

Pesticide residues in vineyard soils and water-eroded sediments

Vera SILVA¹, Bert ZUILHOF, Sjors
BUSINK, Oscar GONZALEZ-PELAYO²,
Nelson ABRANTES², Jan Jacob KEIZER²,
Hans MOL³, Coen RITSEMA¹, Violette
GEISSEN¹

¹ Soil Physics and Land Management Group,
Wageningen University & Research, The
Netherlands

² Earth Surface Processes team, Centre for
Environmental and Marine Studies (CESAM),
University of Aveiro, Portugal

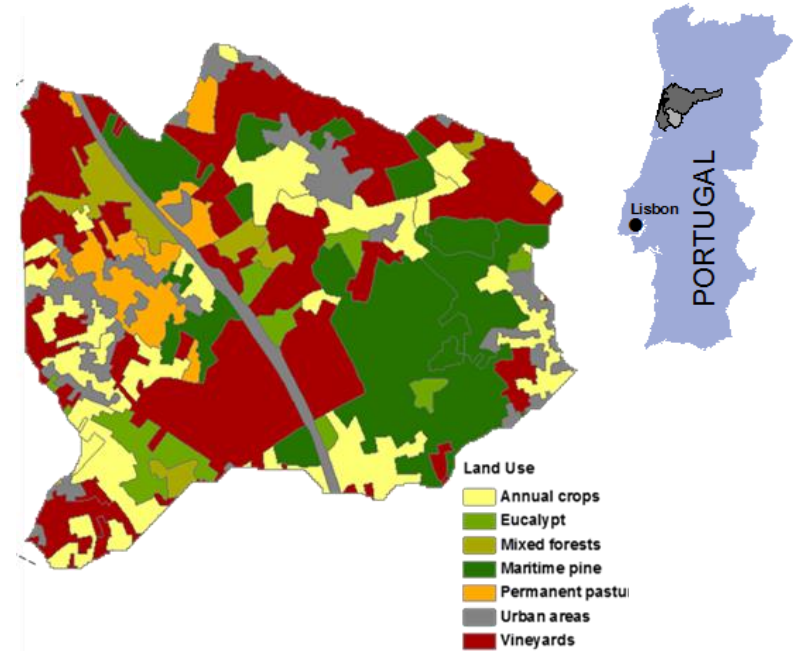
³ Wageningen Food Safety Research
(WFSR), The Netherlands

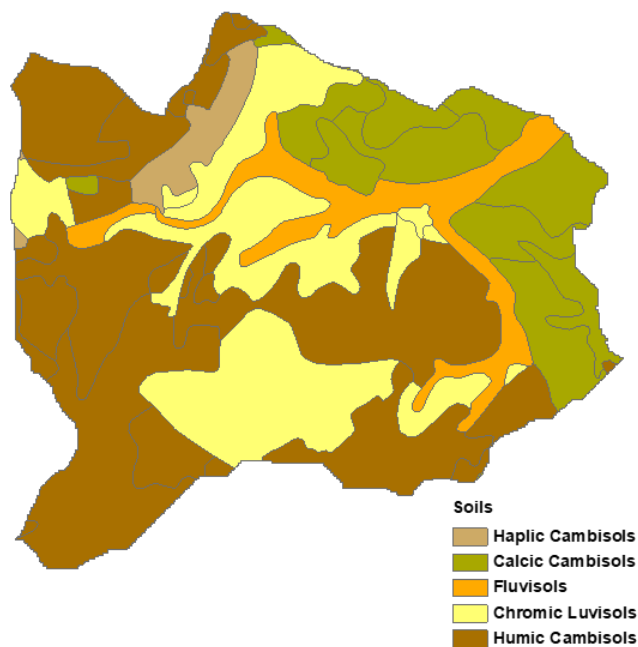


Sao Lourenco sub-basin

- 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)**





HC1



LU1



CC1



| | <u>Humic cambisol</u> | <u>Chromic luvisol</u> | <u>Calcic cambisol</u> |
|---------------------|-----------------------|------------------------|------------------------|
| Average slope | 7,8° | 6,3° | 10,3° |
| Plant cover | 3% | 39% | 54% |
| Soil texture | Sandy Loam | Loam | <u>Silty Clay</u> |
| - Sand | 75% | 43% | 4% |
| - Silt | 11% | 20% | 40% |
| - Clay | 14% | 37% | 56% |
| Mean organic matter | 2,4% | 4,3% | 3,7% |
| Mean pH | 5,7 | 6,4 | 8,5 |

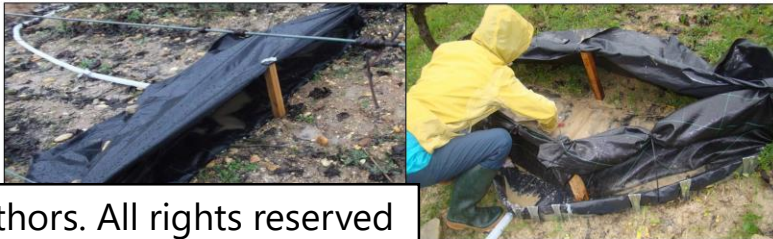
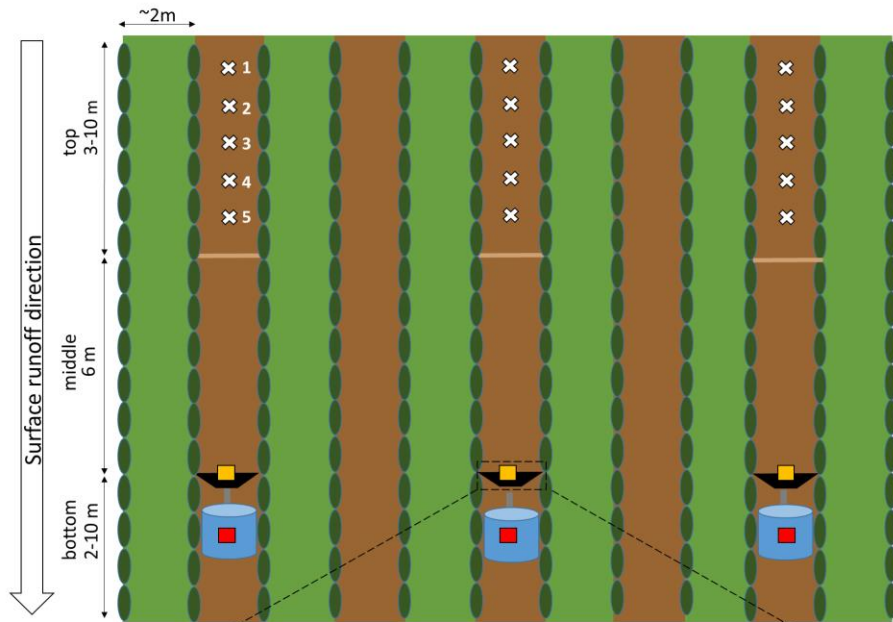
Winter 2015

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)



