Cranfield UNIVERSITY Silsoe

Mechanisms and dynamics within a biobed

European biobed workshop

Malmö, September 27 -29 2004

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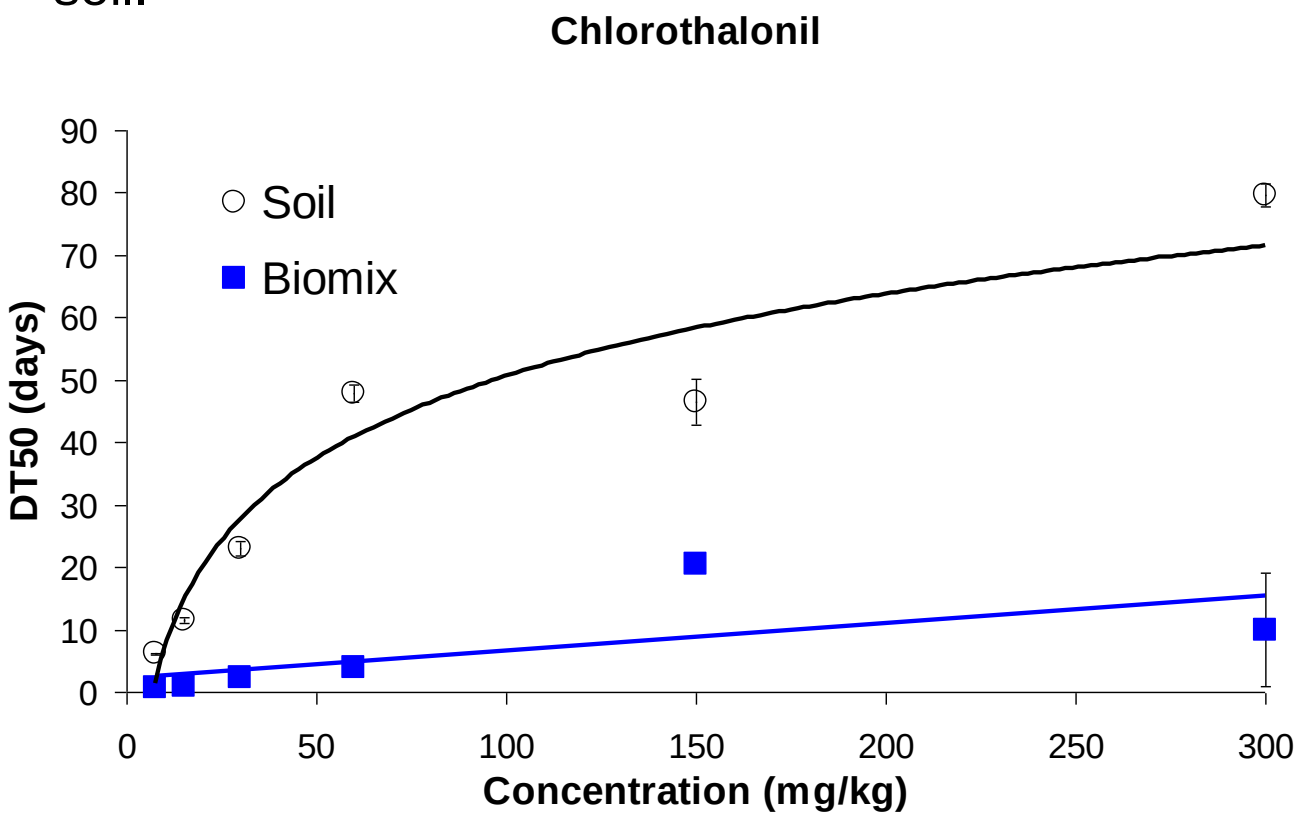
CRANFIELD CENTRE FOR ECOCHEMISTRY

Structure

- Laboratory studies
  - Pesticide concentration
  - Pesticide mixtures
  - Repeat applications
  - Different soil types
  - Bound residues
  - Tank cleaning agents
- Semi-field experiments
  - Lined vs. un-lined
  - Topsoil vs. Biomix
  - Effect of high water loadings
  - Different soil types
  - “Real world Use”

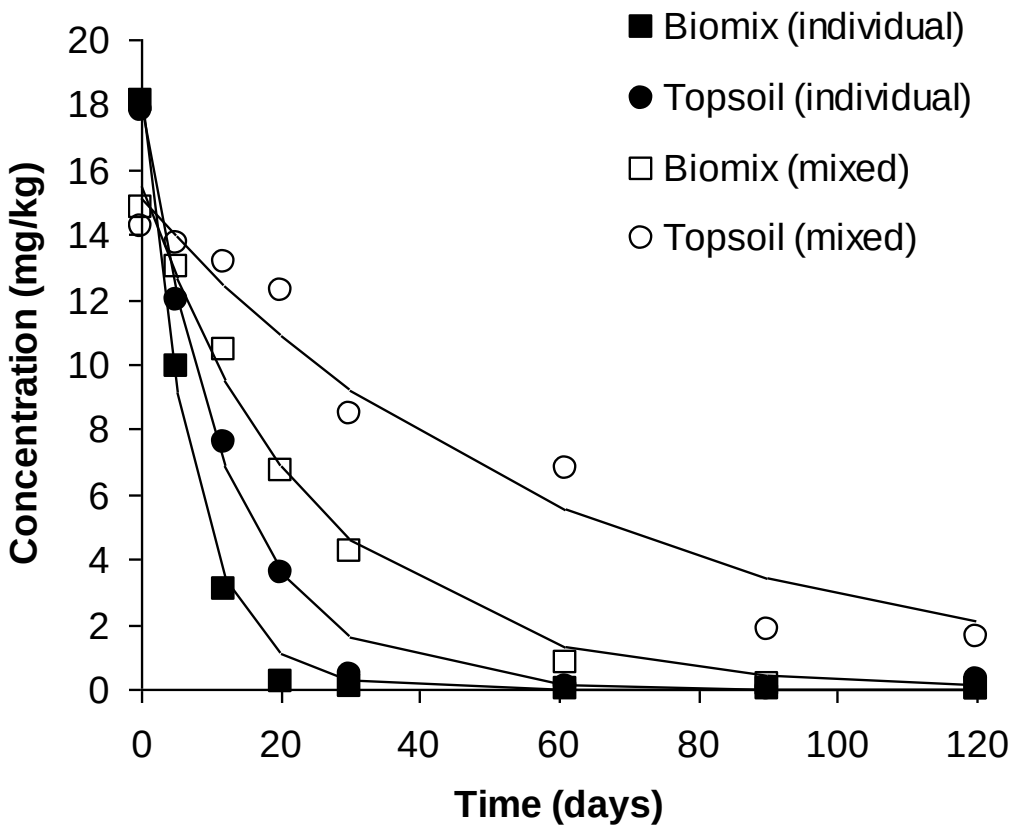
Pesticide Concentration

- Pesticides degrade more slowly at higher concentrations, but the effects appear to be less significant in the biomix than in soil.



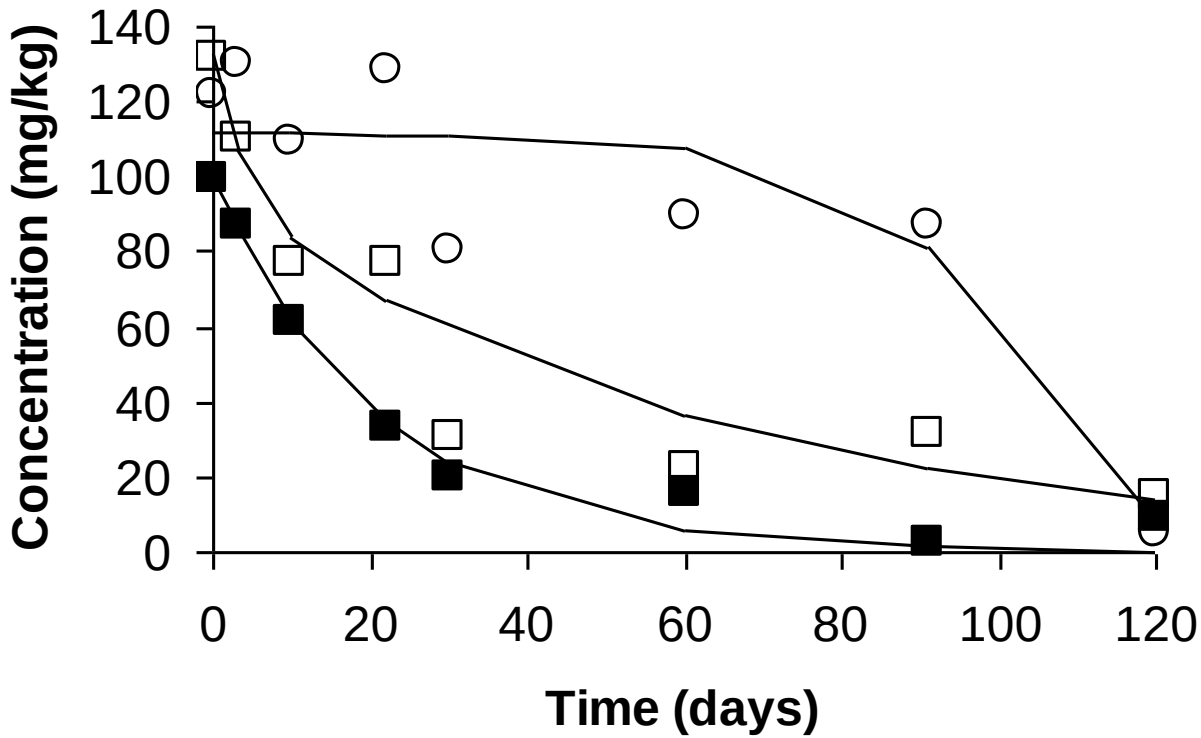
Pesticide mixtures (Dimethoate)

- Interactions between pesticides are possible, but generally these appear to be less significant in the biobed.



Repeat Applications (Isoproturon)

