A rainfall simulation study on P removal in buffer zones amended with Fe and Ca compounds

Riparian buffer strips as a multifunctional management tool in agricultural landscapes - COST Action 869
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The Lintupaju buffer zone field

Fig. Katri Siimes
Buffer zones since 1991

Grass buffer zone (GBZ)

No buffer zone (NBZ)

Vegetated buffer zone (VBZ)
DRP losses

Uusi-Kämppä & Jauhiainen, 2010 (Agriculture, Ecosystems and Environment)
Surface runoff in spring

1. Several freezing and thawing events
2. Surface runoff is the highest
3. High DRP losses
4. Nutrients take up by plants is small
Sampling
Added amendment

Gypsum

Fe-gypsum
Rainfall simulation
Experiment sites and treatments

Two old grass buffer zones under simulated rainfall (5 mm h\(^{-1}\))

- Jokioinen (P\(_{\text{AAAc}}\): 6.4 mg L\(^{-1}\))
- Pöytyä (P\(_{\text{AAAc}}\): 47 mg L\(^{-1}\))

Treatments (four replicates)

1. Control
2. CaCO\(_3\)
3. Gypsum
4. Fe-gypsum
5. Ferix-3 [Fe\(_2\)(SO\(_4\))\(_3\)]

Surface runoff (2 x 500 mL)

I  Before freezing
II After 1\(^{st}\) freezing
III After 2\(^{nd}\) freezing
## Added soil amendments

<table>
<thead>
<tr>
<th>Added amendment</th>
<th>Amount $\text{t ha}^{-1}$</th>
<th>Ca $\text{kg ha}^{-1}$</th>
<th>Fe $\text{kg ha}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gypsum</td>
<td>6</td>
<td>1300</td>
<td>5</td>
</tr>
<tr>
<td>Fe-gypsum</td>
<td>8.5</td>
<td>1240</td>
<td>1010</td>
</tr>
<tr>
<td>CaCO$_3$</td>
<td>3.3</td>
<td>1320</td>
<td>-</td>
</tr>
<tr>
<td>Ferix-3</td>
<td>0.67</td>
<td>-</td>
<td>130</td>
</tr>
</tbody>
</table>
DRP concentration in surface runoff

Before freezing

After the first freezing

After the second freezing
TP concentration in surface runoff

Before freezing
- Jokioinen
- Pöytyä

After the first freezing
- Jokioinen
- Pöytyä

After the second freezing
- Jokioinen
- Pöytyä
Mean DRP concentration in surface runoff

Jokioinen

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>CaCO₃</th>
<th>Gypsum</th>
<th>Ferix-3</th>
<th>Fe-gypsum</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRP (mg L⁻¹)</td>
<td>0.3</td>
<td>0.8</td>
<td>1.1</td>
<td>0.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Pöytyä

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>CaCO₃</th>
<th>Gypsum</th>
<th>Ferix-3</th>
<th>Fe-gypsum</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRP (mg L⁻¹)</td>
<td>1.5</td>
<td>1.8</td>
<td>2.0</td>
<td>0.9</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Mean TP concentration in surface runoff

- Jokioinen
  - Control
  - CaCO$_3$
  - Gypsum
  - Ferix-3
  - Fe-gypsum

- Pöytyä
  - Control
  - CaCO$_3$
  - Gypsum
  - Ferix-3
  - Fe-gypsum

The data is presented in a bar graph with TP concentrations in mg L$^{-1}$.
Summary

• Freezing and thawing increased DRP concentration of control up to 13-fold

• The retention efficiency for DRP was increased in the order: gypsum<CaCO$_3$<<Ferix-3<Fe-gypsum

• Fe-amendments retained 74–85 % of DRP and 47–64 % of TP

• Gypsum and CaCO$_3$ were not effective
Thank you!