



Sveriges lantbruksuniversitet  
Swedish University of Agricultural Sciences

# Surface runoff of pesticides in Sweden

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Workshop on pesticide fate in soil and water in the northern zone  
Uppsala 7-8 September 2016

## 1. Field experiments

Larsbo, M., M. Sandin, N. Jarvis, A. Etana, and J. Kreuger (2016),  
Surface Runoff of Pesticides from a Clay Loam Field in Sweden,  
*Journal of Environmental Quality*, 45, 1367-1374.



## 2. Lab experiments – soil consolidation



1 2 3 4 5



6 7 8 9

## Background

**Surface runoff is considered an important pathway for pesticide losses to surface waters**

- Losses are typically about 0.5% of applied doses (Burgoa and Wauchope, 1995)
- FOCUS Surface runoff scenarios
- In Sweden buffer zones are needed for products containing substances which do not pass the R1 scenario

**Very limited data on surface runoff of pesticides for the northern zone**

- Siimes et al. (2006)
  - 95% of surface runoff during snowmelt
  - Losses of ethofumesate, glufosinate-ammonium and glyphosate <1% of applied
  - Concentrations were higher during the growing season but losses were larger during snowmelt
- Riise et al. (2004)
  - Three fields studied during three years
  - Relative losses of bentazone and propiconazole <0.36%
- Data from Röbbäcksdalen (no pesticides)
  - **Surface runoff every third year during spring application period**

**Finnish and Norwegian studies presented yesterday**

Burgoa, B., and R. D. Wauchope (1995), *Pesticides in run-off and surface waters*, In: T.R. Roberts and P.C. Kearney, editors. *Environmental behavior of agrichemicals*. John Wiley & Sons, New York. P.221-255.

Siimes, K., S. Ramo, L. Welling, U. Nikunen, and P. Laitinen (2006), Comparison of the behaviour of three herbicides in a field experiment under bare soil conditions, *Agricultural Water Management*, 84(1-2), 53-64.

Riise, G., H. Lundekvam, Q. L. Wu, L. E. Haugen, and J. Mulder (2004), Loss of Pesticides from Agricultural Fields in SE Norway – Runoff Through Surface and Drainage Water, *Environmental Geochemistry and Health*, 26(2), 269-276.

## The objective of our study was to quantify pesticide losses in surface runoff in a conventionally managed field in Sweden

- Relate losses during the growing season to near-saturated hydraulic conductivities
- Focus on losses during winter/spring periods

