INTRODUCTION

Guadiamar valley soils were covered with a 0-30 cm-thick layer of sludge (74-80% arsenopyrite) after the Aznalcollar mine accident.

Despite the sludge removal together with the first 10 cm of the soils:

- Soils still exhibit residual trace metal pollution Table 1
- Soil microbial properties were seriously affected

Soil microorganisms respond quickly to environmental stress and may therefore be used as indicators of change in soil health

The aim of this research was to study the effect of different amendments and a plant cover on the remediation of a trace element contaminated soil through three microbiological parameters: dehydrogenase activity (DH), microbial biomass carbon (MBC) and substrate induced respiration (SIR).

MATERIALS AND METHODS

24 containers (70x60x50 cm) filled with contaminated soil from the Aznalcollar spill

- Experimental design: Complete randomised blocks; 6 treatments and 4 replicates per treatment
- Amendments: 100 Mg ha$^{-1}$ applied on the top 10 cm of soil
  - MWC, Municipal waste compost
  - BC, Biosolid compost
  - LEO, Leonardite
  - LIT, Deciduous forest litter
  - SL, Sugarbeet lime
  - Control (unamended soil)

- Agrostis Stolonifera was sown
  - 2 samplings (top 10 cm) were carried out after amendment application
  - 1 month later (before Agrostis sowing)
  - 6 months later (after Agrostis sowing)

- Microbiological analyses were carried out:
  - Dehydrogenase activity (DH)
  - Microbial biomass carbon (MBC)
  - Substrate induced respiration (SIR)

RESULTS AND DISCUSSION

- DH mean values increased in all soils in the second sampling
- MWC, BC and SL amended soils showed the highest DH mean values
- DH was positively correlated with pH ($r=0.868$, $p<0.01$) and negatively correlated with soluble Cd ($r=0.802$, $p<0.01$) and Zn ($r=-0.838$, $p<0.01$) concentrations

Soil microbial properties were useful indicators of the changes produced in soil health status by amendments and plant cover

<table>
<thead>
<tr>
<th>Treatment</th>
<th>First sampling</th>
<th>Second sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>169 ± 42.5 a</td>
<td>42.5 a 199 ab</td>
</tr>
<tr>
<td>MWC</td>
<td>426 ± 44.2 a</td>
<td>409 c 47.6 abc</td>
</tr>
<tr>
<td>BC</td>
<td>230 ± 43.5 a</td>
<td>319 bc 47.9 bc</td>
</tr>
<tr>
<td>LEO</td>
<td>201 ± 42.6 a</td>
<td>290 abc 53.9 c</td>
</tr>
<tr>
<td>LIT</td>
<td>216 ± 35.9 a</td>
<td>321 bc 41.6 a</td>
</tr>
<tr>
<td>SL</td>
<td>130 ± 37.0 a</td>
<td>199 ab 40.2 ab</td>
</tr>
</tbody>
</table>

$R = P_{max} (1 - e^{-kt})$

First order kinetics model to fit mineralization data

$P_{max}$ is the extent of mineralisation

CONCLUSIONS

- Amendments contributed to restore soil microbiological properties
- Plant cover played a crucial role in soil stabilization and microbial development
- The reduction of soluble Cd and Zn concentrations affected positively DH and MBC
- The microbiological parameters measured were useful indicators of the changes produced in soil health status by amendments and plant cover