b) pepper yield for 0% zeolite and 5.0% OMW; 2,5% zeolite and 5.0% OMW; 5% zeolite and 5.0% OMW (from right to the left).

Plants were irrigated twice a week, leachates were collected at a weekly basis and further analyzed in order to assess risk for soil and groundwater degradation. 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 OMW and clinoptilolite impacts on soil properties after harvesting.

Through this experiment it was revealed that there is a substantial increase in soil organic matter and also in nutrients content that may significantly decrease the use of mineral fertilizers; a decrease in weed growth due to the OMW in the substrates; limited leaching of nutrients and no detectable leaching of polyphenols due to the combination of organic wastes and the clinoptilolite.

In conclusion, although all soil properties were changed after experiment completion, there are significant advantages of using OMW in combination with clinoptilolite for non-salts sensitive vegetables cultivation, which may also offer economical benefits. However, in order to ensure soil quality protection and sustainability, specific precautions and measures must be taken when using such substrates, which are discussed in this study.