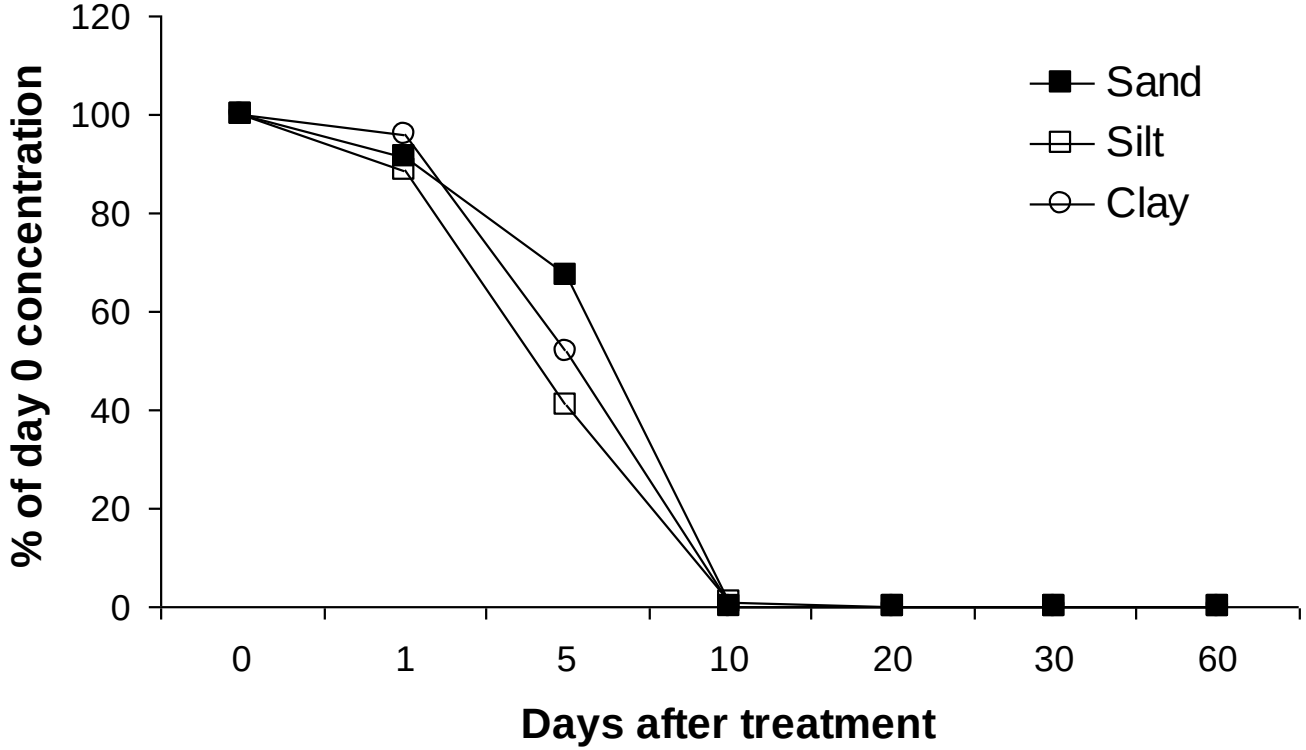
- The biobed was able to cope with relatively complex mixtures of pesticide applied repeatedly



Different soil types

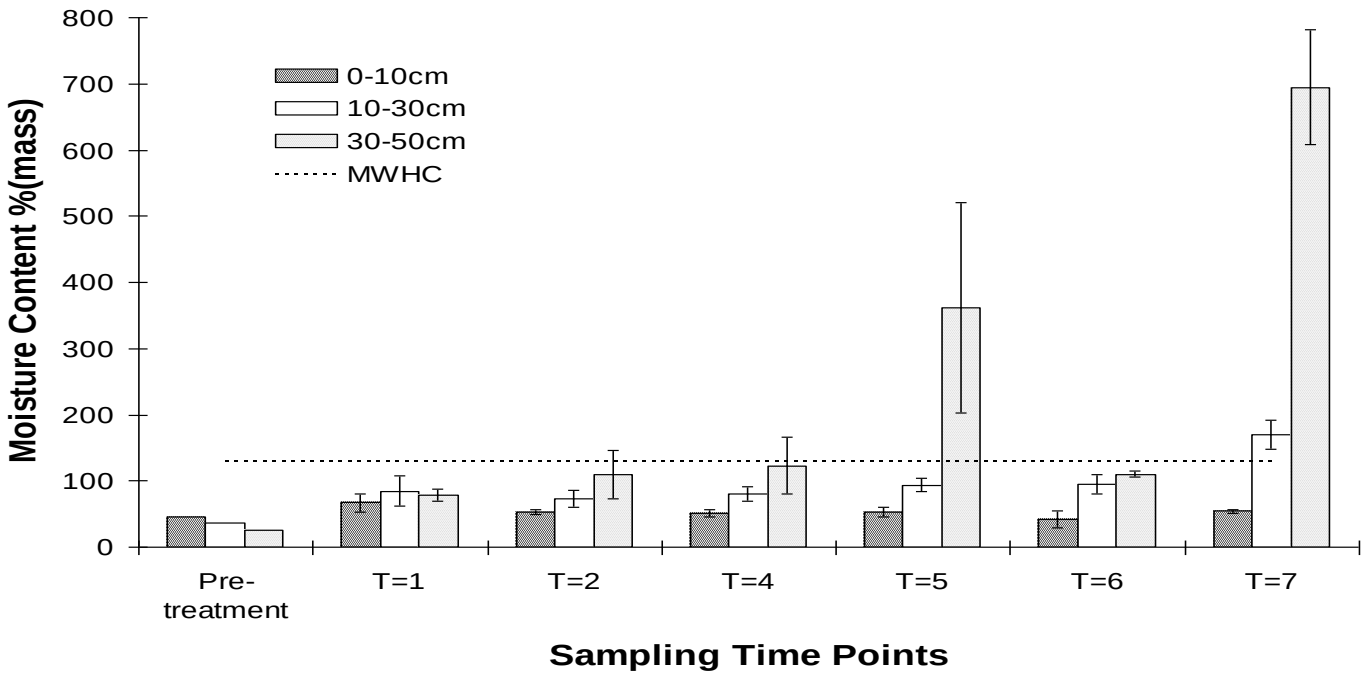
	Wick	Worcester	Blacktoft
Sand %	69	22	12
Silt %	13	29	60
Clay %	18	49	28
O.C %	1.95	1.5	2.7
Texture	SCL	C	ZCL
% of Agricultural land (texture)	14	23	9

Degradation in biomix made with different soils (Mecoprop-P)



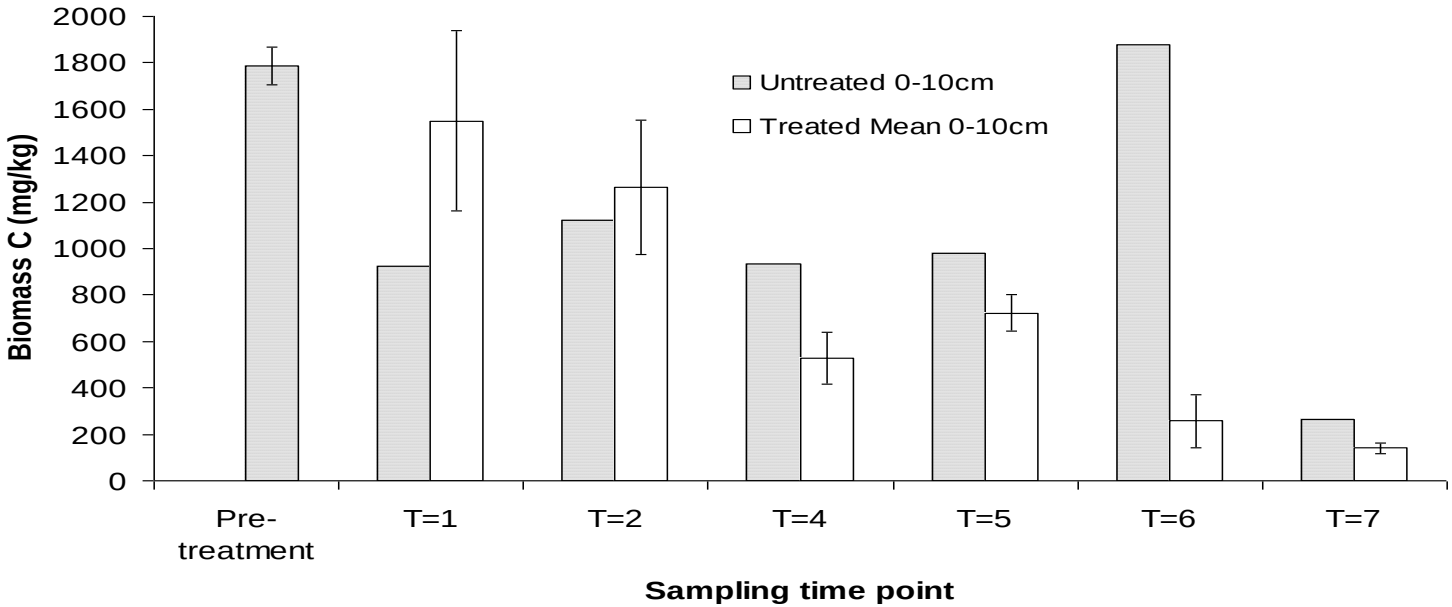
Lined Biobeds

- Biobeds need to be covered to prevent water logging
- Once covered top 10cm became hydrophobic restricting evaporation
- Minimal water loss resulted in saturated conditions below 10cm within 12 months



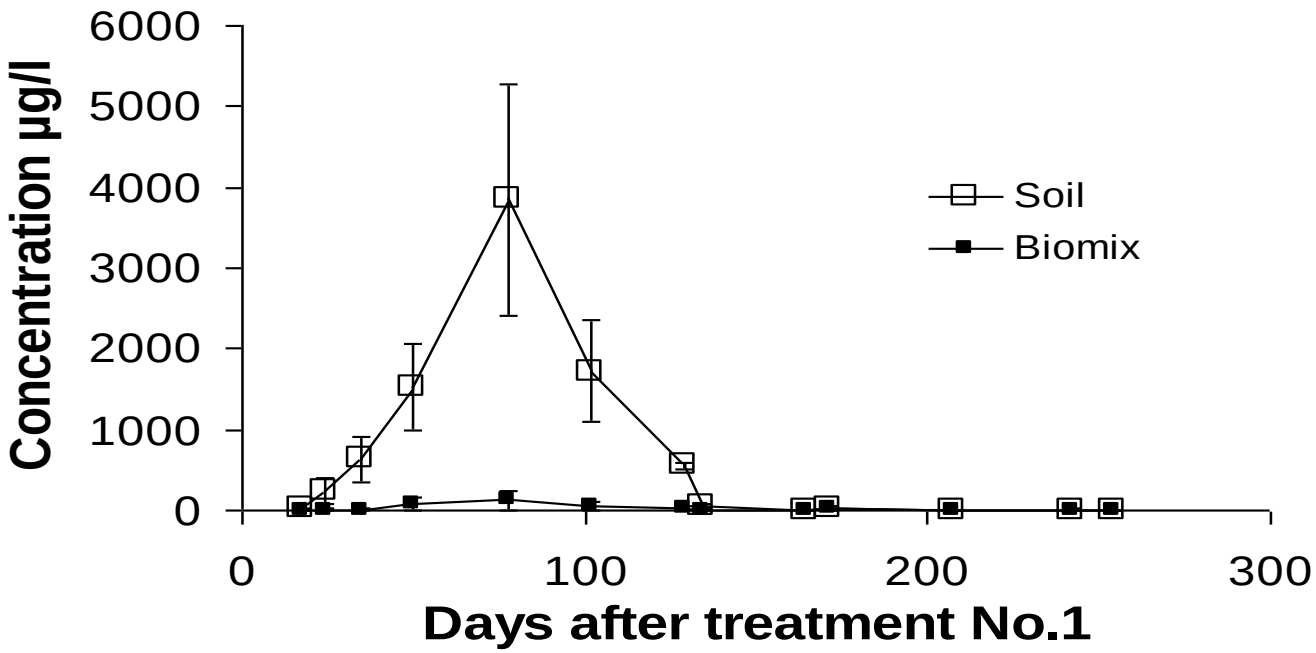
Lined Biobeds

- High levels of pesticide were retained in the top layer (0-5cm) of the biobed
- Microbial biomass decreased in the top 10cm
  - surface layer drying out
  - inhibitory effect of the pesticide residues