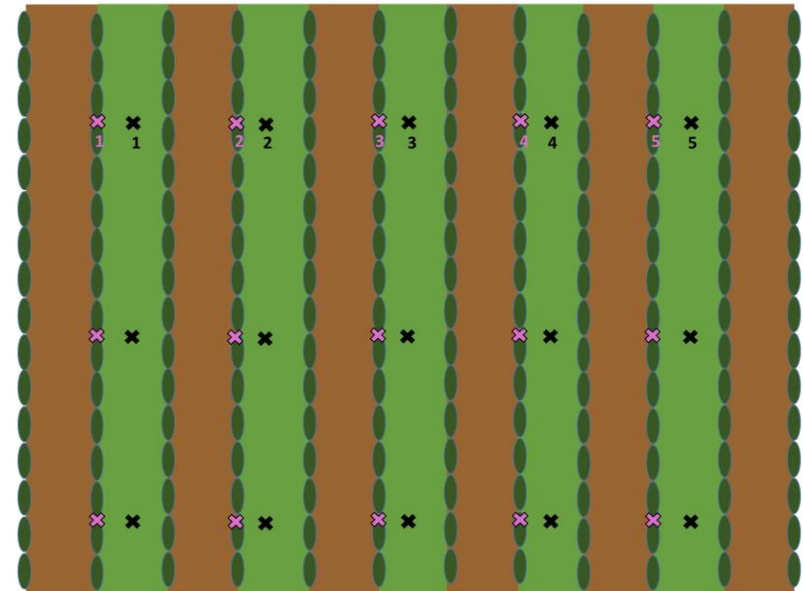
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Fall 2016

Soil survey

HC1, HC2, HC3, CC1, CC2, CC3, LU1, LU2, LU3

N soil samples =108 (6 samples/depth/field)



- ⊗ Soil_IR_P sub-sample (0-2 cm)
- ⊗ Soil_R sub-sample (0-2 cm and 15 cm)
- ⊗ Soil_IR_NP sub-sample (0-2 cm and 15 cm)

■ Sediment > 38 μ m

■ Sediment < 38 μ m

- Channel
- ▤ Sediment fence
- Hose
- Storage tank

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

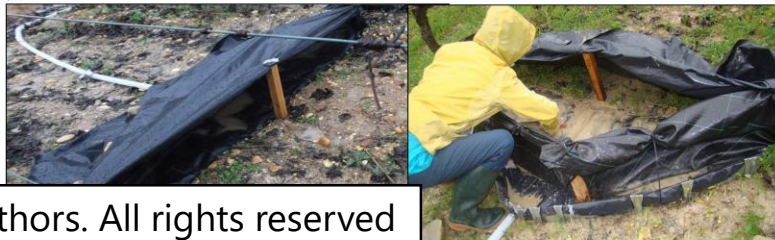
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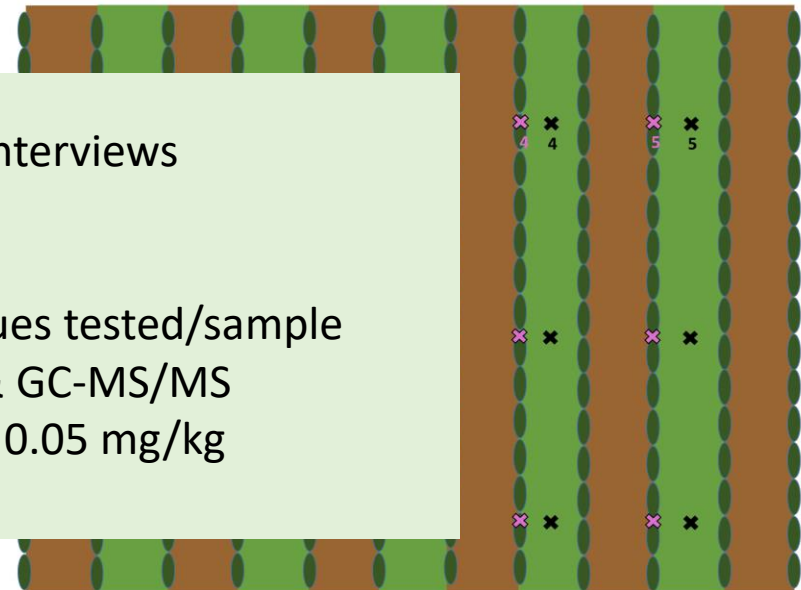
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Fall 2016

Soil survey

HC1, HC2, HC3, CC1, CC2, CC3, LU1, LU2, LU3

N soil samples =108 (6 samples/depth/field)

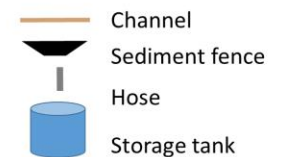


Farmers interviews



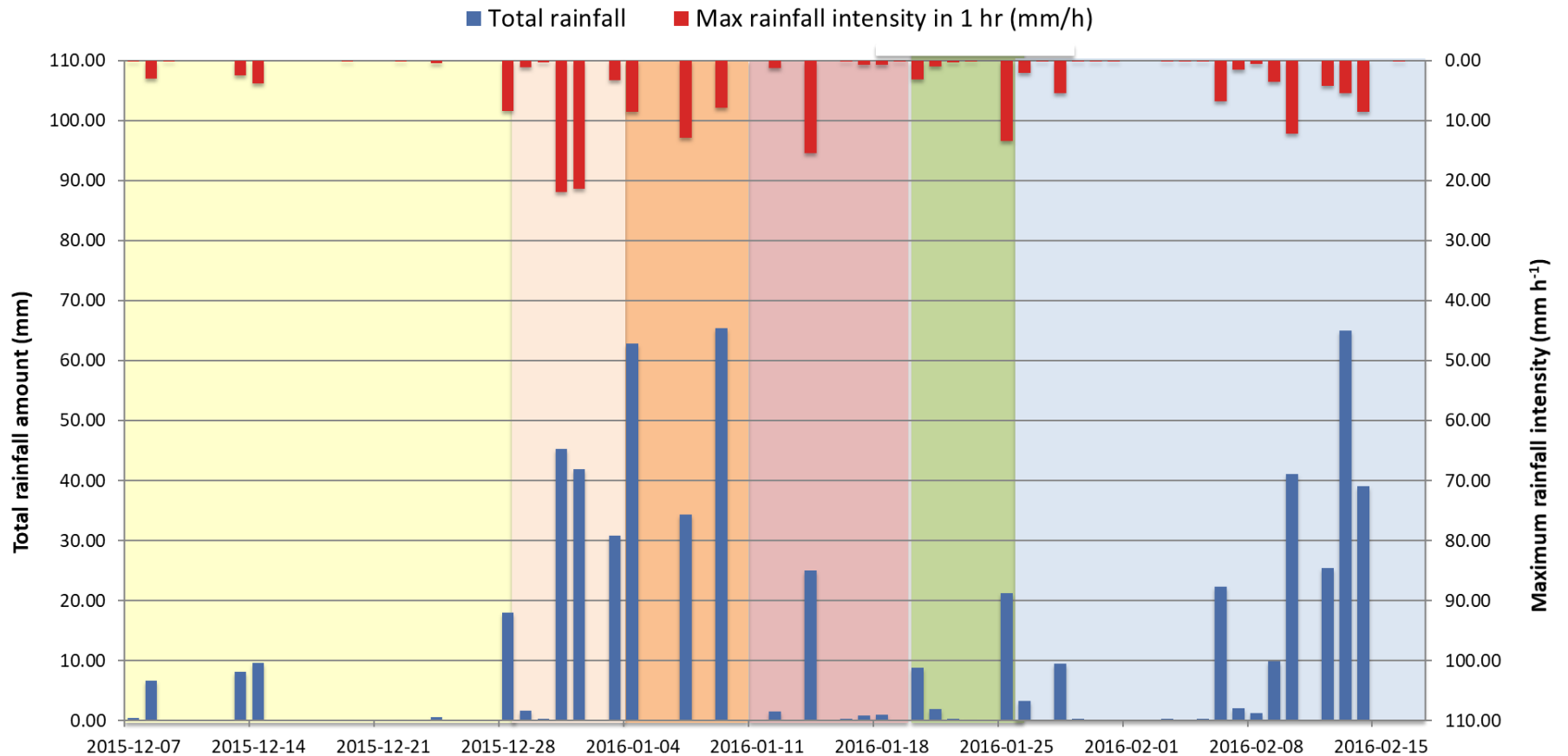
48 pesticide residues tested/sample
LC-MS/MS & GC-MS/MS
LoQs: 0.01 - 0.05 mg/kg

- ⊗ Soil_IR_P sub-sample (0-2 cm)
- ⊗ Soil_R sub-sample (0-2 cm and 15 cm)
- ⊗ Soil_IR_NP sub-sample (0-2 cm and 15 cm)
- Sediment > 38 µm
- Sediment < 38 µm



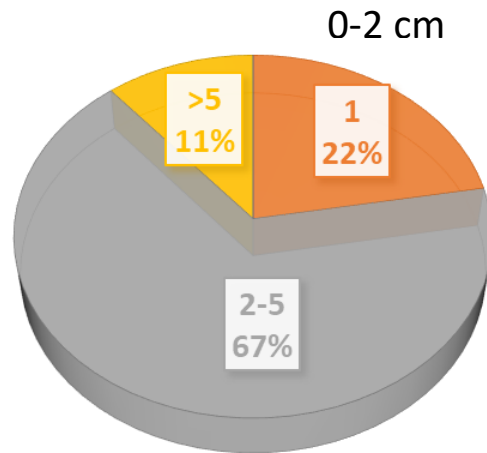
HC= humic cambisols, CC= calcic cambisols, LU=chromic luvisols

| sampling | Date | Readout | Total rainfall (mm) | Max rainfall intensity (mm h ⁻¹) |
|----------|------------|---------|------------------------|---|
| 0 | 2015-12-09 | - | | |
| 1 | 2015-12-29 | 1 | 44.00 | 8.40 |
| 2 | 2016-01-04 | 2 | 120.25 | 21.94 |
| 3 | 2016-01-11 | 3 | 162.58 | 12.8 |
| 4 | 2016-01-19 | 4 | 29.3 | 15.4 |
| - | 2016-01-25 | 5 | 33.1 | 13.5 |
| 5 | 2016-02-16 | 6 | 221.5 | 12.2 |

