INDTECH2018

Innovative industries for smart growth

29-31 October, 2018

Vienna, Austria

www.indtech2018.eu
@IndTech2018
#IndTech2018

PILLAR 1 - Technologies for sustainable growth

Session 1.3. Environment and decarbonisation

Title of presentation/case study

New bioremediation approach for soils and sediments

Name

Grazia Masciandaro

Organisation

CNR-IRET

Date

31 October

FFG Promoting Innova
FFG Promoting Innovation.
Federal Ministry Transport, Innovation and Technology
e2018 eu·at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

Biological treatments

Range of **clean up methodologies** using **natural organisms** to **degrade organic contaminants** or to **convert inorganic contaminants** to environmentally less toxic or non-toxic compounds

Complex systems
SOIL & SEDIMENT

Plants

Plant root exudates affect: the **number**, **diversity** and **activity** of **microorganisms**; the **bioavailability** and **absorption** of **contaminants**

Microorganisms

Active role in biological decontamination processes

SOIL-PLANT-ORGANISMS
INTERACTION

Earthworms

Stimulate **microbial activities**; increase **permeability** and **areation**, **acidification** of soil

TECHNO SOIL
(LOW SALINITY)

COMMERCIAL PLANTS

PELLETS

FFG Promoting Innovation.
Federal Ministry Transport, Innovation and Technology
e2018 u·at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

NATIONAL PROJECT

2006-2012 "ECOLOGICAL APPROACH TO REMEDIATE POLLUTED SOIL THROUGH NATURAL TECHNOLOGIES"

Funded by: Tuscany Region and Municipality of San Giuliano Terme (Pisa).
Site location: Madonna dell'Acqua (Pisa)

