



CNR-Pisa

The biggest research area in Italy



Institutes:

1. Biofisica
2. Biologia e Biotecnologia Agraria
3. Chimica dei composti organo-metallici
4. Fisiologia clinica
5. Geoscienze e georisorse
6. Informatica e Telematica
7. Istituto Nazionale Ottica
8. Linguistica Computazionale
9. Neuroscienze
10. Processi Chimico-Fisici
11. Scienza e Tecnologia dell'Informazione
12. Studio degli Ecosistemi
13. Tecnologie Biomediche

Staff: about 1000 employees



Institute of Ecosystem Study (ISE)



The **Institute of Ecosystem Study-ISE** performs research into the structure and functioning of aquatic and terrestrial ecosystems, focusing in particular on anthropogenic pressure and global change. The ISE knowledge gives the scientific basis for identifying the most appropriate protective and corrective interventions, and provides support for the bodies entrusted with formulating policies for environmental protection and recovery. ISE included 4 units, Verbania (head unit), Pisa, Firenze and Sassari. The 20th of September 2018 ISE was abolished. From 21 September ISE Pisa, Florence and Sassari joint with IBAF (Institute of Agro-Environmental and Forest Biology) to become

IRET Research Institute on Terrestrial Ecosystem

Research group

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Cristina Macci
Serena Doni
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Technician: Fernando Di Giovanni, Manuele Scatena

Financer: Alessandra Bartolini

Students: Thesis, Stage, PhD

The administration is still completely unable to «act» with a huge amount of problem in work development

Logo.

Logo to be decided into the “first institute meeting” on 9-10 April 2019

CNR activity

B. Implementation actions

B1. Phytoremediated Sediment treated via landfarming process(responsible) **project date 01/10/2018-31/03/2019**

➡ CNR involvement: Physical, chemical, biological and toxicological characterization of sediments (as reported in the proposal)

C. Monitoring of the impact of the project actions

C1. Monitoring and validation of treated sediments (responsible).
CNR involvement: Physical, chemical and biological characterization of sediments **project date 01/01/2019-30/06/2019**

➡ CNR involvement: Physical, chemical and biological and toxicological characterization of sediments (as reported in the proposal).