Un-lined Biobeds (ISOPROTURON)

- All pesticides were degraded with <30% of the applied remaining after 9 months
- Concentrations of pesticide in leachate were significantly lower than those from soil



Un-lined Biobeds

- Only the most mobile compounds leached and for these the biomix appeared to retain / degrade >99% of the applied
- The open system removed the necessity to manage water inputs

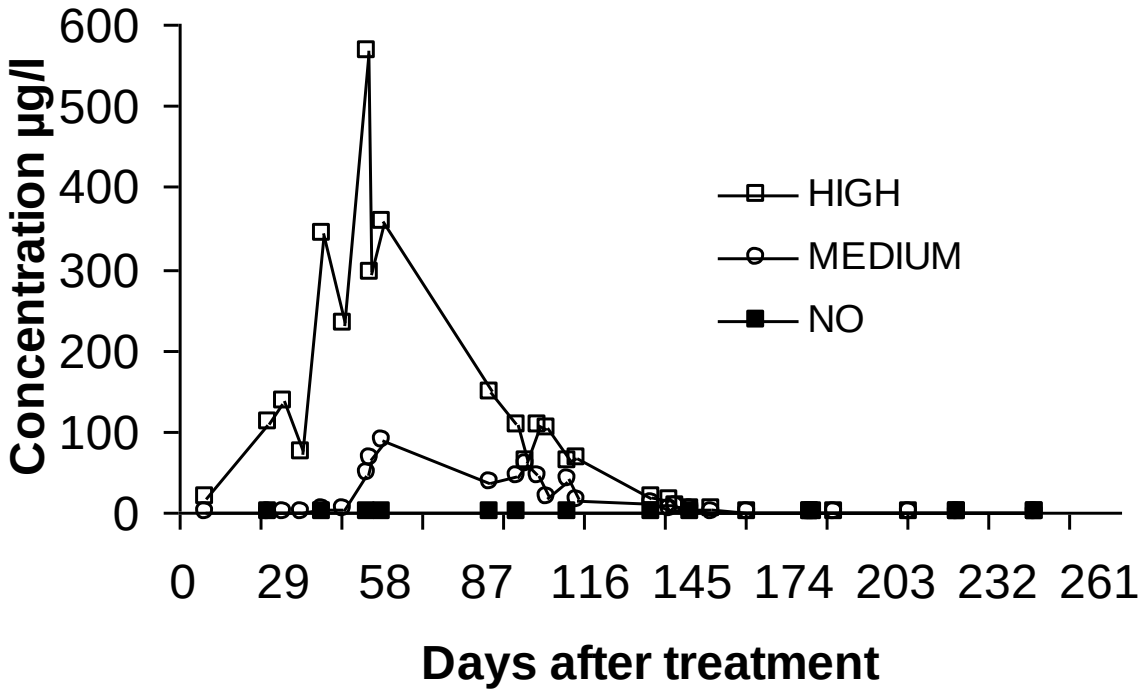
HOWEVER.

- Peak concentrations from biobed lysimeters too high (127 µg/l for isoproturon)
- Not considered the effect of additional hydraulic loading from an adjacent filling area.

Additional water loading

Isoproturon leaching

- Leaching potential is clearly effected by hydraulic loading.
  - medium loading < 1% of the applied (89µg/l maximum)

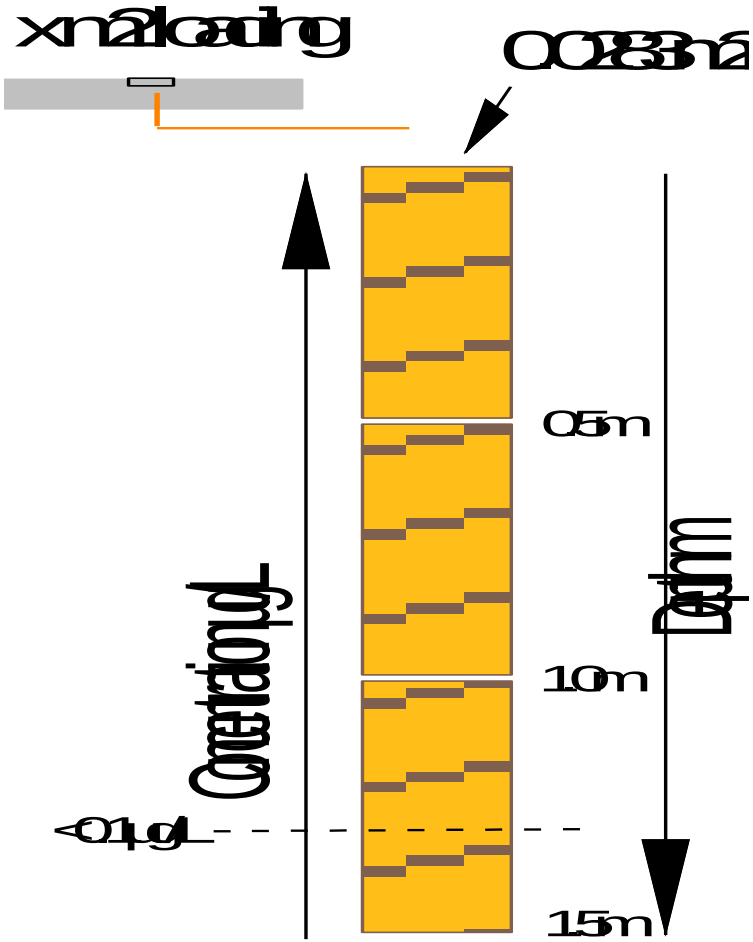


How do we improve biobed performance?