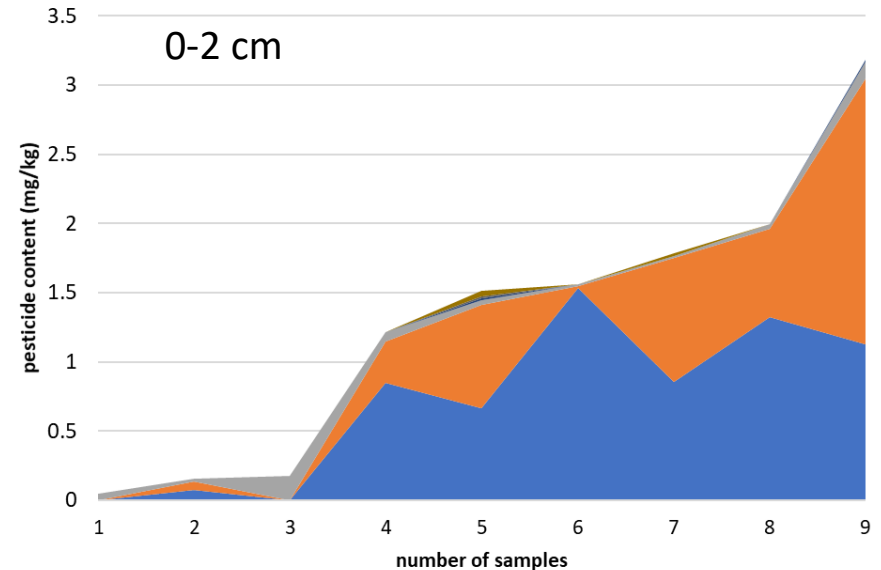


2015 soil survey – initial pool – sampling 0 – 9/12/2015

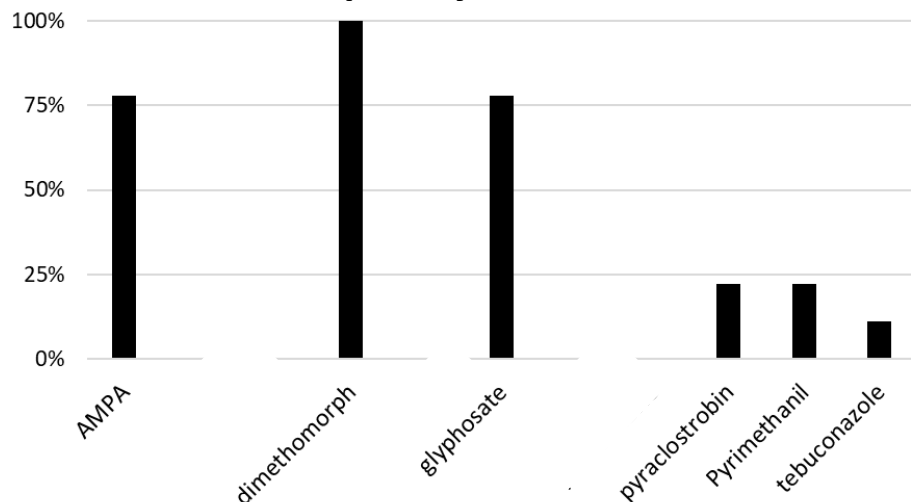
No. pesticides residues in soil



Pesticide content in soil



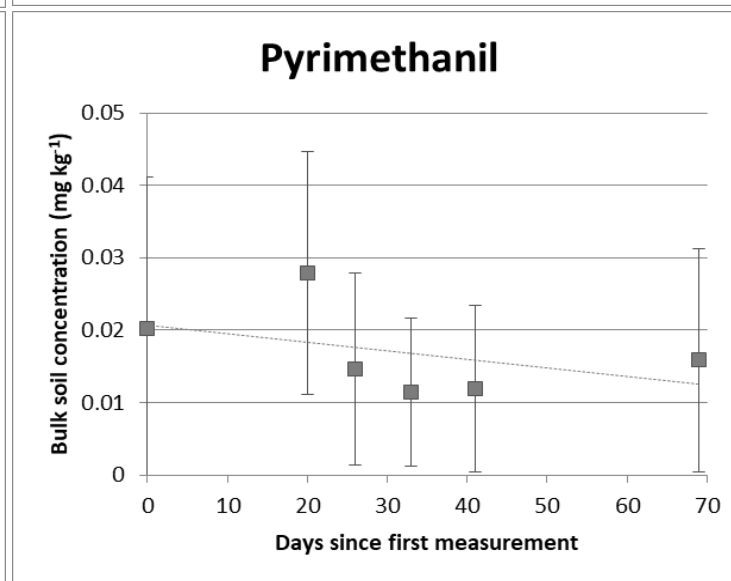
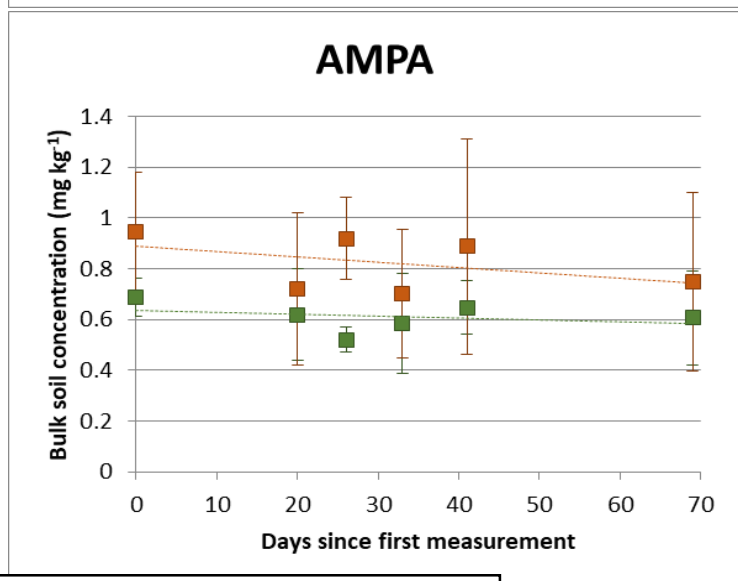
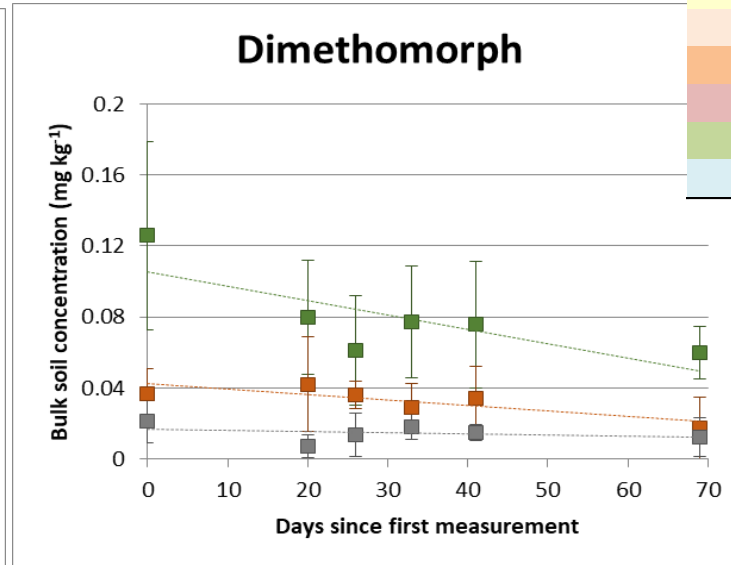
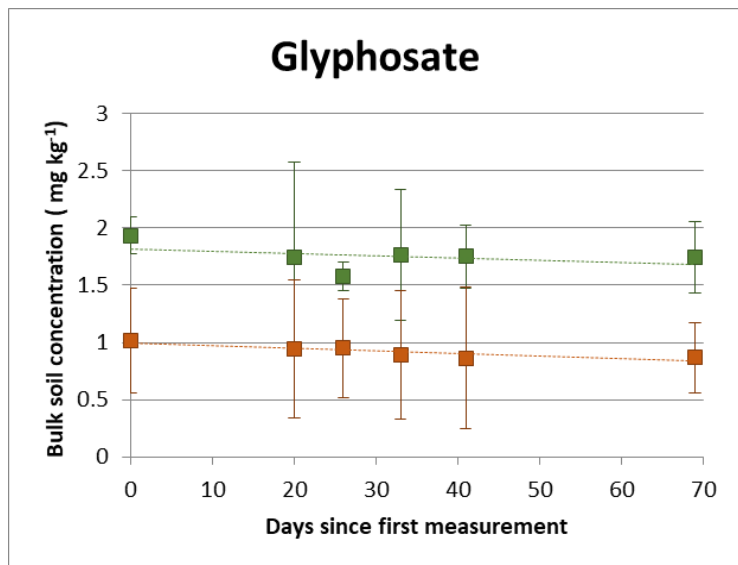
Frequency of detection