Previous Project: AGRIPORT No. ECO/o8/239065/S12.532262

The Experimental Site

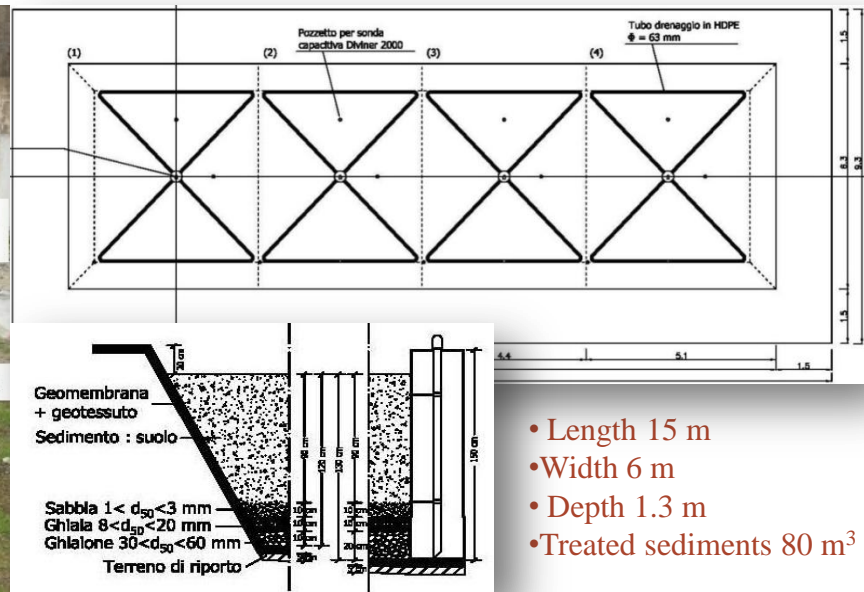
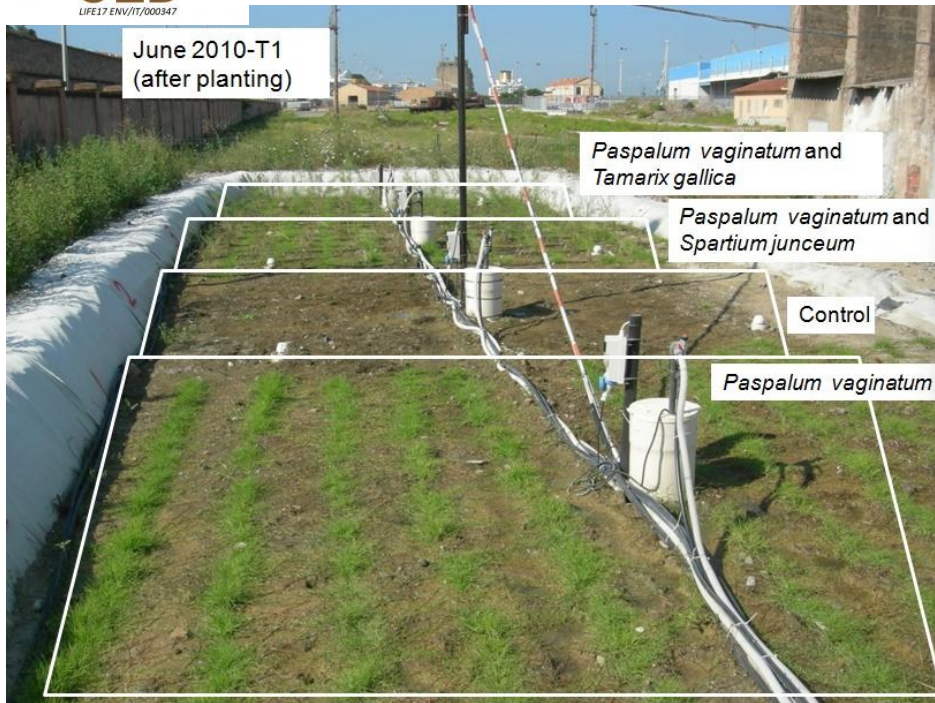


Port of Leghorn



The Basin with
phytoremediated
sediments

43°33'31.78"N, 10°18'29.32"E



- Length 15 m
- Width 6 m
- Depth 1.3 m
- Treated sediments 80 m³

In May 2012 (two years of treatment):

- Organic C: 1.5-2.0% (0-20cm); 1.0% (20-60cm)
 - Total P: 450-550mg kg⁻¹(0-20cm); 350-500 mg kg⁻¹ (20-60cm)
 - Total N: 0.10-0.13% (0-20cm); 0.05-0.10% (20-60cm)
 - C>12 about 250 mg kg⁻¹
 - Zn the only metals higher than the limit for urban use tab. A (Dlgs 152/2006)
- In the control (no plants, lower nutrient content)



B1-C1 Action Landfarming

Landfarming is a bioremediation technology in which contaminated sediment is spread on the upper soil zone or in biotreatment cells, mixed with nutrients and the material is periodically irrigated and aerated. Organic contaminants are degraded by microorganisms and used as carbon source for growth and energy.

-to homogenize the substrate –to increase the biological activities and as, a consequence, -to further reduce the organic contamination

**Periodical (once per week) aeration by mechanically moving the sediments and turning them over :
3 months planned**

- 3 sampling points in about 40m²:
- 10 sub samples for each sampling point
- The results are the average between samples



Campaign of sampling:

- Ti (initial) , starting characterization (end of November 2019)
- Tm (middle), at the middle of landfarming process (middle of January 2019)
- Tf (final), at the end of landfarming process (end of February 2019)



Flora Toscana, Pescia, 21 March 2019

- Sediment characterization and monitoring of treated sediments

Parameters

- **Physical** (starting and end of the process)