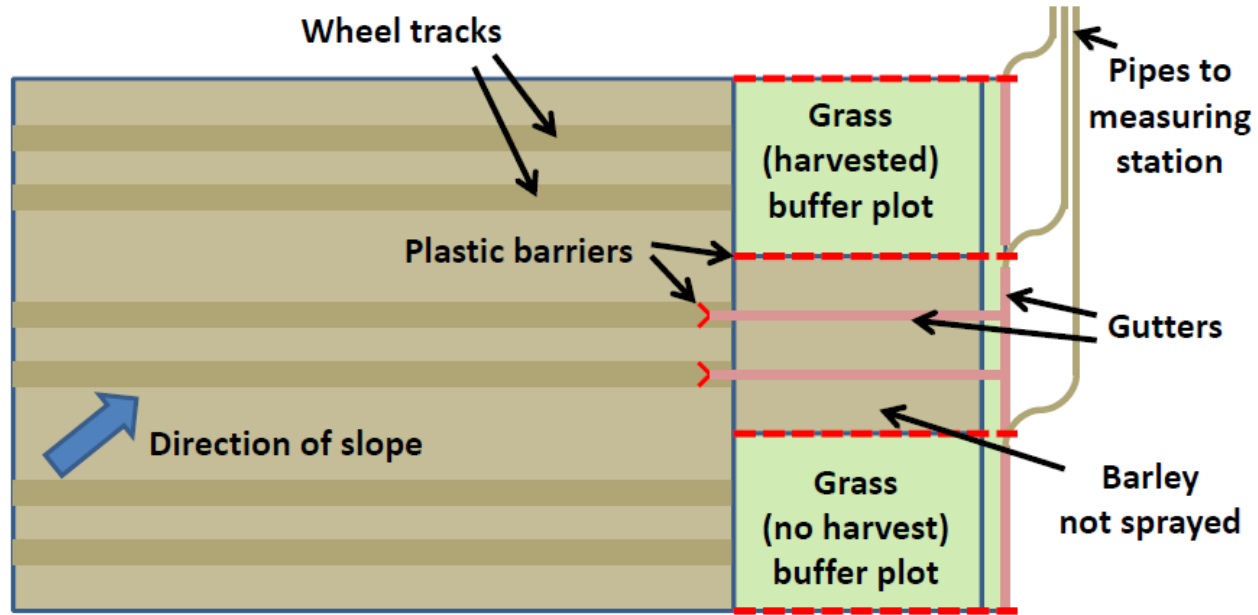


## Materials and methods

### Experimental field site established in 2011 outside Uppsala

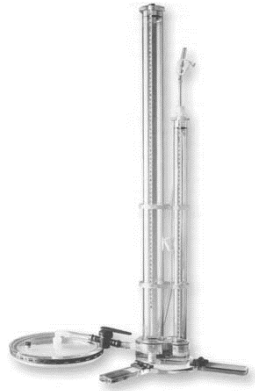
- 1% slope
- Clay loam (32% clay, 33% silt, 35% sand, 1.4% org. C)
- 12 drained plots with collection gutters
- Automatic flow proportional sampling
- 2012: Spring pesticide application
- 2013: Spring pesticide application, autumn glyphosate application
- 2014: Spring pesticide application, autumn glyphosate application

# Materials and methods

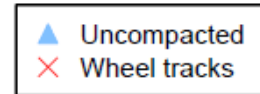
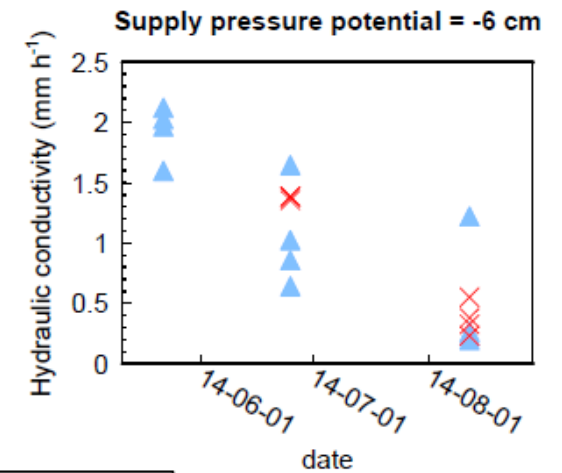
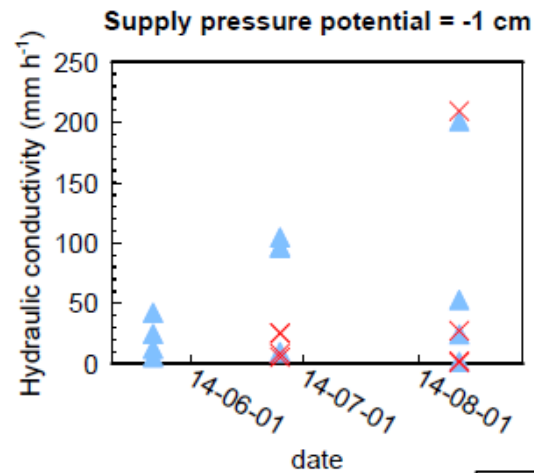
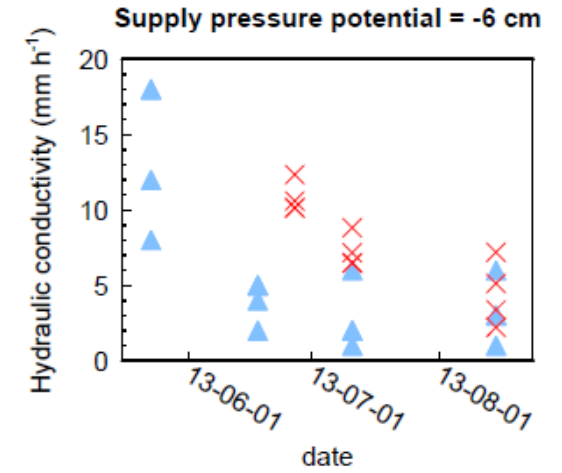
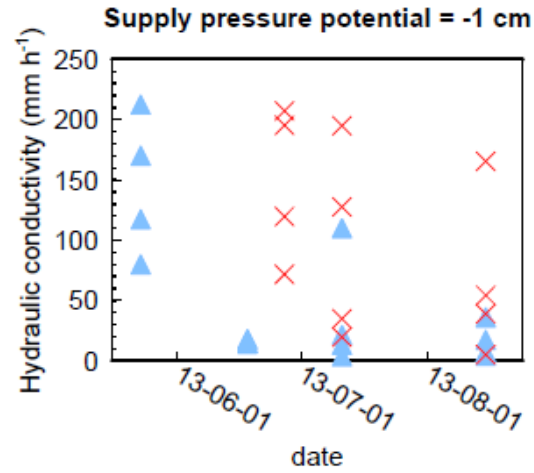
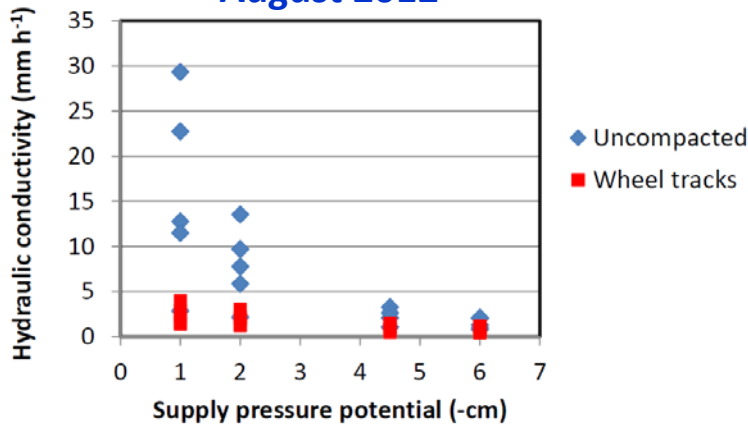




