MIXED HEAVY METAL TOLERANCE AND ACCUMULATION IN THE HALOPHYTIC SPECIES JUNCUS ACUTUS L.

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Introduction:
Halophytes is a promising plant choice for the remediation of heavy metal contaminated sites since these species are known to tolerate various sources of environmental stress including metals. Juncus acutus L. was selected as a wetland halophytic perennial plant with a subcosmopolitan distribution. It has a wide ecological range and has proven before to be tolerance to heavy metal stress such as zinc (Mateos-Naranjo et al., 2014) and hexavalent chromium (Dimitroula et al., 2014).

Aims:
This study evaluated the phytochemical potential of J. acutus for mix heavy metal removal from contaminated wetland sites. The responses of plant growth expressed as biomass dry weight, water content, chlorophyll content and leaf protein content to mix heavy metal pollution were also investigated. Furthermore, the activities of the antioxidant enzymes of the plants were assayed.

Materials and Methods:
A pot experiment was conducted in an open area under natural light and temperature conditions with J. acutus plants (n=6 per treatment) grown in pots filled with the same amount of a loam-sandy loam soil contaminated with 10 mg Cd, 150 mg Ni, 500 mg Zn and 500 mg Pb per kilogram of dry soil.

The experiment was performed for 5 months (October to April) with temperatures ranging from 5.3°C to 31.1°C and with the soil always under over-saturation conditions.

Measurements:
- Metal concentration in tissues (method: EPA method 3052 by an ICP-MS)
- Leaf proteins (Lowry method using bovine serum albumin as a standard)
- Chlorophyll content (method: Harborne, 1984)
- Shoot water content
- Biomass dry weight
- Activity of guaiacol peroxidase (GPX) (method: Erdelský and Frič, 1979)
- Activity of catalase (CAT) (method: Aebi, 1984)

Results:
The experimental data revealed that the heavy metal concentrations were kept in low levels and the roots were the main accumulation site (Table 1).

<table>
<thead>
<tr>
<th>Control</th>
<th>Cd</th>
<th>Pb</th>
<th>Ni</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoots</td>
<td>n.d.</td>
<td>1.25±0.08</td>
<td>n.d.</td>
<td>15.66±2.3</td>
</tr>
<tr>
<td>Roots</td>
<td>n.d.</td>
<td>5.98±0.9</td>
<td>12.78±6.6</td>
<td>28.64±5.6</td>
</tr>
<tr>
<td>Metal</td>
<td>Shoots</td>
<td>1.59±0.6</td>
<td>84.94±30.7</td>
<td>100.22±18.7</td>
</tr>
<tr>
<td>Treatment</td>
<td>Roots</td>
<td>12.77±1.9</td>
<td>626.35±306.5</td>
<td>259.65±36.4</td>
</tr>
</tbody>
</table>

The presence of metals usually affects adversely plant health, but during the whole experiment all plants showed no visible toxicity symptoms such as chlorosis. Moreover, no statistical difference was found in plant’s biomass (Fig. 1) and shoot water content (Fig. 2) between the treatments.

Conclusions:
- The roots were the main accumulation site of all the metals.
- Treated plants developed no visible toxicity symptoms and their chlorophyll content, leaf protein content, shoot water content, biomass and activities of CAT and POD enzymes were not affected by the metals.
- All the above suggest that J. acutus is heavy metal tolerant plant that could be used in phytoremediation strategies for revegetation of mixed heavy metal polluted areas.

References:
Erdelský K., Frič F. (1979) Prakticum and analytical methods in plant physiology. SPN Bratislava

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