Texture, Bulk density, retention curve

- **Chemical** (at each sampling time)

pH, Electrical Conductivity, Nutrients Total content and Availability (C, N, P, Ca, Mn, K, Fe, Mg), Cation Exchange Capacity

- **Biochemical** (at each sampling time)

Enzyme activities:

Hydrolytic enzyme: β -glucosidase, phosphatase, Arylsulfatase

Oxidoreductase enzyme: Butirrato esterase

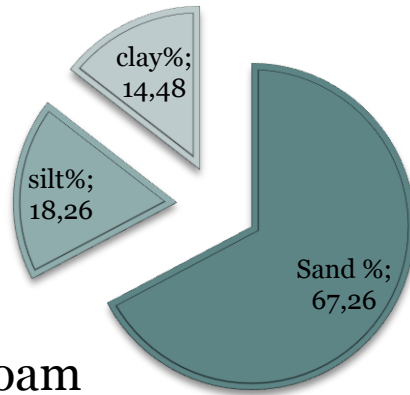
- **Contaminants:** (starting and end of process)

Total heavy metals and available heavy metals (Zn, Cd, Pb, Cu, Cr, Ni), C>12, PAH

change slowly
(static conditions)

Very sensitive
(dynamic conditions)

Final Texture

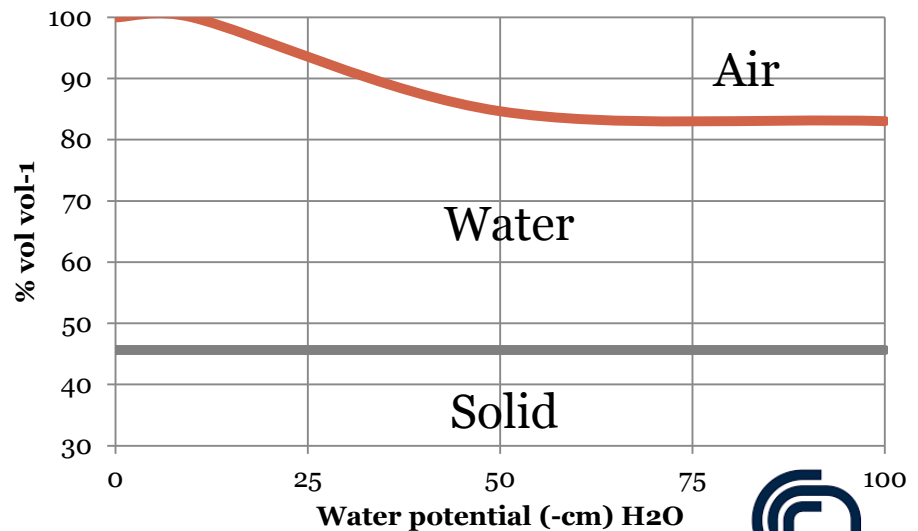
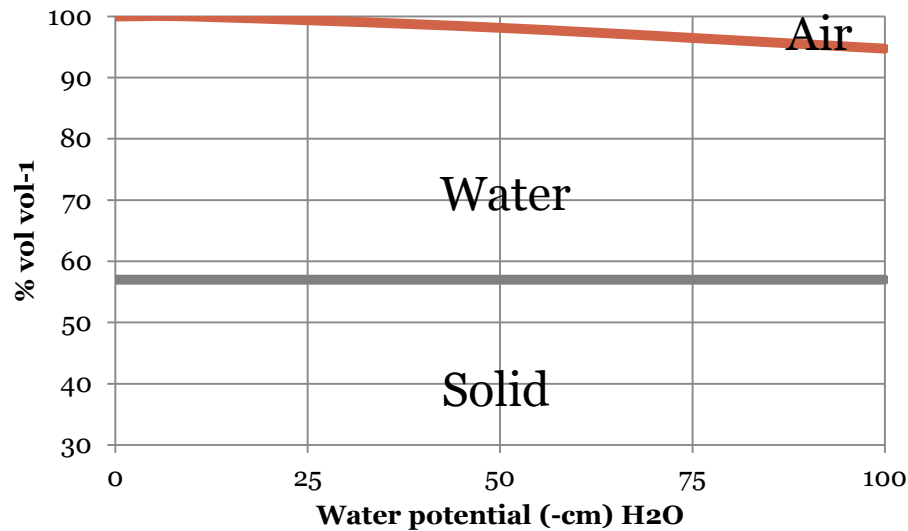