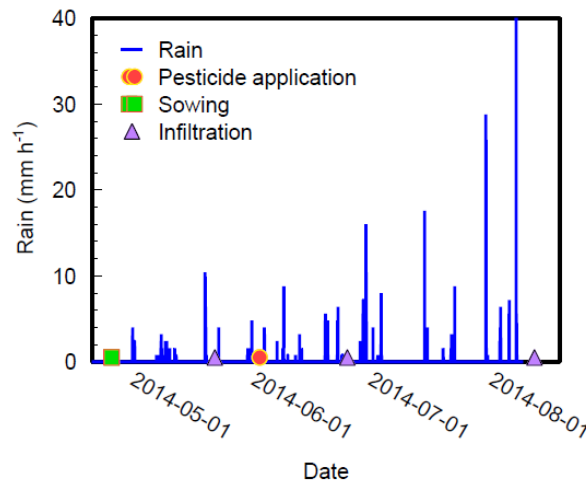
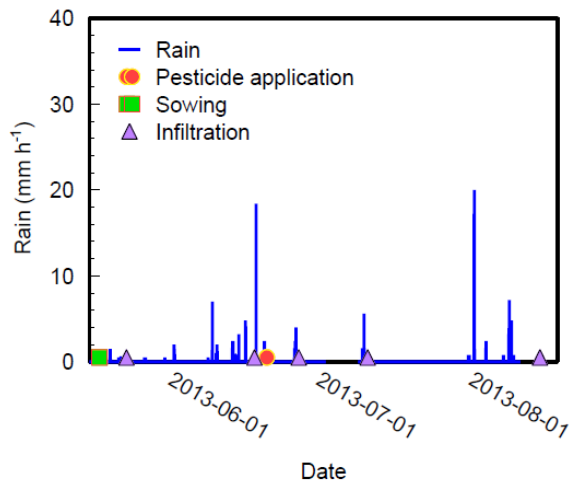
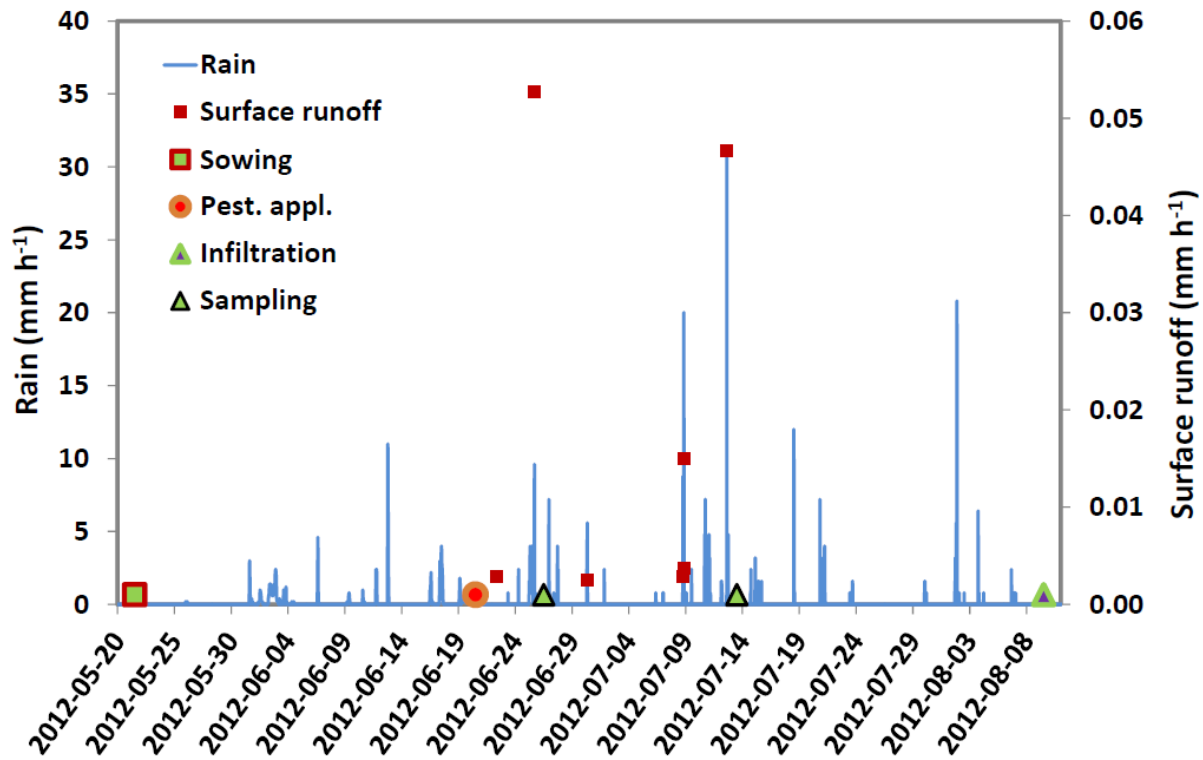
# Results- hydraulic conductivities



