Pesticide residues in vineyard soils and water-eroded sediments

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Sao Lourenco sub-basin

- Total area: 620 ha – Vineyards: 198 ha

- Integrated pest management (IPM)
  - Pesticide application Spring-summer
  - Previous works on water contamination

- Minimum tillage
  - Ploughing in Autumn
  - 10-15 cm deep, in alternate inter-rows strips, being the strips plowed every other year

- Erosion rates up to 30 Mg/ha year.
  - High intensity rainfall events in autumn and winter

**Double threat: soil erosion & soil contamination? (off-site contamination)**

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<table>
<thead>
<tr>
<th></th>
<th>HC1</th>
<th>LU1</th>
<th>CC1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soils</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humic cambisol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromic luvisol</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Calcic cambisol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average slope</strong></td>
<td>7,8°</td>
<td>6,3°</td>
<td>10,3°</td>
</tr>
<tr>
<td><strong>Plant cover</strong></td>
<td>3%</td>
<td>39%</td>
<td>54%</td>
</tr>
<tr>
<td><strong>Soil texture</strong></td>
<td>Sandy Loam</td>
<td>Loam</td>
<td>Silty Clay</td>
</tr>
<tr>
<td>- Sand</td>
<td>75%</td>
<td>43%</td>
<td>4%</td>
</tr>
<tr>
<td>- Silt</td>
<td>11%</td>
<td>20%</td>
<td>40%</td>
</tr>
<tr>
<td>- Clay</td>
<td>14%</td>
<td>37%</td>
<td>56%</td>
</tr>
<tr>
<td><strong>Mean organic matter</strong></td>
<td>2,4%</td>
<td>4,3%</td>
<td>3,7%</td>
</tr>
<tr>
<td><strong>Mean pH</strong></td>
<td>5,7</td>
<td>6,4</td>
<td>8,5</td>
</tr>
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Winter 2015

Soil survey
Runoff-erosion experiment

Fields: HC1, CC1, LU1
N soil samples=54 (3 samples/field * 6 sampling times)
N sediment samples=42+38 (3+3 samples/field * 6 readouts)

Fall 2016

Soil survey

HC1, HC2, HC3, CC1, CC2, CC3, LU1, LU2, LU3
N soil samples =108 (6 samples/depth/field)

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Winter 2015

Soil survey
Runoff-erosion experiment

Fields: HC1, CC1, LU1
N soil samples = 54 (3 samples/field * 6 sampling times)
N sediment samples = 42 + 38 (3 + 3 samples/field * 6 readouts)

Farmers interviews

48 pesticide residues tested/sample
LC-MS/MS & GC-MS/MS
LoQs: 0.01 - 0.05 mg/kg

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Fall 2016

Soil survey

HC1, HC2, HC3, CC1, CC2, CC3, LU1, LU2, LU3
N soil samples = 108 (6 samples/depth/field)

HC= humic cambisols, CC= calcic cambisols, LU=chromic luvisols

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<table>
<thead>
<tr>
<th>sampling</th>
<th>Date</th>
<th>Readout</th>
<th>Total rainfall (mm)</th>
<th>Max rainfall intensity (mm h⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2015-12-09</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>2015-12-29</td>
<td>1</td>
<td>44.00</td>
<td>8.40</td>
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<tr>
<td>2</td>
<td>2016-01-04</td>
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<td>15.4</td>
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<td>-</td>
<td>2016-01-25</td>
<td>5</td>
<td>33.1</td>
<td>13.5</td>
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<tr>
<td>5</td>
<td>2016-02-16</td>
<td>6</td>
<td>221.5</td>
<td>12.2</td>
</tr>
</tbody>
</table>
2015 soil survey – initial pool – sampling 0 – 9/12/2015

No. pesticides residues in soil

Frequency of detection

Pesticide content in soil

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## Pesticides in soil - time evolution

**HC1 LU1 CC1**

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2015 soil samples VS sediment samples

Frequency of detection

- AMPA
- Dimethomorph
- Glyphosate
- Pyraclostrobin
- Pyrimethanil
- Tebuconazole

Pesticide content in soil
(median concentrations, mg/kg)

- Tebuconazole
- Pyrimethanil
- Pyraclostrobin
- Dimethomorph
- AMPA
- Glyphosate

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2015 soil samples VS sediment samples
Sediment and pesticide export

HC1

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Sediment and pesticide export

LU1
Sediment and pesticide export

CC1

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2016 soil survey – overall

No. pesticides residues in soil

- **0-2 cm**
  - >5: 28%
  - 2-5: 72%

- **15 cm**
  - >5: 11%
  - 2-5: 87%

Frequency of detection

- **0-2 cm**
  - AMPA: 100%
  - Azoxystrobin: 75%
  - Dieldrin: 50%
  - Dimethomorph: 25%
  - Folpet: 25%
  - Glyphosate: 100%
  - Metalaxyl: 100%
  - Penconazole: 75%
  - Pyraclostrobin: 75%
  - Pyrimethanil: 50%
  - Tebuconazole: 50%

- **15 cm**
  - AMPA: 100%
  - Azoxystrobin: 100%
  - Dieldrin: 75%
  - Dimethomorph: 75%
  - Folpet: 50%
  - Glyphosate: 50%
  - Metalaxyl: 50%
  - Penconazole: 75%
  - Pyraclostrobin: 75%
  - Pyrimethanil: 100%
  - Tebuconazole: 75%

Pesticide content in soil

- **0-2 cm**
  - Penconazole
  - Metalaxyl
  - Glyphosate

- **15 cm**
  - Penconazole
  - Metalaxyl
  - Glyphosate

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Spatial distribution patterns

Pesticide levels:
- Higher at bottom of the slopes
- No relation with position within or between vine rows.
- Soil depth:

Dilution effect (average values of paired samples ratios)
CONCLUSIONS

• All tested soil samples had pesticide residues
  ➔ Cocktail effects?
  ➔ Adaptions on pesticide risk assessment procedure?

• Intensive pesticide use turns soils into pesticide sinks
  ➔ Pesticide alternatives?
  ➔ Soil and water quality?

• Soil erosion leads to lateral transport of pesticides
  ➔ Soil erosion mitigation strategies?
  ➔ Trade-off between the use of glyphosate based herbicides and ploughing?
Thank you for your attention!

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