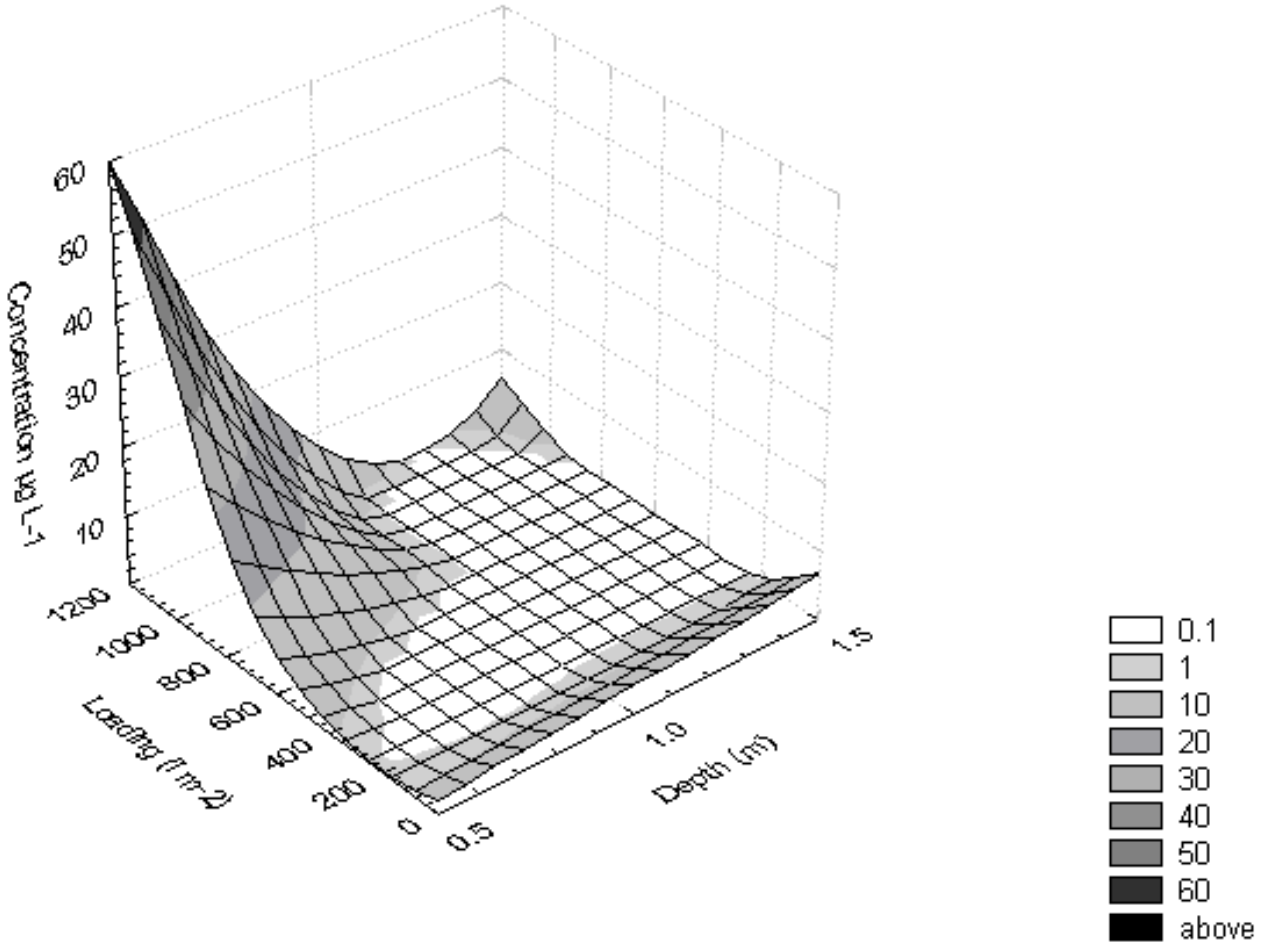
- Reduce the hydraulic loading
- Increase the retention time in the biobed (> depth)
- Restrict which pesticides are applied