Sandy Loam

Physical analyses

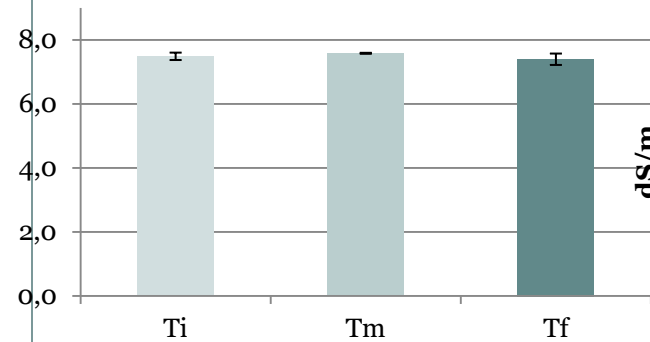
	Ti	Tf
Bulk density g/cm ³	1,49±0,04	1,19±0,05
Particle density g/cm ³	2,61±0,01	2,61±0,01
Porosity %	43,0±0,1	54,3±0,1
Available water %	3,67±0,11	16,94±0,2

Water retention curve



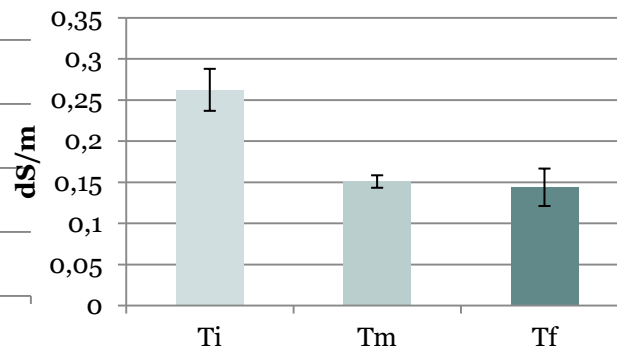
B1 and C1 Monitoring of landfarming Chemical analysis

pH



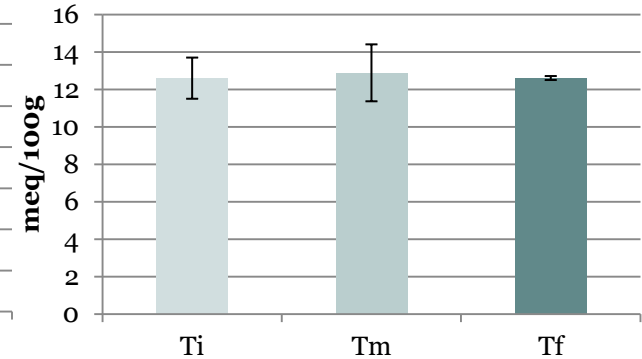
No variations during the time

E.C.



