SUB-IRRIGATION AND CONTROLLED DRAINAGE INCREASE YIELDS AND MITIGATE ACID LOADING IN FINNISH CULTIVATED ACID SULFATE SOILS

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Photo: Rainer Rosendahl
L'IRRIGATION SOUTERRAINE ET LE DRAINAGE CONTRÔLÉ AUGMENTENT LES RENDEMENTS ET ATTÉNUENT LA CHARGE ACIDE DANS LES SOLS SULFATÉS ACIDES FINLANDAIS

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Presentation outlines

1. Background information
2. Experimental setup
3. Results
4. Discussion
5. Conclusion
Hydrological conditions in Finland

![Graph showing hydrological conditions in Finland]

- Runoff + Storage
- Precipitation-Evaporation
- Ground frost
- Water equivalent of snow
- Evaporation
- Precipitation
Prevalent water management systems in Europe

Code for normal presence and purpose of an existing water management system in agricultural land on more than 50% of the Soil Typological Unit (STU)

<table>
<thead>
<tr>
<th>% OF MAP:</th>
<th>(Attribute WM1):</th>
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<tr>
<td>83 %</td>
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<tr>
<td>0 %</td>
<td>Not applicable (no agriculture)</td>
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<tr>
<td>13 %</td>
<td>No water management system</td>
</tr>
<tr>
<td>4 %</td>
<td>A water management system exists to alleviate waterlogging (drainage)</td>
</tr>
<tr>
<td>1 %</td>
<td>A water management system exists to alleviate drought stress (irrigation)</td>
</tr>
<tr>
<td>1 %</td>
<td>A water management system exists to alleviate salinity (drainage)</td>
</tr>
<tr>
<td>1 %</td>
<td>A water management system exists to alleviate both waterlogging and drought stress</td>
</tr>
<tr>
<td>1 %</td>
<td>A water management system exists to alleviate both waterlogging and salinity</td>
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WORKSHOP: Future of Drainage under environmental challenges and emerging technologies
The most important limitation to agricultural land use in Europe

Acid sulphate soils in Finland

- The largest AS areas in Europe are located in Finland
- AS fields have high economic value due to their high yields
- Acid loads from fields are hazardous to aqueous ecosystems
- Large fish kills have occurred after dry summers (e.g. 2006)
Acid sulphate soils in Finland

FeS + FeS$_2$

(FeS) + FeS$_2$
Can off-site hazards of AS soils be mitigated by controlled drainage and subirrigation?

- Hypothesis: acid loads decrease

Do controlled drainage and subirrigation result in better yields?

- Hypothesis: yields increase
Experimental setup

Ref

CD, CDP

Groundwater table

-1.1 m

-0.5 m

-1.5 m

Extra water in CDP

Control well

Main drain

Lower part of the field

Main drain

CDI

CD

Middle part of the field

Ref

Upper part of the field

a pump for sub-irrigation

subsurface drain

plastic sheet

yield sampling plot

groundwater pipe

contour lines

WORKSHOP: Future of drainage under environmental challenges and emerging technologies
Results I
Groudwater table variation in the fields

WORKSHOP: Future of drainage under environmental challenges and emerging technologies
Results II
Acidity of discharge water
Results III

Yields

Yields kg ha\(^{-1}\)

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<tr>
<td>Barley</td>
<td>CDI</td>
<td>CD</td>
<td>CD</td>
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<tr>
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<td>CDI</td>
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</tbody>
</table>

Legend:
- CDI
- CD
- Ref
Discussion

Precipitation percentage (1980-2010)

Summer 2006

Precipitation percentage in summers during The experimental period

2010

2011

2012

2013

2014
Conclusions

• The off-site hazards of AS soils can be slightly mitigated by controlled drainage and subirrigation
  -> Effects in dry summer are unknown

• Yields were higher only in one summer
  -> Effects in dry summer are unknown
Thank you for your attention!

Merci beaucoup pour votre attention!

Acknowledgements to: