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USE OF DREDGED SEDIMENTS FOR PLANT NURSERY AND SOIL REHABILITATION: THE EXAMPLE OF "LIFE AGRISED" PROJECT

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Abstract

A large amount of sediments is dredged every year from ports and waterways in order to maintain adequate depths for ship navigation, but the fate of these sediments is an issue worldwide recognized. Usually, dredged sediments are disposed in specific facilities and may cause environmental problems due to their contamination by metals and organic compounds. The European policy encourages valorization of dredged sediments, and this will be a technological challenge in the near future. The AGRISED project goal is to demonstrate the use of reclaimed dredged river sediments in the field of plant nursing, restoration of degraded soils and urban green maintenance, as a substitute for peat, pumice and coir fiber for growing ornamental plants, and agrochemicals and excavation materials generally used for soil restoration and maintenance of urban green. The main demonstration activities of the project will be:
- Co-composting of sediments and green waste at 3:1, 1:1, 1:3 w/w rates
- Use composted sediments for the production of ornamental plants with high added value for the European market: *Photinia x fraseri e Viburnum tinus.*
- use the composted sediments and fresh dredged sediments as technosols for the maintenance of urban soils either as soil amendment or alone.

The main results the AGRISED project would like to achieve are:
i) The demonstration of the suitability of the co-composted sediment/green waste mixes for the growth and production of ornamental plants in containers as amendment for rehabilitation of degraded soils and technosols for urban green maintenance
ii) The development of an innovative technology and specific protocols for more sustainable management of dredged sediments and green-waste.
iii) The definition of specific protocols in the normative and legislative issues related to the use of co-composted sediments in agricultural production and soil rehabilitation.

keywords: *compost, sediments, green waste, recycling, plant nursery and soil rehabilitation*

Environmental problems

Harbors and waterways are routinely dredged to ensure safe navigable waters. Since most waterway are located within industrial and urban areas or immediately nearby, the sediments transported by surface runoffs turn out to be often polluted by organic and inorganic contaminants (Frohne et al., 2014). About 100-200 million m^3 of polluted dredged sediments in Europe need to be disposed each year in precise and costly ways (Bortone et al., 2004). The European policy encourages valorization of dredged sediments, and this will be a technological challenge in

the near future (SedNet, 2013). Physical, chemical, and thermal decontamination treatments are generally very expensive (Meers et al., 2005) while biological methodologies, based on the use of plants and/or microorganisms, like phytoremediation, landfarming and co-composting, are considered promising, feasible and low cost technologies to remediate contaminated sediments, improving at the same time their nutrients content and structure (Bert et al., 2009; Masciandaro et al., 2014). Moreover, green waste, constituted of branch, leaves grass cuttings and hedge trimmings of garden or parks, represent another underutilized waste category. Co-composting of dredged sediments with green waste has the potential to degrade organic contaminants and also create a technosol with suitable chemical-physical and biological property (Thanh et al., 2015). Currently, there is poor knowledge on both sediment contaminants degradation by composting and on the evaluation of the reclaimed sediments as technosols for nursery or degraded land revegetation (Guangwei et al., 2009).

Project aim

The LIFE AGRISED (LIFE17 ENV/IT/000269), relying on the co-composting methodology developed by the beneficiary UniFi and published by Mattei et al. (2016), aims at demonstrate the suitability of dredged sediments used with no intervention or co-composted with green waste to produce innovative technosols for reclamation of degraded land and brownfields and innovative growing media for plant nursery. The performance of the innovative sediment-based growing media and of reconstituted soil will be compared with the traditional land reclamation approaches and traditional growing media used for producing ornamental plants with high added value (Fig. 1).