August 2012



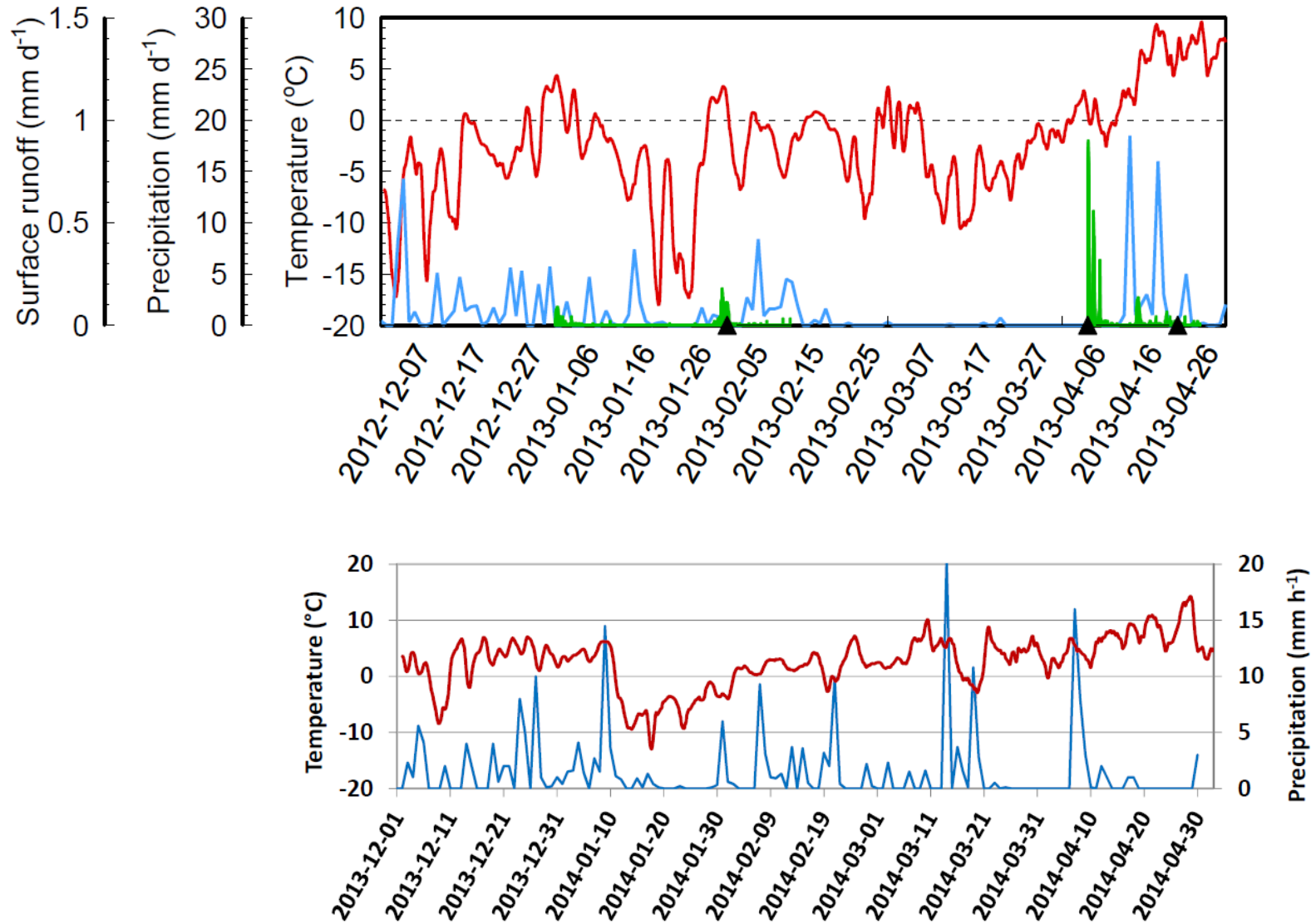
# Results – runoff events during growing seasons