Cytisus scoparius

Populus nigra

Paulownia tomentosa

Treatments:
1. Untreated soil
2. Organic matter + plants+earthworms

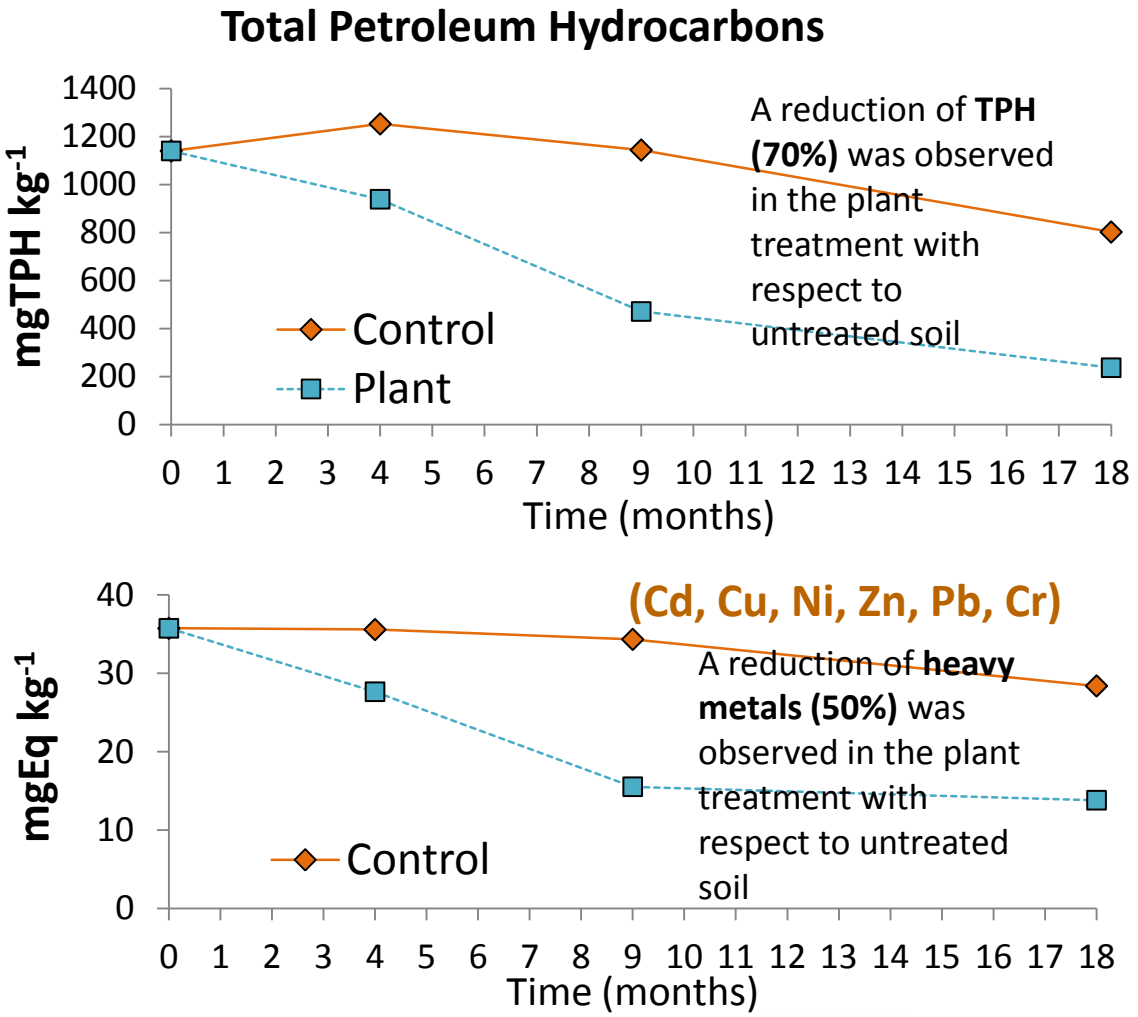
BIOREMEDIATION AT FULL SCALE

Treated surface: 1.5 ha

FFG Promoting Innovation.
Federal Ministry Transport, Innovation and Technology
e2018 at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

Main results at the project end



- 29.5 t/ha increase in soil organic carbon;
- +93% soil carbon content;
- +120% increase in microbial functionality
- + 96% increase in microbial biodiversity
- +100 % plant cover;
- 100% reduction of loss of organic matter;
- 50% reduction of soil erosion;
- 50% increment in soil fertility;
- yearly sequestration of 12 mg/cm2 of carbon (as humic carbon).

FFG Promoting Innovation. Federal Ministry Transport, Innovation and Technology e2018 eu-at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

DREDGED SEDIMENTS

…in quantitative terms:

the continuous stream of sediments, dredged from harbors and waterways for **maintaining shipping traffic efficiency** determines the production of **several million cubic meters** of dredged material every year.

in Europe about 100-200 million m^3 need to be disposed of in specific and expensive ways

… in qualitative terms:

the sediments are often characterized by a **high level of contaminants** (heavy metals and hydrocarbons)

PEAT: NURSERY GROWTH SUBSTRATE

- Substrates most used for its physico-chemical properties
- Non-renewable resource
- Imported countries North-East Europe

- High costs
- Need to identify alternative materials

Peat yearly used in Italy in nursery $5 \cdot 10^6$ m^3

FFG Promoting Innovation. Federal Ministry Transport, Innovation and Technology e2018 eu-at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

2009-2012 AGRICULTURAL REUSE OF POLLUTED DREDGED SEDIMENTS
NO. ECO/08/239065/S12.532262

agriport
Agricultural Reuse of Polluted Dredged Sediments

ECO-INNOVATION

Brackish sediments
Canale dei Navicelli

gravel-sand drainage

plastic network

soil-sediment 30%

Selected plants

Nerium oleander

Paspalum vaginatum

Tamarix Gallica

Phragmites australis

Spartium Junceum

Marine sediments
Livorno harbour

Decontamination

- Decrease in **heavy metals (20%)** and total petroleum **hydrocarbons (50-60%)** concentration.

Agronomical recovery

- Improvement of the chemical-nutritional properties (**25% increase in N and P**) of the treated sediments indicating the recovery of agronomical fertility.

Ecological-Functional Recovery

- Stimulation of the biological parameters contributed to create a functional "soil ecosystem" (**50% increase in number and activity of microorganisms**), called

"**technosoil**"

National patent: Iannelli R, Masciandaro G, Ceccanti B, Bianchi V, Doni S (2012). Metodo per il trattamento di residui di dragaggio mediante fitorimediazione e impianto che realizza tale metodo. PI2012A000013. Il Brevetto italiano è stato rilasciato il 05/09/2014 con No. 0001410263

izon 2020 research and innovation

EUROPEAN PROJECTS

2013-2016 «INNOVATIVE INTEGRATED METHODOLOGY FOR THE USE OF DECONTAMINATED RIVI SEDIMENTS IN PLANT NURSERY AND ROAD BUILDING» LIFE12 ENV/IT/000652

CLEANSED

Coordinator: **CNR**
Demonstration of the use of decontaminated sediments as growing substrate for the cultivation of **ornamental plants** in the nursery sector.

Eleagnus macrophylla L.

Viburnum tinus L.

Photinia x fraseri

2015-2017 «DEMONSTRATION OF THE SUITABILITY OF DREDGED REMEDIATED SEDIMENTS FOR SAFE AND SUSTAINABLE HORTICULTURE PRODUCTION» LIFE14 ENV/IT/000113

Hortised

Coordinator: **University of Florence**
Demonstrate the suitability of dredged remediated sediments as an alternative for the preparation of growing media in **horticulture (pomegranate and strawberry)**.

