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Recycling in soil of olive mill effluents after energy recovery

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Treatment and disposal of by-products from the “three phases” method of olive-oil extraction represents the main problem of the olive oil industries mainly due to the high volume of waste waters annually produced.
Recently, the introduction of the “two phases” method of olive-oil extraction has drastically reduced the amount of processing waters produced and the so called “olive mill pulp” is the only waste generated. The olive pulp (OP) contains high amount of carbohydrates and thus it could be a good substrate for the production of energy: ethanol, hydrogen and biogas (methane).
This paper presents some results of the research achieved within the triennial BIOTROLL§ project started in 2003 and aimed to: 1) the physical and chemical characterization of the OP arising from the biological treatment for the production of i) ethanol and ii) hydrogen, and iii) the subsequent anaerobic treatment of the effluent with production of methane, and 2) the agricultural reuse of the final effluents as fertilizer. The research is aimed to i) determine the chemical composition of the effluents, ii) evaluate the phytotoxicity; iii) understand the effects on soil N dynamics; iii) verify the role on soil microorganisms; iv) the chemical-structural characterization of the humic-like substances of the effluents and in soil after fertilization.
The results, as far as here obtained, have shown that OP, EH2 and ECH4 have physical-chemical characteristics completely compatible with their use in agriculture due to the appreciable amount of nutrients and in humic-like substances (especially EH2 and ECH4) and negligible concentrations of heavy metals.

The addition of OP, EH2, and ECH4 to a Typic Ustipsamment soil (equal to 60, 120, 180 kg N ha-1) has shown that i) different intensity of mineralization processes occur; ii) any phytotoxicity phenomenon was observed, even OP contains high concentration of hydroxytyrosol-free phenol, and iii) a significant bio-stimulant effect at the beginning of the germination process on wheat seed (Triticum durum) was observed.
The nitrogen (N) cycling in soil was influenced by the addition of the effluents as follows: a) OP and ECH4 caused the highest mineralization rate at the beginning, but after 40 days no differences among treatments were found; b) all the treatments caused NH4+ consumption (nitrification or immobilization) during the first 20 days; c) OP and EH2 caused the greatest immobilization of NO3-; d) ECH4 did not cause any change in the nitrate level in soil and e) OP and EH2 increased N immobilization at the beginning, then they let to a slow release of N as nitrate.
Soil microorganisms: EH2 was the only treatment giving evident quality changes of soil microflora after the addition by inducing changes of microbial populations, with a strong increase of Moniliella sp., an acidophilus fungus. Nevertheless, after 40 days, no differences in fungi and bacteria composition in soil were observed among treatments.
These results confirm that the quality of the effluents after the biological treatments is compatible with their agriculture reuse, especially in Mediterranean areas.

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