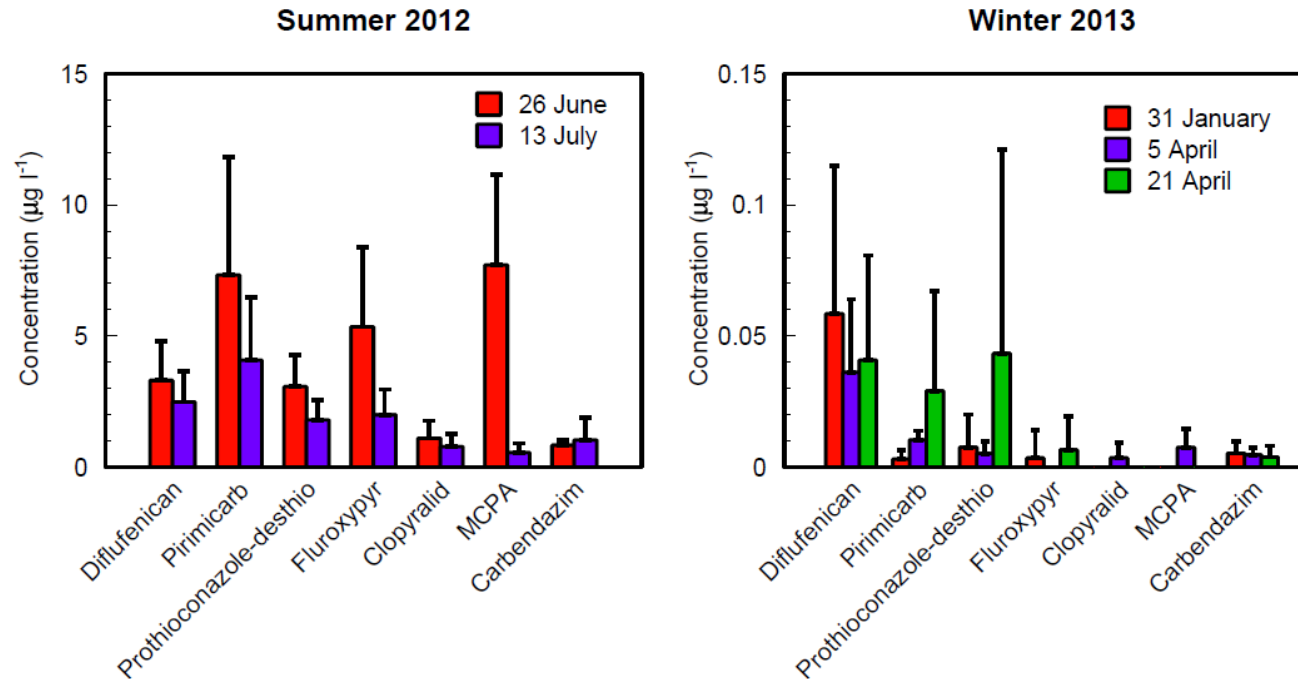




## Results – runoff events during winter/spring periods

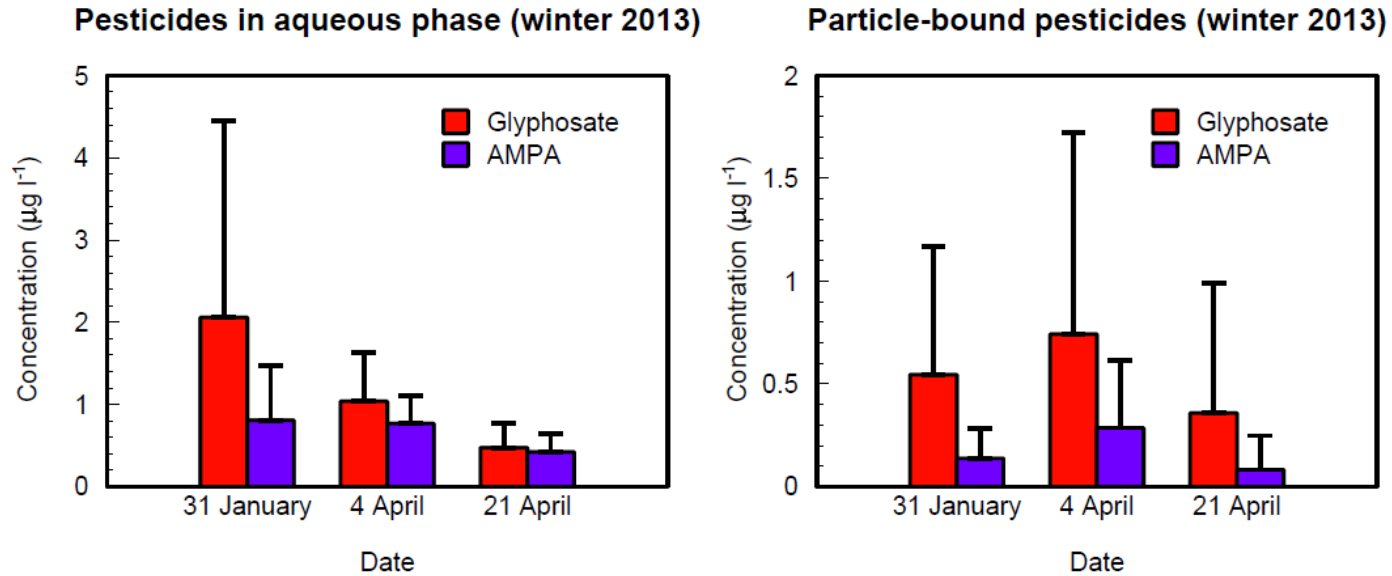


## Results – spring applied pesticide concentrations