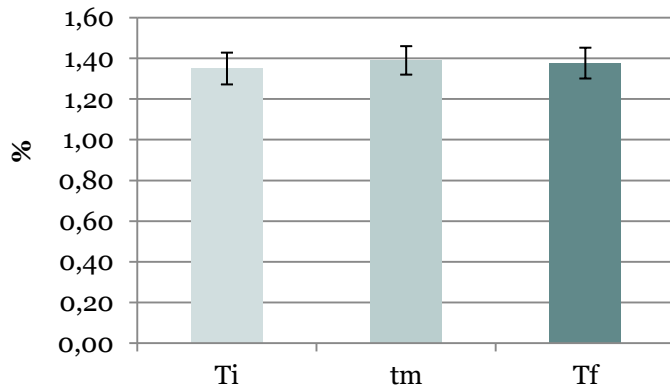
Decrease due to loss of salt
with rain

C.E.C



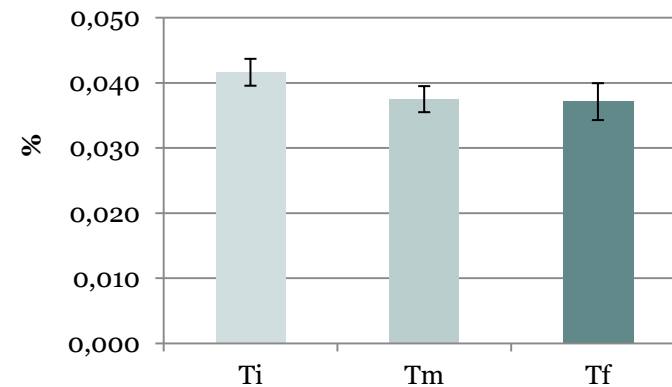
No significant variation

TOC

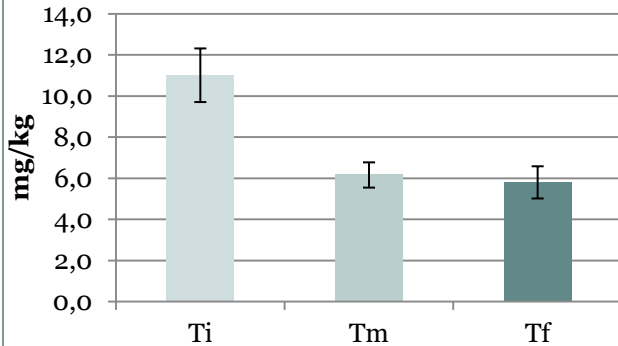


No significant variation

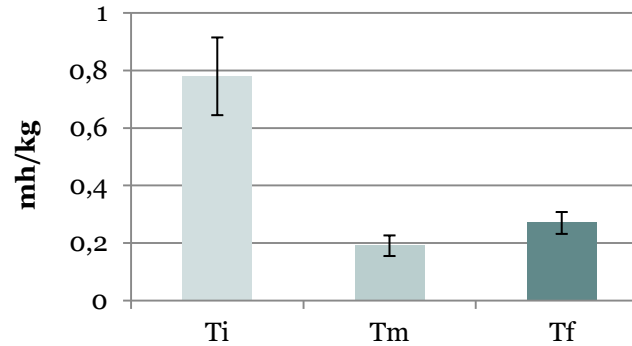
TP



N-NO₃⁻

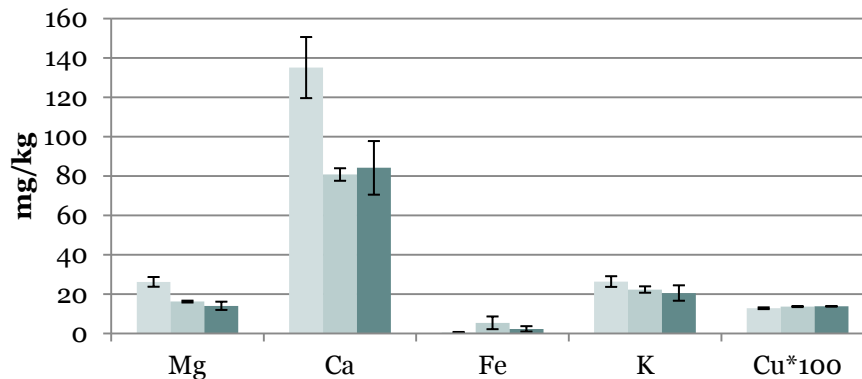


N-NH₄⁺



Available P under
limit of detection

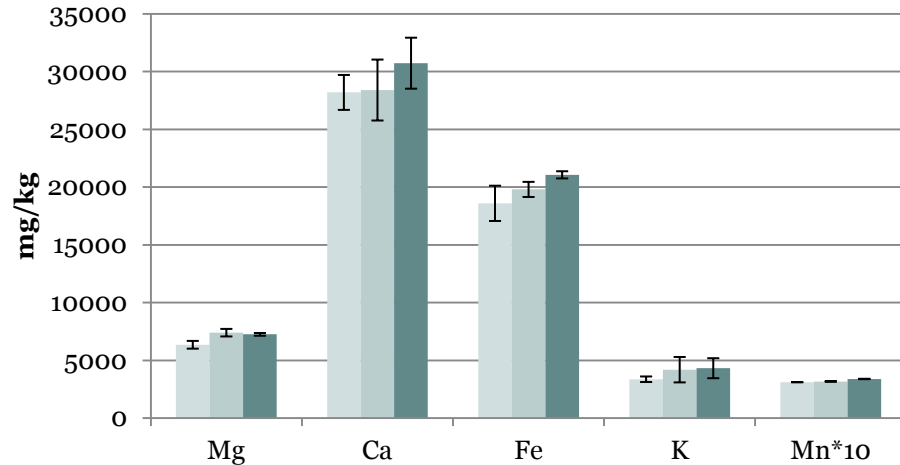