Pesticides in soil - time evolution

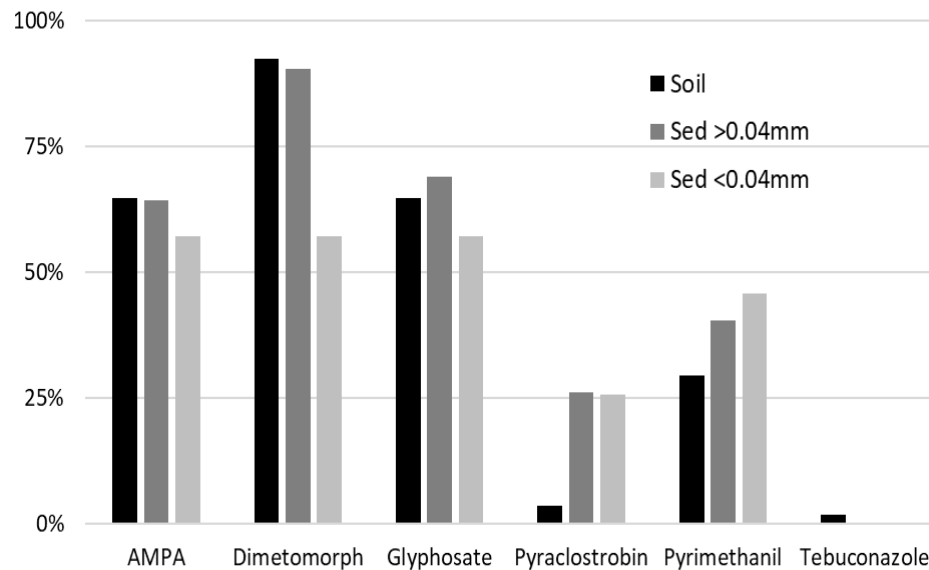
HC1 LU1 CC1

| sampling | Date |
|----------|------------|
| 0 | 2015-12-09 |
| 1 | 2015-12-29 |
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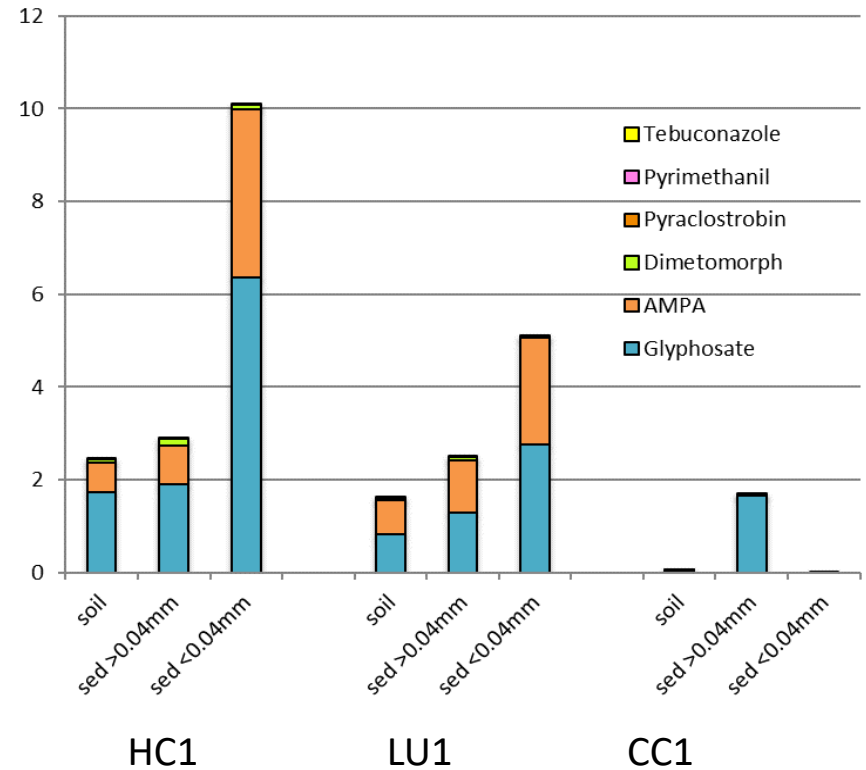


