Remediated marine dredged sediments as growing media for agricultural activities: first results from the Hortised project (LIFE14 ENV/IT/000113)

Edgardo Giordani[1], Simona Pecchioli[1], William Antonio Petrucci[1], Francesca Tozzi[1], Giancarlo Renella[1], Grazia Masciandaro[2], Serena Doni[2], Cristina Macci[2]

[1] DISPAA University of Florence, Viale delle Idee 30, 50019 Florence, Italy
[2] ISE-CNR Institute of Ecosystem Study, Via Moruzzi 1, 56124 Pisa, Italy

Phone: 0554574050
E-mail: edgardo.giordani@unifi.it

Introduction: Peat is widely used as a substrate for nursery production of a large number of plant species. However, the use of peat in nursery activities is debatable for its high cost and the environmental implications related to its extraction and transport no longer sustainable. Overexploitation of peatlands is steadily increasing in the last decades, which had led to the 70% loss of peatland areas in Europe with destruction of several natural habitats. The aim of Life HORTISED project is to convert polluted dredged sediment from a worthless and non-recyclable waste to a renewable resource to be used as a component of substrates for horticultural and nursery production. Dredged marine sediment, properly phyto-remediated, could be an innovative substitute to reduce peat use in common commercial substrates, providing an innovative way to grow plants. At the same time, it should represent an alternative re-use of sediment dredged from port, which are otherwise devolved to the storage *sine die*, conforming to the principle of the circular economy: it is possible to sustainably re-use sediment as ingredients for growing media to gain safe food products, in a new perspective of recycling and integrated ecology.

Methods: Sediments, dredged from Leghorn port, were phyto-remediated using Agriport technology and then subjected to three months landfarming to improve soil characteristics. Remediated sediments were previously characterized by physical, chemical, biological and microbiological point of view; then they have been used as agronomic substrate and mixed with peat-based commercial substrate (PBCS) to prepare three remediated sediment-based substrates (RSBS): Treated Sediment (TS) 100%, TS/PBCS 50/50% (v/v), and PBCS 100%. Demonstration plots were established in Tuscany in order to assess the potential effect of diverse substrate composition at first on the growth and development of lettuce, strawberry and pomegranate. Chemical, biological and microbiological analysis were performed on substrates to evaluate the chemical-nutritional and biochemical sediment properties. Plant growth was measured to evaluate general physiological status and detect eventual stresses. A screening for inorganic and organic compounds on fruits or leaves are being performed in order to asses crop safety.

Results: After the sediment phyto-treatment, three months landfarming process was effective in homogenizing the substrate, increasing microbial activity and further reducing both organic and inorganic contamination; Zn, C>12, and PAHs were still higher than the legal limit for civil reuse (Dlg.s 152/2006 Table A). The ecotoxicological tests showed a lack of toxicity of sediment at the end of landfarming process. Lettuce plant growth was affected by the sediment: for example final dry weight was significantly lower for plants grown on TS100 compared to TS50 and TS0. Plant diameter and height, leaf number and final leaf area and final dry weight were significantly higher in strawberries grown on TS0. Pomegranate plants grown on TS100 have shown a smaller trunk diameter, while for height and leaf area there were no statistical differences between treatments.

Discussion: Landfarming certainly improved soil characteristics but a little amount of contaminants was still present in the remediated marine sediment. Organic and inorganic pollutants were under Italian legal limits for civil reuse only in the TS50 substrate. Lettuce growth is substantially conditioned by the sediment in the substrate. Generally, leafy vegetables tends to absorb more pollutants than fruit or root vegetables and this affects the final plant development. However, strawberries and pomegranates did not show any irregular vegetative behaviour between the commercial peat based and the sediment based substrates. The first year of trial represents a preliminary investigation about plant growth in terms of vegetative development and dry matter accumulation. Content of organic and inorganic contaminants, analysis of fruit production and quality are being evaluated. In conclusion, a second year of demonstration will be carried out to better understand the physiological and qualitative responses of crops grown on sediment based substrates and to validate an evaluation model for experimenting dredged remediated sediment for future horticultural crop horizon.

Acknowledgements
HORTISED Project is supported by LIFE Program – European Commission.