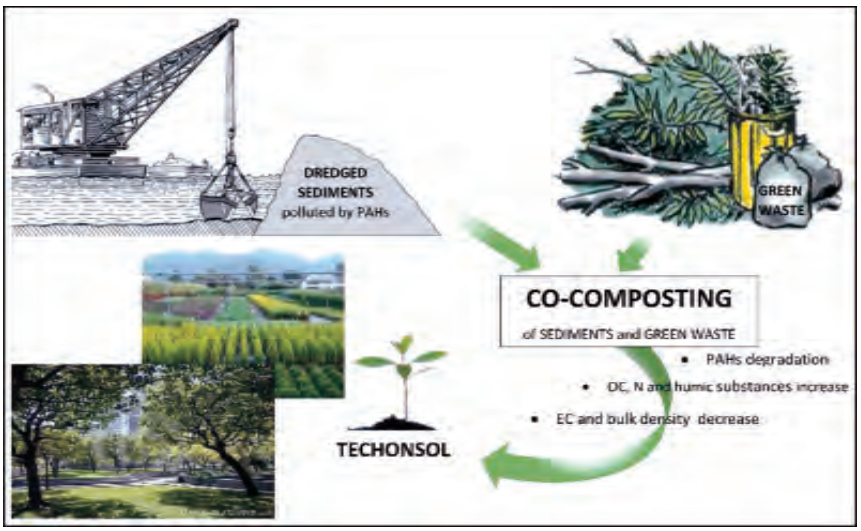

Figure 1. LIFE AGRISED scheme

Project layout

Sediments (S) will be dredging from the middle tract of Navicelli canal (Pisa, Central Italy, 43°38′32.9″N, 10°21′19.4″E) by Navicelli S.P.A., the company responsible for canal management, and then, the sediments will be allowed to dry inshore in specific Navicelli bulking areas for 2 months prior to co-composting treatment. After drying, sediments will be transported to the co-composting site.

The co-composting facility will consist of materials heaps of 10 m^3 total volume, ensuring sufficient materials for the demonstration of their use for ornamental plant growth and technosols for the maintenance of green areas of urban and periurban areas.

Three sediment:green waste treatments will be tested: 1:1 w:w (S:GW 1:1), and sediment:green waste 3:1 w:w (S:GW 3:1), sediment:green waste 1:3 w:w (S:GW 1:3). The foreseen co-composting period is one year, and not specific inputs are planned, unless water may be needed in case of excessive dryness of the co-composting mass. The composting materials will be mixed to homogenate them and allow the optimal completion of the co-composting process. All composting materials will be regularly checked for temperature and moisture levels using temperature and moisture probes, whereas for physical and chemical analyses all composting materials will be sampled at the beginning of the co-composting process, after 30 days and every 90 days afterward using official methods of compost and sediment analysis.

At the end of the co-composting process, the compost will be transported to the sites for demonstration of use in:

i) Plant nursery as growing substrate for the production of ornamental plants.

ii) Soil reconstruction as amendment for rehabilitation of degraded soils and technosols for urban green maintenance

i) **Plant nursery**. The demonstration of the use of reclaimed river sediments in plant nursing will be carried out testing plants grown in containers under real market nursery conditions, easy to monitor and validate. Two ornamental species, with different aesthetical characteristics and sensitivity to environmental parameters and with different stress tolerance, will be cultivated on the 3:1, 1:1 and 1:3 sediment:green waste growing media. *Photinia x fraseri* and *Viburnum tinus* were also chosen because of prime interest for the ornamental plant market

ii) **Soil reconstruction**. Sediments composted with green waste and also fresh dredged sediment will be used for the soil reconstitution process patented by the "M.C.M. Ecosistemi" partner. The suitability of both dewatered and composted sediments will be demonstrated at both pot scale and lysimeters scale, for assessing the potential upscaling of the proposed technological approach.

The optimization of sediments use for the soil reconstitution will be achieved by using various doses of materials depending on the mode of disaggregation and reconstitution of dewatered and composted sediments relying on the expertize of the "M.C.M. Ecosistemi" partner. Based on the protocols set up by the "M.C.M. Ecosistemi" partner, potential materials for preparing customized reconstituted soils are lingo-cellulosic wastes, cellulosic sludge, red mud from drinking water treatments and inert materials.

Sediments and other materials will be mixed at various doses according to the protocol developed by "M.C.M. Ecosistemi" for producing reconstituted soils with different physico-chemical properties.

The reconstituted soils will be analyzed preparing soil columns with a set up allowing the induction of wet-dry cycles and the on-line analysis of the moisture content, and leaching sampling at different depths from the top of the column.

Expected results

The specific technical results expected from the Project AGRISED will be:

- an innovative technology and specific protocols for more sustainable management of dredged sediments and green-waste, and innovative plant production achieved by the preparation of sediment-based growing media replacing

the current peat-based growing media, and with superior performance as compared to other alternative growing media such as coconut fiber.

- 100% evaluation of the suitability of the co-composted sediment/green waste mixes for remediating dredged sediments, recycling green waste, and for the growth and production of ornamental plants in containers as amendment for rehabilitation of degraded soils and technosols for urban green maintenance;
- 100% characterization of the obtained materials in terms of safety for ecosystems and human health, and characterization of plant growth and health after prolonged growth on substrates containing co-composted sediments;
- 100% improvement of the knowledge on the treated sediments and green wastes and mitigation of the impact as compared to the current management options;
- assessment of the ecological impact (LCA)
- evaluation of eventual reasons for hindrance to market the innovative sediment-based technosols and growing media.
- definition of specific protocols in the normative and legislative issues related to the use of co-composted sediments in agricultural production and soil rehabilitation.

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