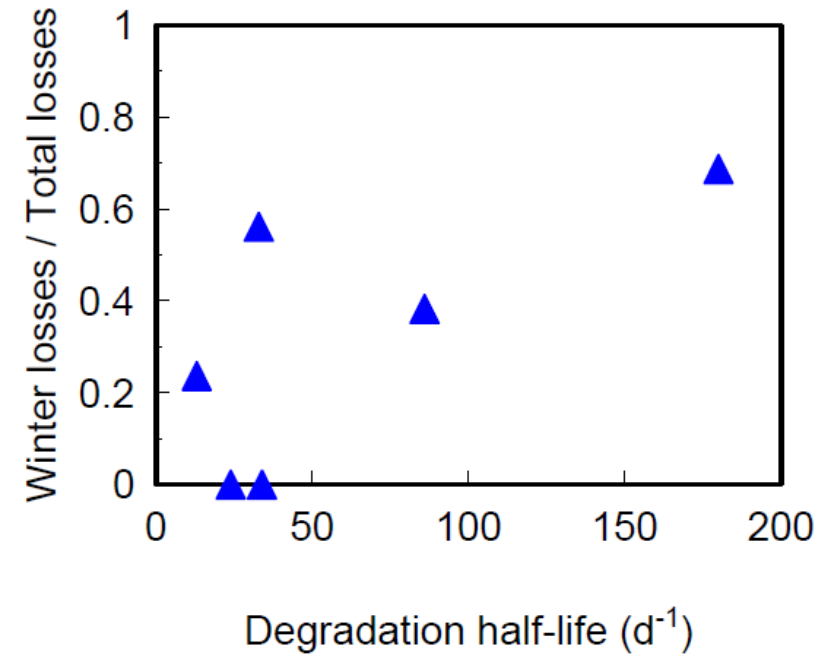
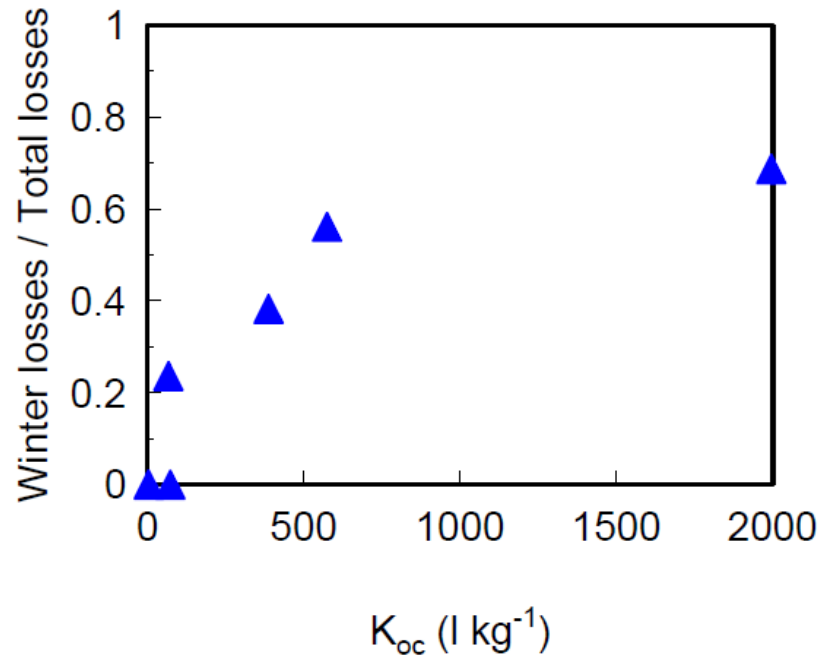
**Total losses were between 0.0012% (MCPA) and 0.0091 (diflufenican)  
On average about 50% of the losses occurred during snowmelt**

