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ROOT DEVELOPMENT IN METAL CONTAMINATED SOILS AMENDED WITH BIOCHAR

Frédéric REES¹, Thibault STERCHEMANN¹, Jean-Louis MOREL¹

¹Université de Lorraine/INRA, Laboratoire Sol et Environnement
F-54500 Vandœuvre-lès-Nancy, France

INTRODUCTION

Biochar, the solid product from biomass pyrolysis used as soil amendment, has emerged as a promising carbon sink and soil improver. Its sorbent properties could also be used in the remediation of contaminated soils, particularly in phytoremediation.

Biochar’s influence on root growth is however poorly known [1], e.g. for soils contaminated with heavy metals. An increase of root surface in those soils may lead to a decrease of metal leaching, as less water is percolating, but also to an increase of metal uptake by the plant, as the exchange surface between soil and plant is increasing.

MATERIALS

- 1 biochar produced by Carbon Terra at ~450°C from woody biomass, <2mm, untreated (pH 9.2)
- 2 soils contaminated with Cd, Zn, Pb, sampled near smelters, with similar properties but different pH.

<table>
<thead>
<tr>
<th>Soil</th>
<th>pH</th>
<th>Cd</th>
<th>Pb</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil A</td>
<td>5.9</td>
<td>5.9</td>
<td>1.7</td>
<td>684</td>
</tr>
<tr>
<td>Soil B</td>
<td>8.2</td>
<td>0.24</td>
<td>0.06</td>
<td>2.0</td>
</tr>
</tbody>
</table>

△ With biochar, metal availability strongly ↘ on Soil A, but only slightly on Soil B due to its higher initial pH [1] △

RESULTS & DISCUSSION

DEVELOPMENT OF ZEA MAYS ROOTS

- 2 plant species grown in large rhizoboxes:
  - Zea mays, non-hyperaccumulating, fast growing
  - Alpine pennycress, Cd and Zn hyperaccumulator

ON SOIL A

- The zones with biochar have a higher density of roots
- Roots are generally moving towards the zones with biochar ➔ root tropism

ON SOIL B

- The zones with biochar do not have a higher density of roots
- No obvious trend of root tropism towards biochar can be observed

DEVELOPMENT OF ALPINE PENNYCRESS ROOTS

- Biochar has no significant effects on root development in a soil with initial low metal availability and high pH

METHODS

- 4 seedlings grown per rhizobox with 2000 g of soil, divided in 8 compartments as a chessboard:
  - 4 squares with pure soil
  - 4 squares with soil + 5% (w/w) biochar

- 2 rhizoboxes for each plant and soil
- Daily watering at 85% of water holding capacity
- High-resolution scanning of the soil profile
- After harvest (2 weeks for maize, 9 weeks for alpine pennycress):
  - Recovery of roots and measurement of root surface with WinRHIZO software

CONCLUSIONS

- Considering that both soils have similar properties except pH, the better root development with biochar only observed on Soil A may be mainly due to the decrease of soil metal availability.

- Modifications of root development only occurs when biochar has a significant effect on chemical soil properties.

PERSPECTIVES

- Positive tropism of roots towards biochar could be an option to reduce the quantity of biochar and the work for biochar amendment.
- The consequences of a better root development on plant metal uptake and long term growth need further investigations.