Available nutrients and heavy metals



•A general decrease in all the detected elements, even if often not significant

Mn, Zn, Cd, Ni, Pb,
Cr under limit of
detection

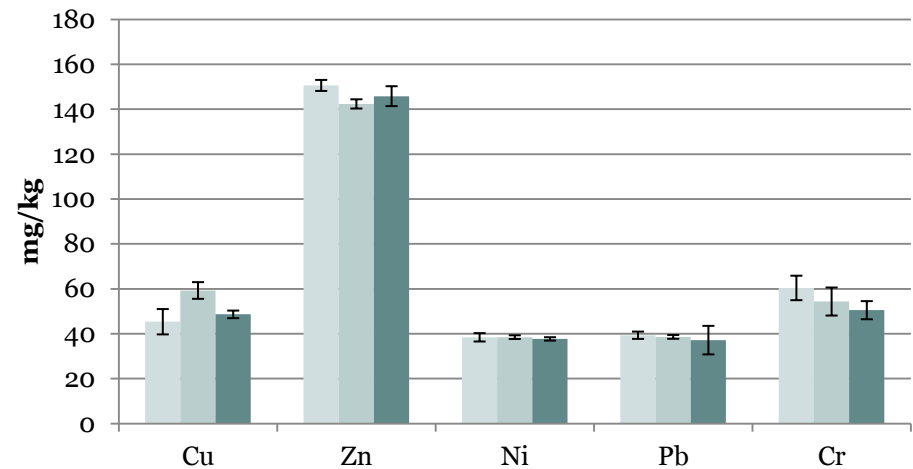
Total nutrients



- Total and available Cd under limit of detection
- As expected, no significant variations in Total Metals and nutrients
- All the metals, included Zn are lower than the limit for urban use tab A (Dlg.s 152/206)