2015 soil samples VS sediment samples

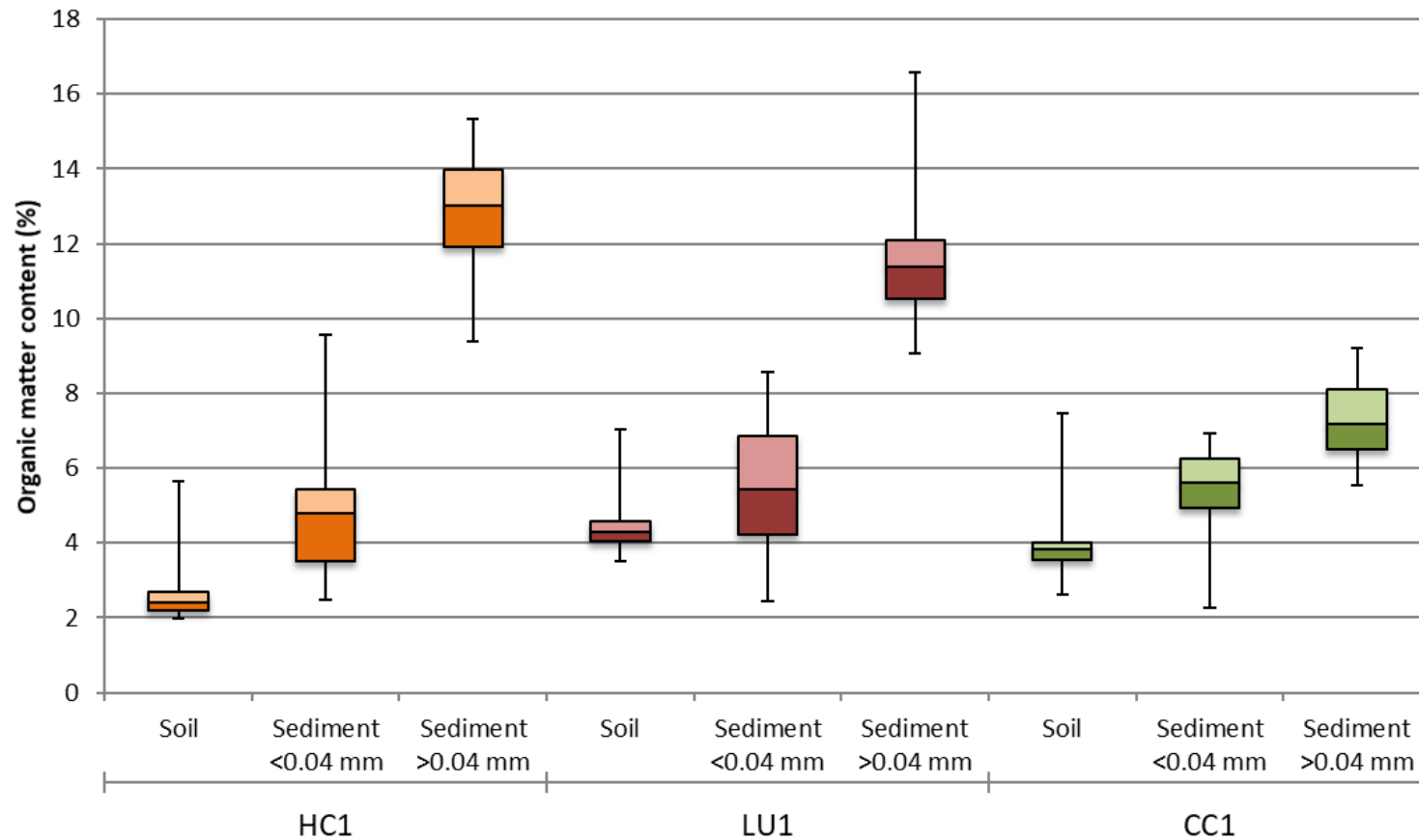
Frequency of detection



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

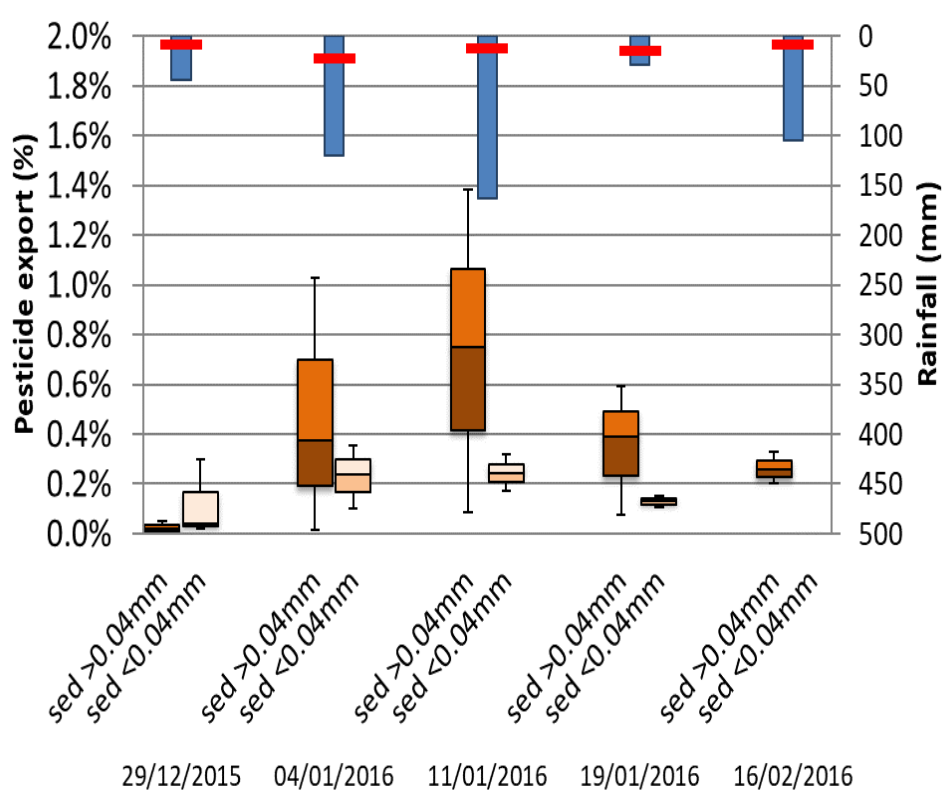
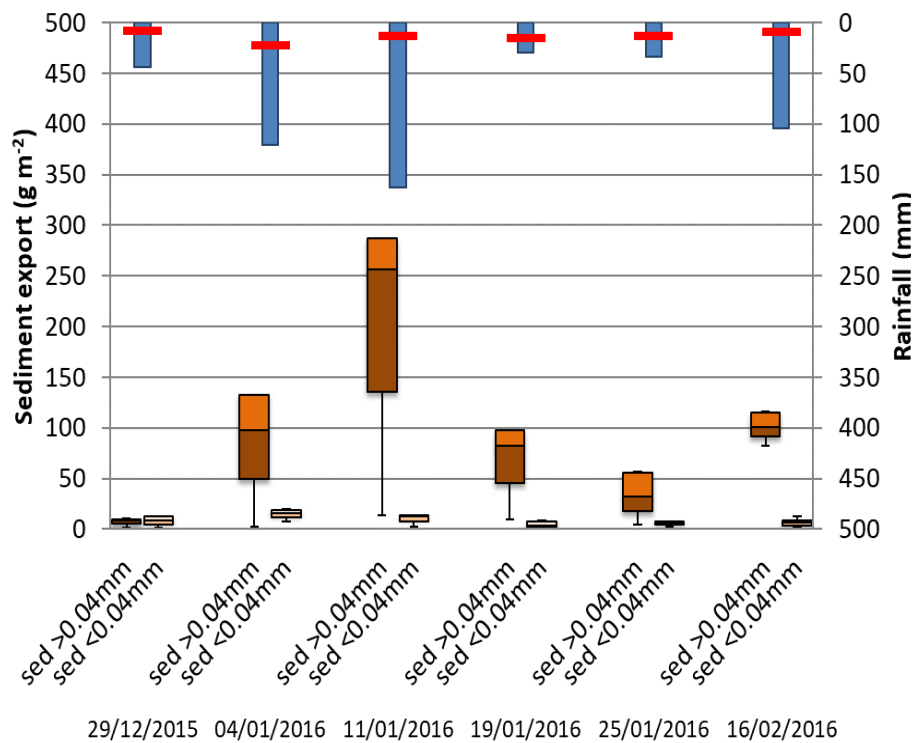


2015 soil samples VS sediment samples



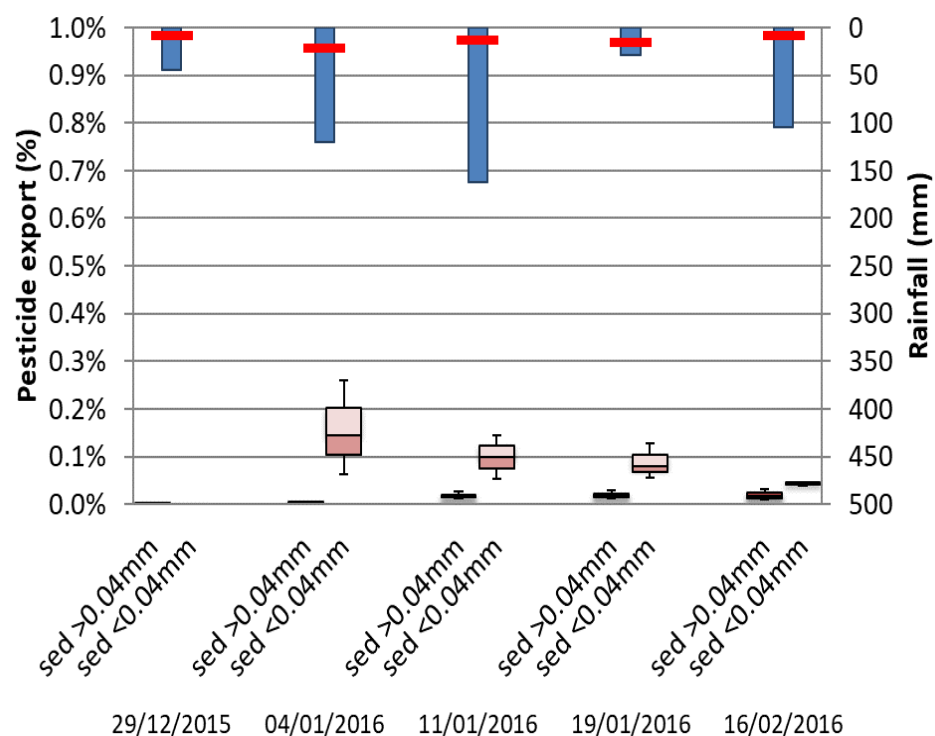
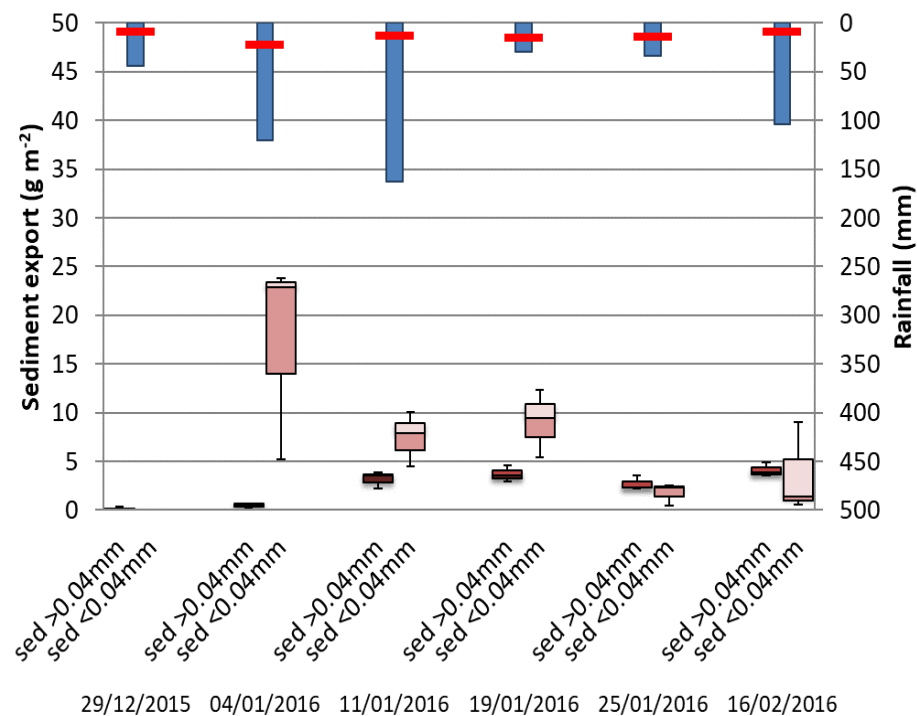
Sediment and pesticide export