The sediment is suitable for chemical and biochemical fertility, for plant growth and development, and for food quality

FFG Promoting Innovation.
Federal Ministry Transport, Innovation and Technology
e2018 u·at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

Chemosphere 201 (2018) 595–602
Contents lists available at ScienceDirect
Chemosphere
journal homepage: www.elsevier.com/locate/chemosphere

Phytoremediated marine sediments as suitable peat-free growing media for production of red robin photinia (*Photinia x fraseri*)

Paola Mattei [a], Alessandro Gnesini [a], Cristina Gonnelli [b], Chiara Marraccini [b], Grazia Masciandaro [c], Cristina Macci [c], Serena Doni [c], Renato Iannelli [d], Stefano Lucchetti [e], Francesco P. Nicese [a], Giancarlo Renella [a, *]

[a] Department of Agrifood Production and Environmental Sciences, University of Florence, P.le delle Cascine 18, 50144, Florence, Italy
[b] Department of Biology, University of Florence, v. Micheli 1, 50121, Florence, Italy
[c] National Council of Research, Institute for Ecosystems Study (CNR-ISE), via. Moruzzi 1, 56124, Pisa, Italy
[d] University of Pisa, Department of Energy, Systems, Territory and Construction Engineering, v. Gabba 22, 56122, Pisa, Italy
[e] Agri Vivai s.r.l., v. Casalina, 118G, 51100, Pistoia, Italy

Impact on greenhouse gas emissions

Sediments disposed in landfills

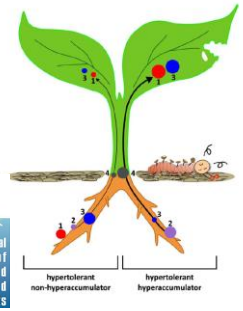
+99,1

Dredged sediment

-99,1

+22,7

Phytoremediation



agriport Agricultural Reuse of Polluted Dredged Sediments

eco-innovation

-76,4

+12,5

peat-free growing media

Life CLEANSED Hortised

-63,9

Two cultivation cycles and disposal

+45,6

-18,3 Kg CO_2 eq.

Peat

+11,6

+17,8

Peat growing media

+29,4

One cultivation cycle and disposal

+24,3

+53,7 Kg CO_2 eq.

FFG Promoting Innovation.
Federal Ministry Transport, Innovation and Technology
e2018 eu-at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

POLICY IMPLICATIONS

EU legislation is still unclear on the possibilities of dredged sediments as by-products usable in agriculture (Oslo 1972, London Protocol 96, Paris 1974, OSPAR 1992 and Barcelona 1995 Conventions, EU waste and water directives (1999/31/CE, 2000/60/CE) and EU Parliament Decisions 2000/532/CE, 2001/118/CE, 2001/119/CE, 2001/573/CE (European Waste Inventory).

European Countries has only individual national legislations

The results of European Projects may lead to a single European legislation in order to allow the EU use of transformed sediments in horticulture for cultivation of vegetable and fruit plants, after proper testing of human and environmental safety.

FFG Promoting Innovation.
Federal Ministry Transport, Innovation and Technology
e 2 0 1 8 u · a t
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

New European Projects

2018 -2021 European project ***AGRISED LIFE17 ENV/IT/269*** *"Use of dredged sediments for creating innovative growing media and technosols for plant nursery and rehabilitation"*

2018 -2021 European project ***SUBSED LIFE17 ENV/IT/000347*** *"Sustainable substrates for agriculture from dredged remediated marine sediments: from ports to pots"*

New National Project

2017-2019 Funded by Cassa di Risparmio Pistoia e Pescia "Posidonia oceanica and sediments for the production of an agronomic substrate to be used in nursery activity and horticolture"

FFG Promoting Innovation. Federal Ministry Transport, Innovation and Technology e2018 eu-at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

Conclusions

•The bioremediation strategies resulted successful at removing pollutants and improving the agronomical properties (biodiversity, functionality and carbon sequestration) in contaminated soils and sediments thanks to the mutually interaction between plants, microbes and earthworms;

•The sediment re-cycling as ingredient of growing media for plant nursery reduced the C footprint of plant production as compared to the use of the traditional peat based growing media.

•The decontamination and recycling of dredging sediments in agriculture significantly contribute to the sustainable management of wastes by implementing the concept of circular economy.

FFG Promoting Innovation. Federal Ministry Transport, Innovation and Technology e2018.at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.

INDustrial TECHnologies 20

Innovative Industries for Smart Growth

Thanks for your attention

Grazia Masciandaro
mail: grazia.masciandaro@cnr.it

Cristina Macci
Eleonora Peruzzi
Fernando Di Giovanni

FFG Promoting Innovation.
Federal Ministry Transport, Innovation and Technology
e2018 eu-at

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 767162.