Use of Soil Inversion to Control Phosphorus Flux in the Everglades Stormwater Treatment Areas

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Objectives

- Assess effect of soil inversion on P release to water column
- Evaluate effect of soil inversion on soil P content
Study Site & Approach

- STA1-W Expansion 1
  - Cell 6 (~ 807 ha)
  - Cell 7 (~ 495 ha)
  - Cell 8 (~ 470 ha)

- Soil Inversion

- Soil Core Incubation Study
P Flux Measurements

- Collected soil cores from three areas:
  - Untilled
  - Predominantly peat, Inverted-Peat
  - Predominantly marl, Inverted-Marl

- Core: 15-cm diameter, 15-20 cm depth

- 8 cores from each area

- Triplicate cores (○) at one site for each area
### Laboratory Incubation

<table>
<thead>
<tr>
<th>Incubation Cycle</th>
<th>Parameter</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>SRP Water Sampling (day)</td>
<td>TP Water Sampling (day)</td>
<td>Soil Sampling</td>
</tr>
<tr>
<td>Cycle 1</td>
<td>0, 3, 7, and 14</td>
<td>0 and 14</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Cycle 2</td>
<td>0, 3, 7, and 14</td>
<td>0 and 14</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Cycle 3</td>
<td>0, 3, 7, and 14 for <strong>triplicates cores</strong></td>
<td>0 and 14</td>
<td>TP and plant available P (after third cycle)</td>
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<tr>
<td></td>
<td>0 &amp; 14 rest of the cores</td>
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</tbody>
</table>

- Post-incubation soil cores were analyzed for:
  - Total P 0-5, & 5-15 cm
  - Plant available P 0-5 cm (0.5 M NaHCO₃, Olsen et al. 1954)
Data Analysis Approach

- Water SRP and TP concentrations during each incubation cycle averaged for each soil type.

- Soluble reactive P Flux (mg P/m²/day) = \((C_t - C_0) \times V / A\)
  - \(C_t\) = SRP concentration in water column at day 14
  - \(C_0\) = SRP concentration in water column at day 0
  - \(V\) = Volume of water in core (5.3 L)
  - \(A\) = surface area of core (0.0176 m²)
Soil Core Incubation: Water Column SRP

Graph showing the relationship between elapsed time (in days) and SRP concentration (in µg/L) for different treatments: Control, Inv-Marl, Inv-Peat, and Untilled. The graph indicates an increase in SRP concentration over time for all treatments, with some variability at different time points.
Soil Core Incubation: SRP Flux Rate

Soil P Flux into Water (mg P/m^2/day)

- INV-MARL: Cycle 1 (0.2), Cycle 2 (0.0), Cycle 3 (0.1)
- INV-PEAT: Cycle 1 (2.4), Cycle 2 (1.2), Cycle 3 (1.3)
- UNTILLED: Cycle 1 (4.4), Cycle 2 (2.4), Cycle 3 (3.1)
Distribution of Core Olsen-P

0-5 cm core section

Bicarbonate extractable P (mg/kg)

Inv-Marl  Inv-Peat  Untilled
Summary

- Soil inversion reduced surficial TP
- Cores with inverted marl released lowest SRP
- Remaining Cell 6 soils were inverted based on soil incubation study
- Longer-term field scale evaluation of soil inversion benefits is planned through Restoration Strategies Science Plan
Questions?

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Cell 6 Soil Inversion in Progress, Facing NW, 08/17/2018.
Credits: N. Ralph
Cell 7 Soil Inversion Pilot Study: Soil TP and TOC

Graphs showing box plots for Soil TP (mg/kg) and Soil TOC (%) across different soil horizons (Pre surface, Post surface, Pre subsurface, Post subsurface).
Cell 7 Soil Inversion Pilot Study

- Pre-inversion soil sampling (3/4/2015)
- Post-inversion soil sampling (3/12/2015)
- One sample per acre in the 20-acre pilot P area (AECOM, 2018)

Parameters measured:
- Total-P
- Total organic carbon
- Soil pH