HC1



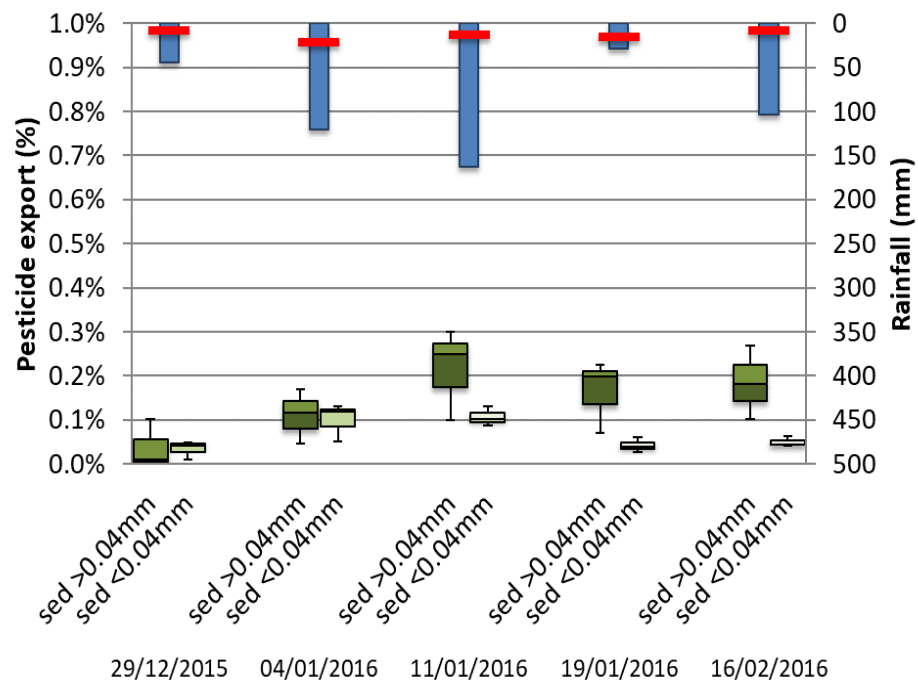
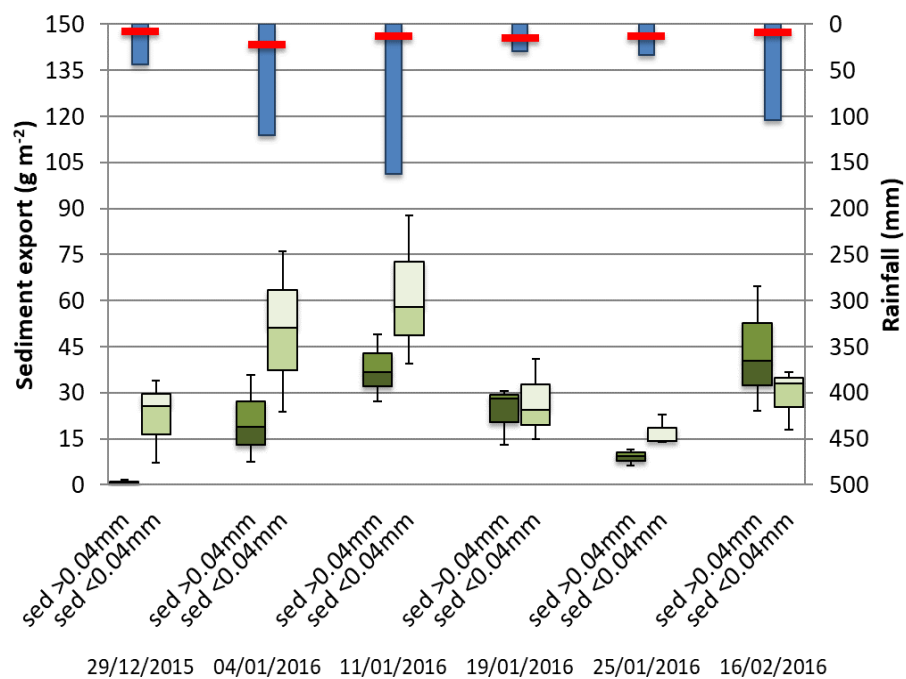
Sediment and pesticide export

