Field Validation of a Laboratory Pilot Demonstrating the Ability of Biochar to Reduce Mercury Bioavailability in Floodplain Soils

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ABSTRACT

Biochar (‘Cowboy’ charcoal) amendment is an option to be considered in remediation of mercury-impacted soils. An initial laboratory pilot study (Phase I) was performed with positive results in reducing methylmercury (MeHg) in juvenile Lumbricus terrestris (Eisenia fetida), with no adverse effects on earthworms or plants. The field pilot (Phase II) aims to validate the Phase I results, in situ, as well as investigate additional parameters.

PHASE II - FIELD PILOT

Objectives
- The intent of Phase II (Field Pilot) is to validate the Phase I results
- Assess potential efficacy of biochar in reducing MeHg bioaccumulation in juvenile Lumbricus terrestris (soil-dwelling earthworms)
- Monitor effects on L. terrestris survival, growth, and reproduction
- Demonstrate progress toward innovative remedial strategies

Sampling and Results
- After a 7-week exposure period, adult and juvenile earthworms were sampled (Figure 6) for tissue analysis, survival, growth, and reproduction, soils were sampled for Hg analysis
- Generally, low numbers of surviving adult and juvenile earthworms were observed in each cage, among all treatments (0.2–0.6 adults per cage; 0–3 juveniles per cage) (Table 1)

Table 1. Week 7 Sampling - Observed Earthworms

<table>
<thead>
<tr>
<th>Replicate</th>
<th>Age Class</th>
<th>Week 7 - No. Organisms Observed (Sampled)</th>
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<tbody>
<tr>
<td>A</td>
<td>Adult</td>
<td>0 (1) biochar amendment; 0 (2) control</td>
</tr>
<tr>
<td>B</td>
<td>Juvenile</td>
<td>2 (3) biochar amendment; 1 (1) control</td>
</tr>
<tr>
<td>C</td>
<td>Adult</td>
<td>1 (2) biochar amendment; 0 (1) control</td>
</tr>
<tr>
<td>D</td>
<td>Juvenile</td>
<td>2 (3) biochar amendment; 1 (1) control</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>5 (6) biochar amendment; 3 (2) control</td>
</tr>
</tbody>
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Figure 6. Week 7 Sampling: A) Exposure cage array; B) Amended soil retrieved; C) Juvenile earthworm; D) Adult earthworm

PRELIMINARY RESULTS

The sampling yields of adult and juvenile earthworms were generally low among all five amendment treatments (0% control, 5%, and 10% saturated (wet) and unsaturated (dry) biochar), indicating that it is unlikely that the biochar had an adverse effect on earthworm survival, growth, and reproduction. Work is still in progress; it is expected that the juvenile earthworms will show similar results to Phase I (Laboratory Pilot), with a reduction in MeHg in tissues (Phase II analytical results are pending).