## Results – glyphosate and AMPA concentrations



**Total losses of glyphosate and AMPA in both phases were 0.021% of the applied amount of glyphosate**

## Results – pesticide properties



## Conclusions

- Surface runoff of pesticides does occur in the northern zone
- Snow melt periods are important
- Traffic compaction and structural degradation due to raindrop impact seem to be important
- Data are still very limited



# Lab experiments – soil consolidation

## Background

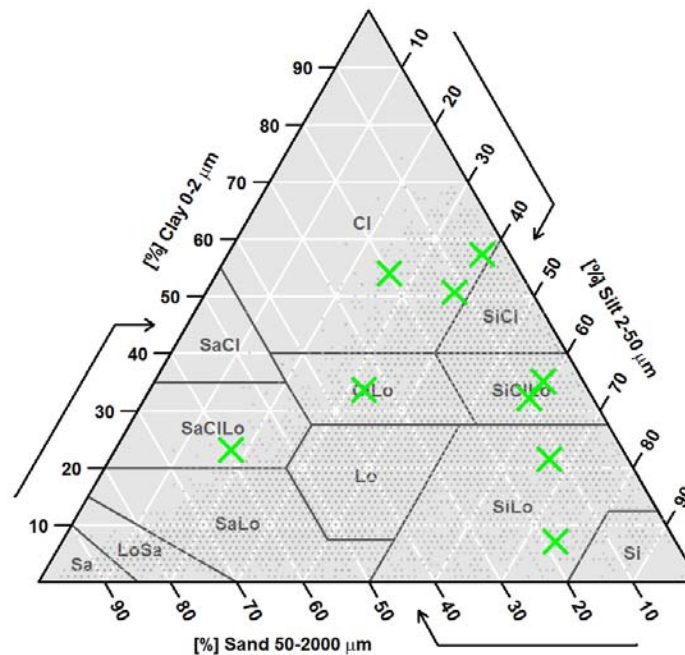
- Pore networks and hydraulic properties are not constant in time (e.g. Sandin et al. 2017)
  - Infiltration, surface runoff and water flow through the soil
- Not included in models used for risk assessment
- Available data are very limited

**The objective of the study is to collect data that are useful for model development and testing**



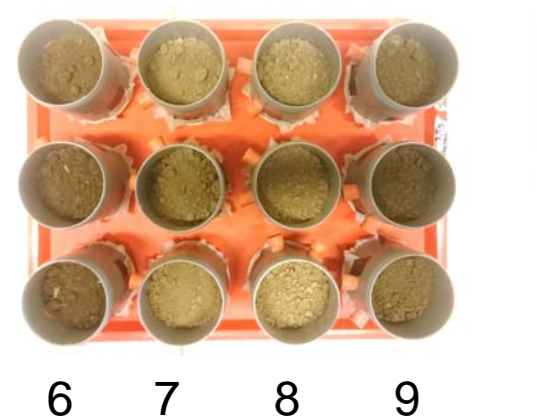
# Methods

	Clay (%)	Silt (%)	Sand (%)	Org. C (%)
1. Ålbo	21.5	66.6	11.9	1.6
2. Krusenberg	33.7	32.4	33.9	1.4
3. Ultuna I	50.7	37.6	11.7	1.2
4. Säby I	35.1	58.8	6.1	3.3
5. Säby III	57.3	38.5	4.2	2.4
6. Röbbäcksdalen	7.1	74.7	18.2	4.0
7. Ultuna II	23.2	17.5	59.3	1.2
8. Ultuna III	54	26.1	19.9	1.5
9. Säby II	32.2	58.2	9.6	2.5

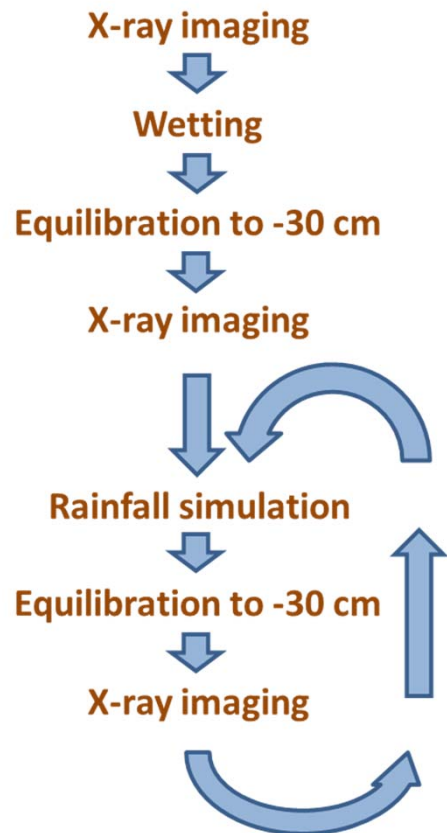


## Methods

- We sampled the harrowed layer directly after sowing
- The soil was placed in plastic cylinders (6-cm depth, 7-cm diameter)



