

# The Garden Soil Project

## EGU 2020

Short version on

[A case study investigating the effects of EDTA washing and amendments on trace metal-contaminated soil](#)

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# Overview 1

- Historical contamination (Pb~1000 ppm, Cd~5 ppm) Austria
  - **Friesl-Hanl W.**, Platzer K., Riesing J., Horak O., Waldner G., Watzinger A., Gerzabek M.H. (2017). Non-destructive soil amendment application techniques on heavy metal-contaminated grassland: Success and long-term immobilising efficiency. Journal of Environmental Management 186: 167-174.  
<http://dx.doi.org.1624.pisces.boku.ac.at/10.1016/j.jenvman.2016.08.068>
- Soil washing by the company ENVIT (SLO) with EDTA, including EDTA recycling (~95 %)
  - Voglar, D., Lestan, D., 2012. Pilot-scale washing of metal contaminated garden soil using EDTA. Journal of hazardous materials 215, 32–39.

# Overview 2

- Pre-experiments
  - Pot experiment with zero valent iron (ZVI)
  - Pot experiment with different organic amendments
  - Cultivar screening and selection experiments
- Field-experiment
  - 12 raised beds (each appr. 1000 kg)
  - Different cultivars of radish, spinach ...
  - Percolating water collection
  - Nutrient cycling ( $^{13}\text{C}$ ,  $^{15}\text{N}$ ) investigation
  - Mesofauna experiment

# Problems resulting from EDTA washing

- Residual EDTA could increase the trace metal mobility/toxicity
- Alteration of physical and microbiological soil characteristics
- Extraction of nutrients

## Need for rehabilitation

- Reestablishing soil fertility and the microbiota
- Improving the soil structure
- Increase water holding capacity
- Immobilize mobile trace metals



### Soil amendments:

- Compost
- Biochar
- Inorganic (NPK, ZVI, etc.)

# Conclusions from the pre-trials

- EDTA washing has the potential to decrease the concentration of trace metals in vegetables, meeting food security thresholds.
  - Further reduction by cultivar selection for some vegetables.
  - Soil amendments like vermicompost improve plant productivity.
  - Biochar amendments led to increased water holding capacity.
- 
- Taking it to a bigger scale...





## Raised Bed construction

- Raised bed constructed of birch wood.
- Implementing a drainage system to analyze leachates.
- 3 treatments (Original, Washed, Amended)
- 4 replicates = 12 beds

(Christoph Noller)





## Homogenization, adding soil amendments

- The soil was homogenized and amended with biochar and vermicompost using a trommel sieve.
- 2.6 wt% vermicompost (worm compost from Vermigrand).
- 2.4 wt% biochar (Sonnenerde, wheat husks and cellulose fibers, 600°C).
- Each bed holds ca.  $800 \pm 50$  kg of soil.



# Finished beds



- The raised beds were equipped with a drip irrigation system.
- Soil water sensors and Tensiometers were installed to adjust the water content.

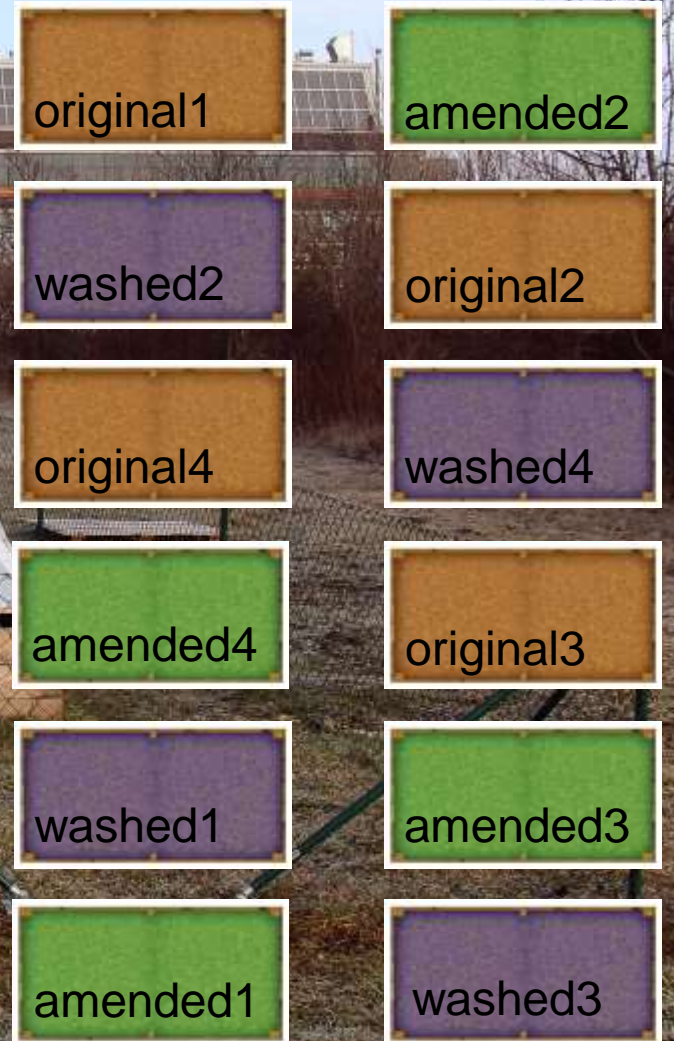




# Experiment design



2019  
August: Spinach  
September: Radish  
2020:  
April: Carrots/Lettuce





# Resent results from the raised bed experiment (Soil)

Soil Sample	Pb [mg kg <sup>-1</sup> ]	Cd [mg kg <sup>-1</sup> ]
<b>Total Content</b>		
Contaminated	795 ± 18.0	4.47 ± 0.19
Washed	189 ± 11.1	2.36 ± 0.07
Amended	201 ± 2.45	2.14 ± 0.14
<b>Ammonium Nitrate Extractable</b>		
Contaminated	3.54 ± 0.12	0.60 ± 0.02
Washed	1.37 ± 0.02	0.22 ± 0.03
Amended	0.90 ± 0.06	0.19 ± 0.02

C ... Control

W ... Washed Soil

A ... Washed and Amended Soil



# Resent results from the raised bed experiment (Spinach)

Soil/Cultivar	Pb [mg kg <sup>-1</sup> ]	Cd [mg kg <sup>-1</sup> ]
C/Butterfly	33.5 ± 2.05	63.6 ± 11.7
C/Resistoflay	38.5 ± 3.12	68.1 ± 5.95
W/Butterfly	4.64 ± 3.85	19.6 ± 4.46
W/Resistoflay	7.34 ± 3.67	22.7 ± 0.78
A/Butterfly	1.29 ± 0.91	12.0 ± 2.15
A/Resistoflay	0.73 ± 0.44	11.3 ± 1.24

C ... Control

W ... Washed Soil

A ... Washed and Amended Soil





# Work in progress – PHD from Christoph Noller

Additionally ...

Physicochemical analysis  
(Mathäus Steurer)



Nutrient cycling ( $^{13}\text{C}$ ,  $^{15}\text{N}$ )  
(Corinna Eichinger)



Mesofauna  
(Janet Wissuwa)





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# Thank you for your attention!



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