NEW STUDIES

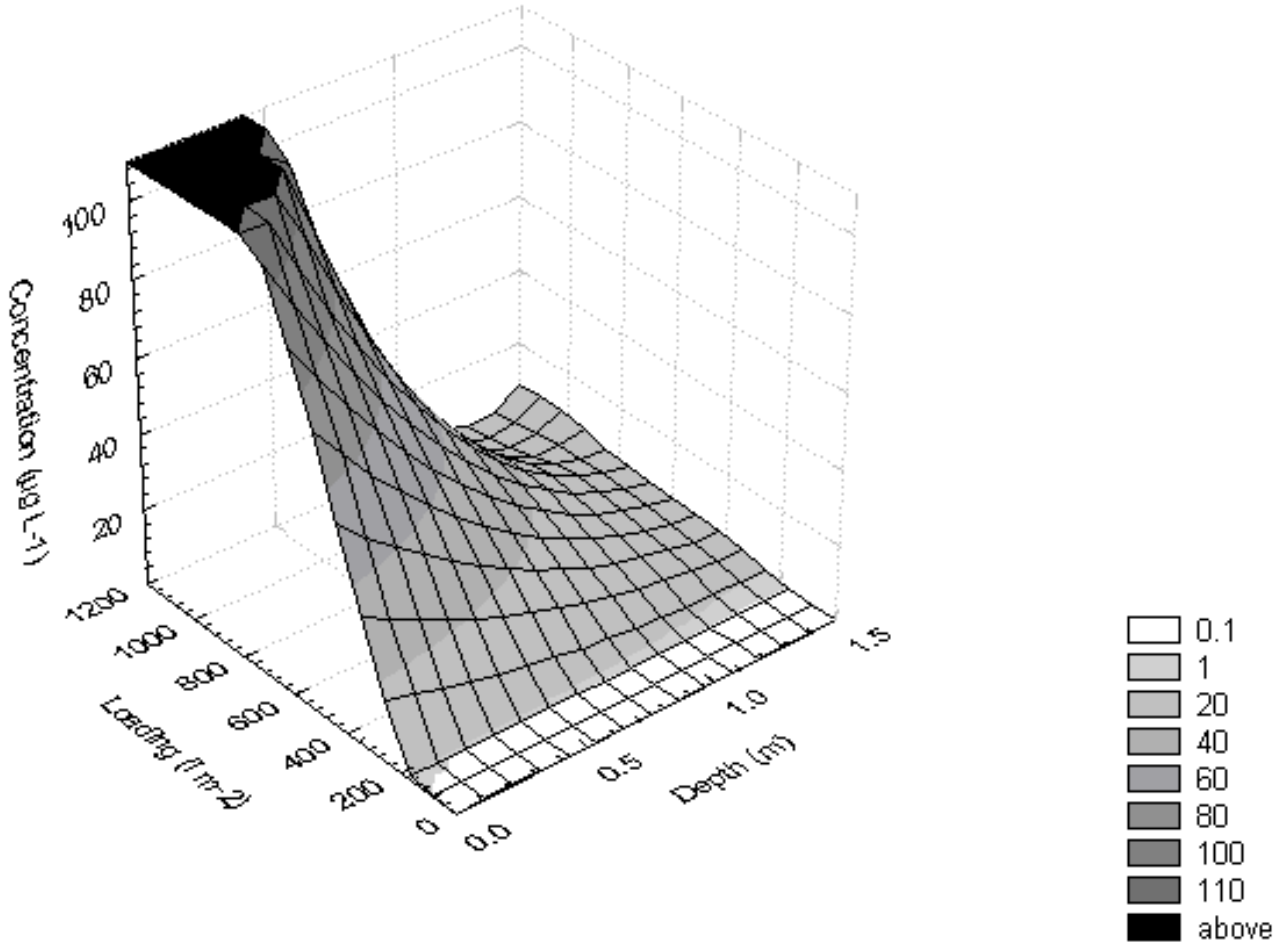
- 3 Biobed depths
- 3 hydraulic loadings
- 4 mobile pesticides
  - Isoproturon, dimethoate, mecoprop-P and metsulfuron-methyl