# Background

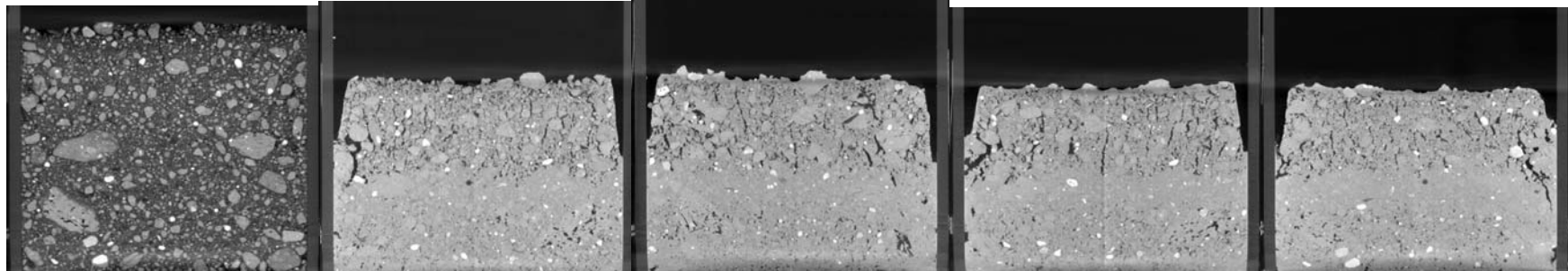




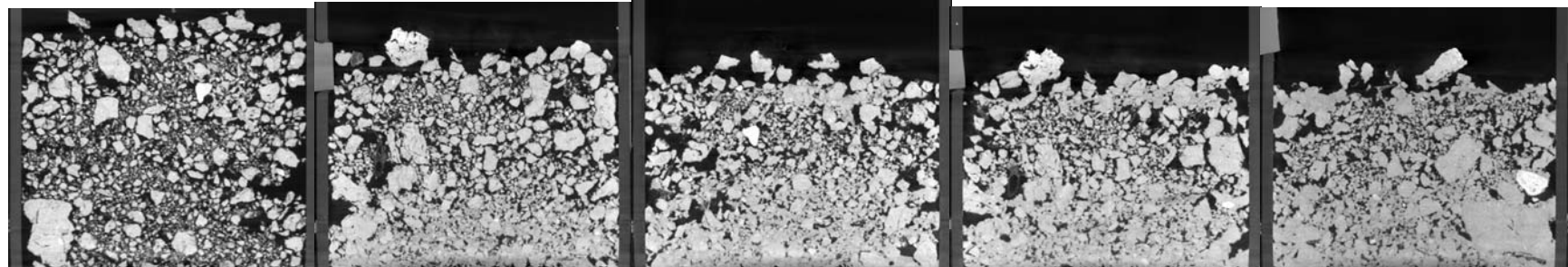
# Results – three examples

Ålbo (silty loam)

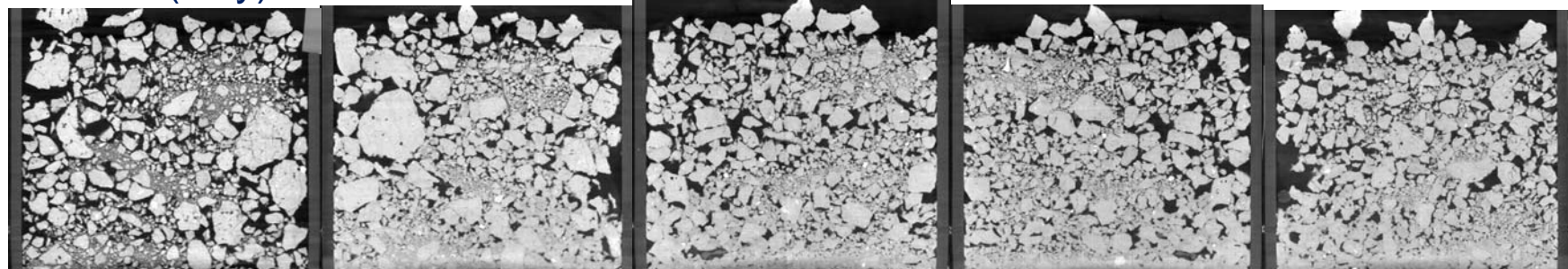
← 7 cm →



Krusenberg (clay loam)



Ultuna (clay)



Repacked field  
moist soil

Wetting +  
Equilibration

Irrigation 1 +  
Equilibration

Irrigation 2 +  
Equilibration

Irrigation 2 +  
Equilibration



Thank you!

Swedish Board of Agriculture



KompetensCentrum för Kemiska Bekämpningsmedel