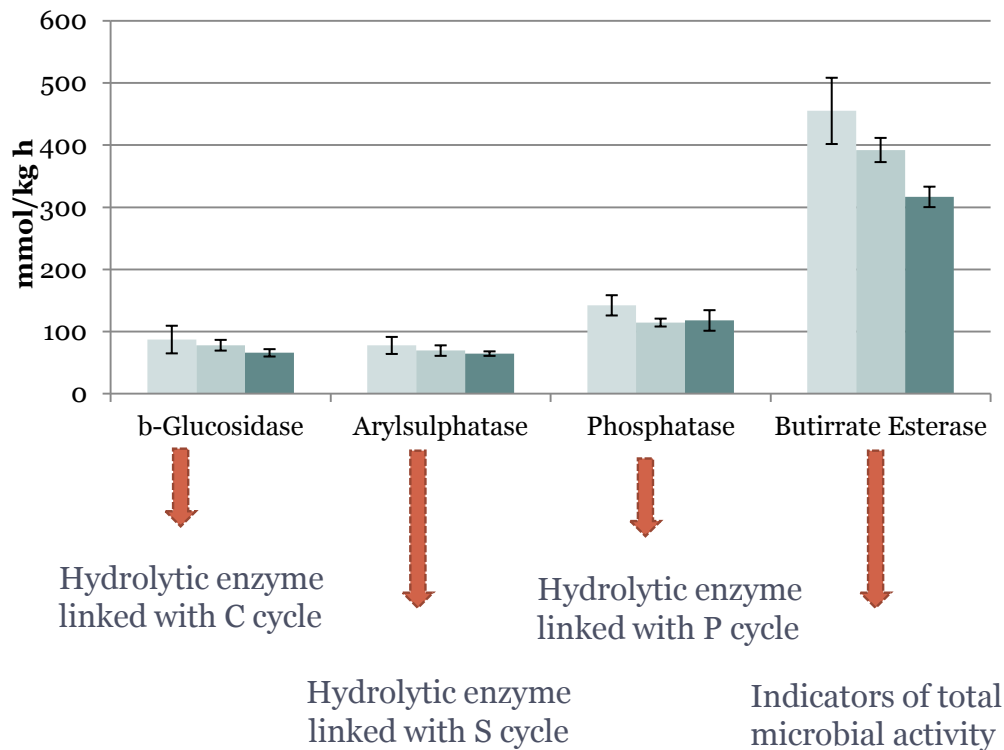
Organic contaminants to be determined

Total Heavy metals



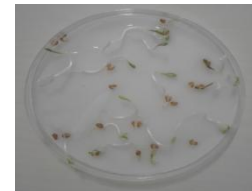
B1 and C1: Monitoring of landfarming Biological analysis

Enzyme activities

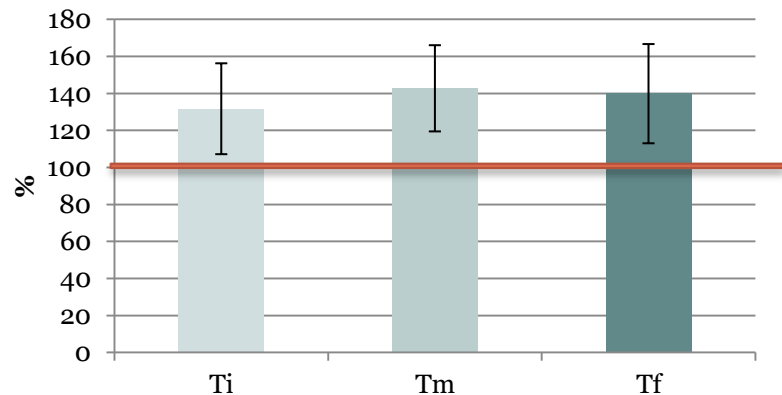


A general decrease in all the detected enzymes, even if often not significant with exception of Butirrate esterase

Phytotest: *Lepidium sativum* (crescione)



Germination Index



Stimulation of seed germination and growth

Physical and chemical characteristics of an agronomic substrate (D.lgs 75/2010)



Parameter	Sediments at the end of landfarming in the Subsed Project	D. lgs. 75/2010
Bulk density (g/cm ³)	1,19 ±0,05	<0,95
pH	7,4±0,2	4,5-8,5
Electrical conductivity (dS/m)	0,13 ±0,01	<1
TOC %	1,38 ±0,08	>4
TN %	-	<2,5
P ₂ O ₅ %	0,17 ±0,01	<1,5
Cd (mg/kg)	< LOD	1,5
Cu (mg/kg)	48,6 ±1,7	230
Hg (mg/kg)	0,070 ±0,001	1,5
Ni(mg/kg)	37,7 ±0,7	100
Pb(mg/kg)	37,2 ±6,4	100
Zn (mg/kg)	145 ±4	500

No toxicity, After three months of landfarming physical and chemical characteristics are comparable with those of an agronomic substrate



In order to reach the C concentration and bulk density required by Italian regulation, the mixing of sediments with a source of organic matter rich in Carbon, such as peat, is suggested

To complete the analyses

Flora Toscana, Pescia, 21 March 2019



**Thanks for your attention and GOOD
WORK**