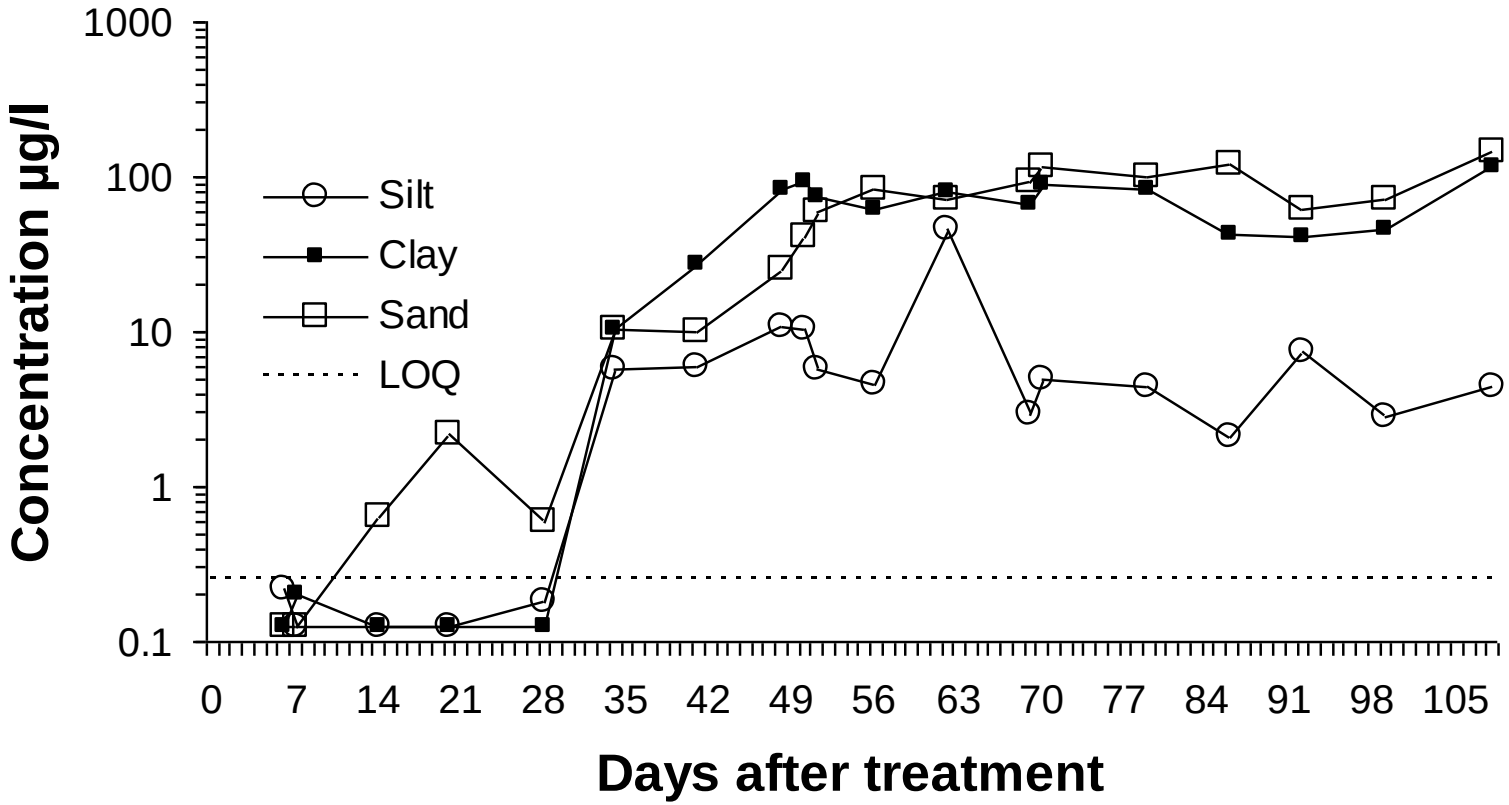
Isoproturon



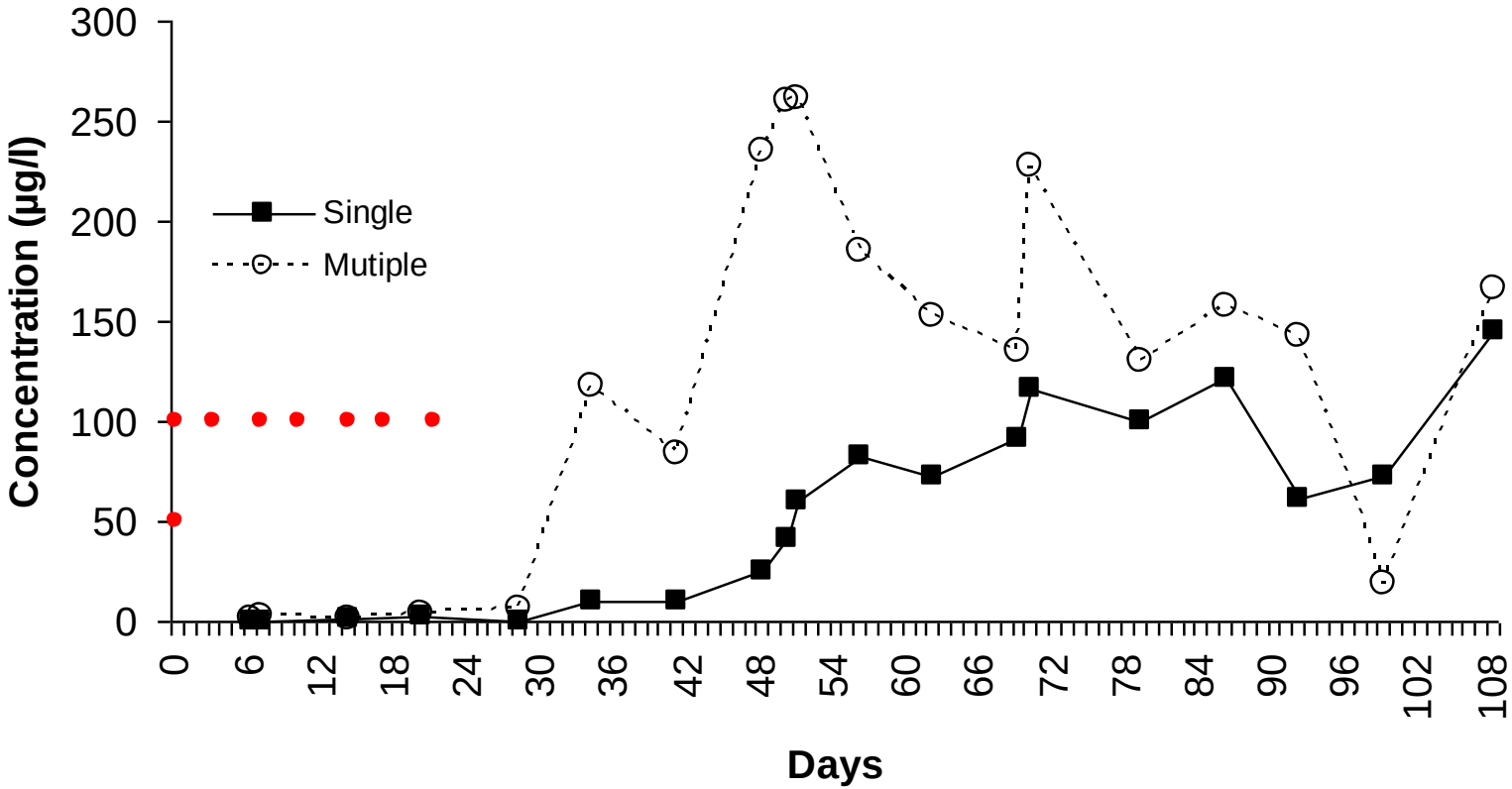
Metsulfuron-methyl



How soil type effects leaching in biobeds? (Mecoprop-P)



"Real World Use" (Mecoprop-P)



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Conclusions

- Generally biobeds appear to be able to degrade high concentrations of a relatively complex mixture of pesticides when applied repeatedly
- Water management is crucial
  - performance
  - cost of construction
  - management
- With the exception of all but the most mobile pesticides (Koc<35) performance was similar to that of more expensive treatment systems with >99.9% of the applied pesticide retained and or degraded within 12 months

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Future Work

Long term monitoring

- Leachate
- Mixture of old and new

Pesticide(s) that don't degrade

- Identify
- Manipulate

Pesticide that leach

- Modify biobed
- Prevent restrictions

Management requirements

- How much, How often
- Fresh or pre-composted
- Retain residues (mobility?)
- Complete replacement (C:N)

Disposal of biomix

- Direct to land?
- Store / to land?

Risk based technology transfer

Robust Sustainable system