LU1



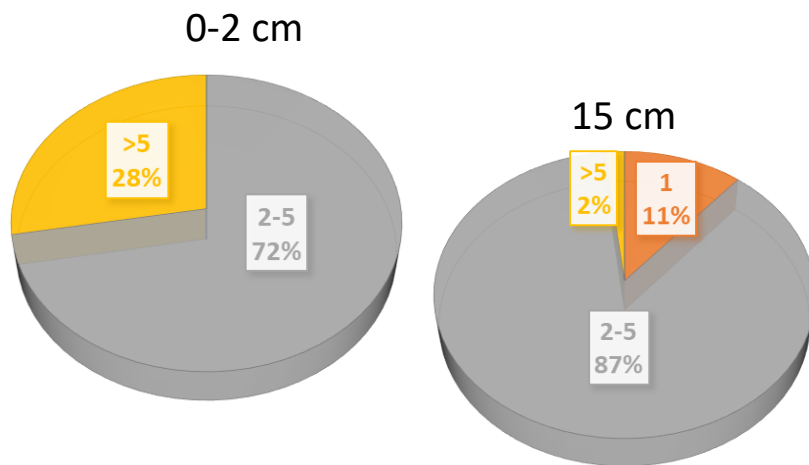
Sediment and pesticide export

CC1

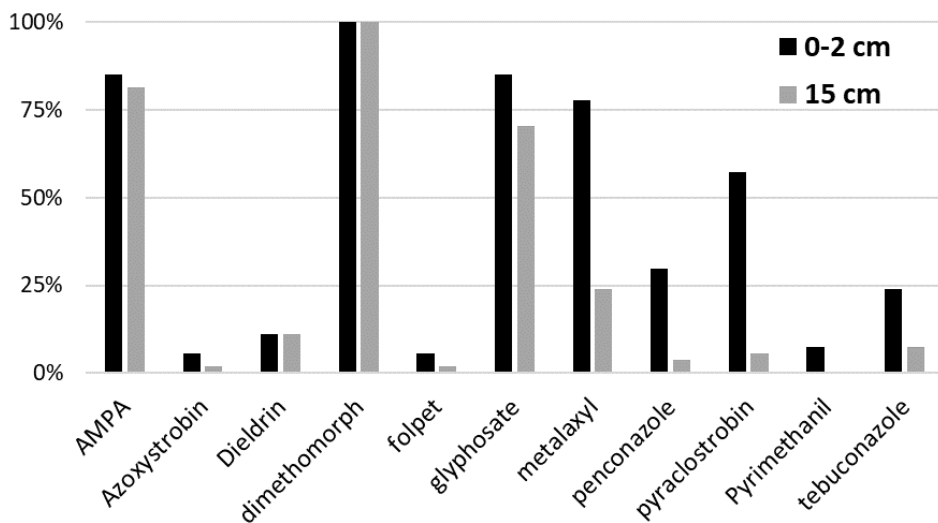


2016 soil survey – overall

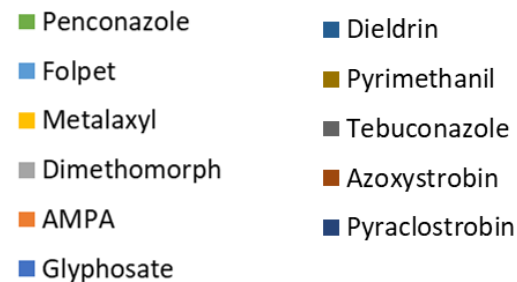
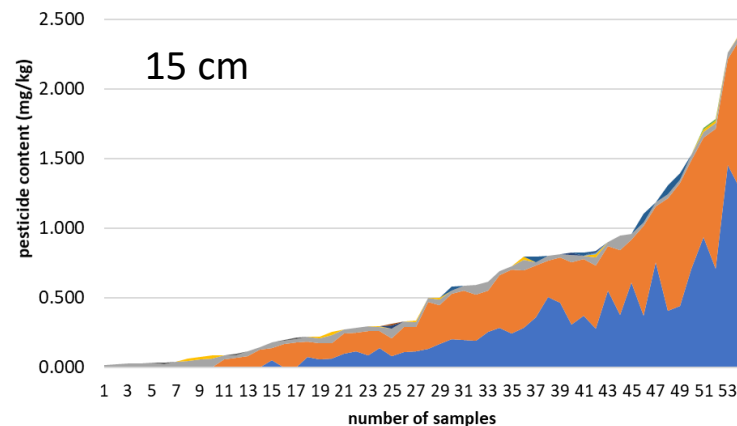
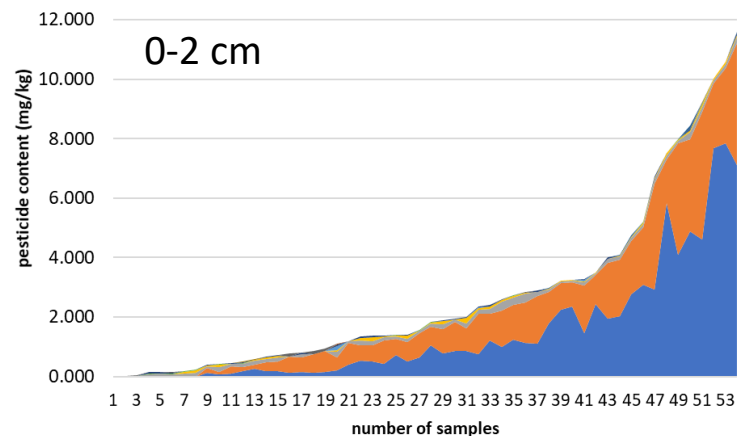
No. pesticides residues in soil



Frequency of detection



Pesticide content in soil

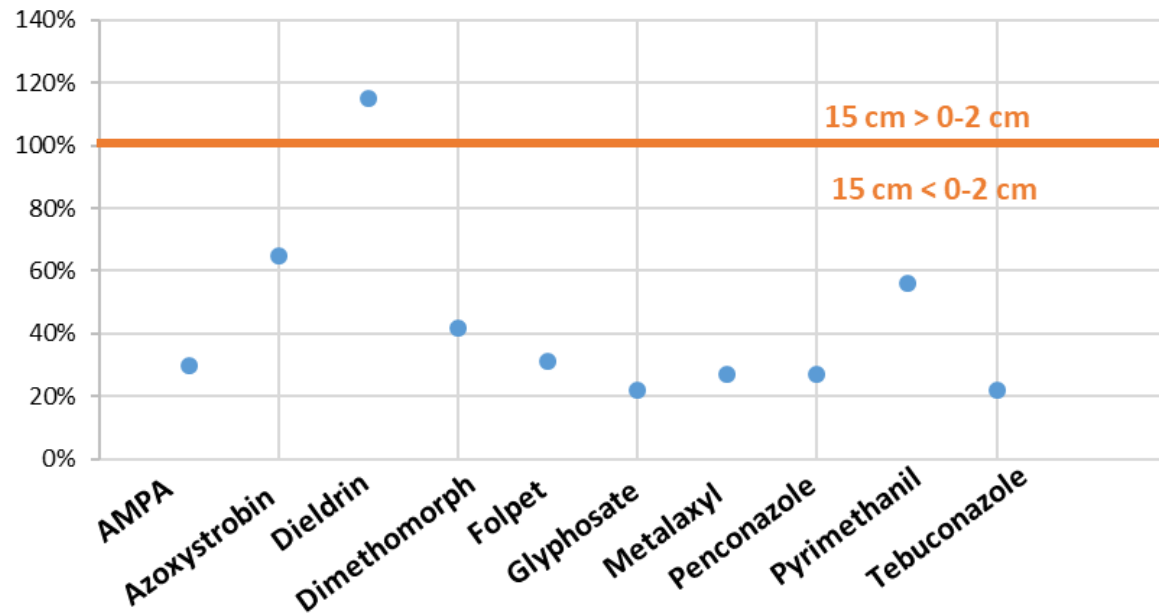


Spatial distribution patterns

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!



Earth Surface Processes Team,
University of Aveiro.

