

# **EcoPOD®**

**In-vessel composting system  
used for composting organic  
wastes and contaminated soils.**

**Typical organic feedstocks used were:  
green waste, digested sewage cake, de-  
inking paper fibre.**

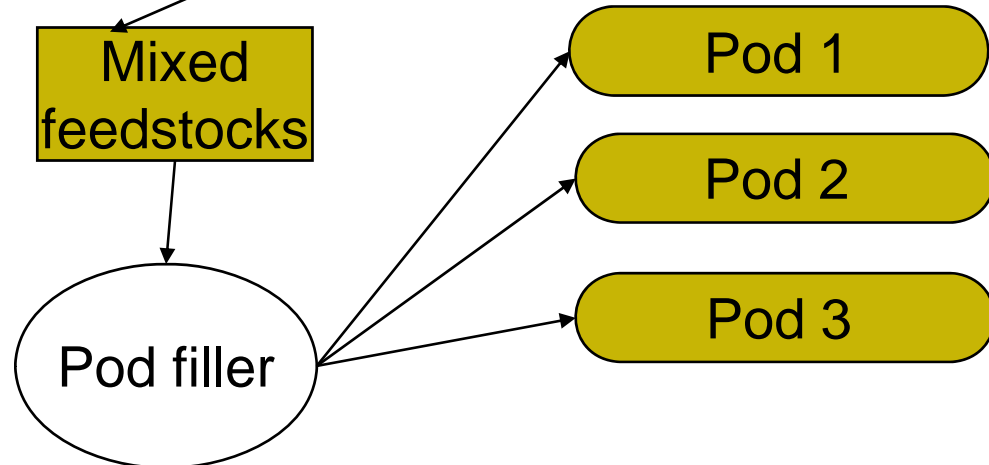
# The **EcoPOD<sup>®</sup>** Process

Feedstocks



Mix to give C: N ratio between 20 and 40 and moisture content *ca* 60 %

Place mixed feedstocks in pod filling machine



Connect aeration fans, leave for 8 – 12 weeks

# Some feedstocks

Wood chips

Paper

Biosolids



# Mixing the feedstocks



Mixing is accurate to 1 kilogram



Feedstocks are mixed in a cattle-feed mixer wagon.



# The complete process





Aeration ducting



Inserting temperature probes radio-linked to a computer enables control of aeration regime.



Making 1000 m<sup>3</sup> compost at our brownfield site



A generator powers fan boxes which force air through pods.

# Remediating soil contaminated with organic pollutants: Site history

- Former steelworks; 30 ha
- Soil and groundwater contaminated with PAHs, VOCs, cyanide, phenols; ammonia in groundwater;
- Intervention: site capped with 4 m of estuarine sand (but variable) in 1990's;
- **TWIRLS study: identified surface (bio)piles of moderately contaminated soil (max. 1 g PAH16 kg<sup>-1</sup>) and zones of moderate BTEX (max. 0.25 mg kg<sup>-1</sup>).**

# Former steelworks brownfield site close to SSSI and RAMSAR sites



## Problem

- low organic matter
- low water-holding capacity
- contaminated (PAHs & VOCs)



## Action

- add organic matter as composted wastes
- co-compost soil to remove contaminants
- seed with biodiverse grassland mix

# Composting contaminated soil to enhance bioremediation



Sand capping to block source-receptor pathway.



Biopile soil moderate PAH and BTEX contaminants.

# Co-composting experiment

Contaminated soil, only, composted.

Contaminated soil, green waste + biosolids composted.

Contaminated soil, biosolids + paper fibre composted.

Contaminated soil, green waste+biosolids+paper fibre composted.

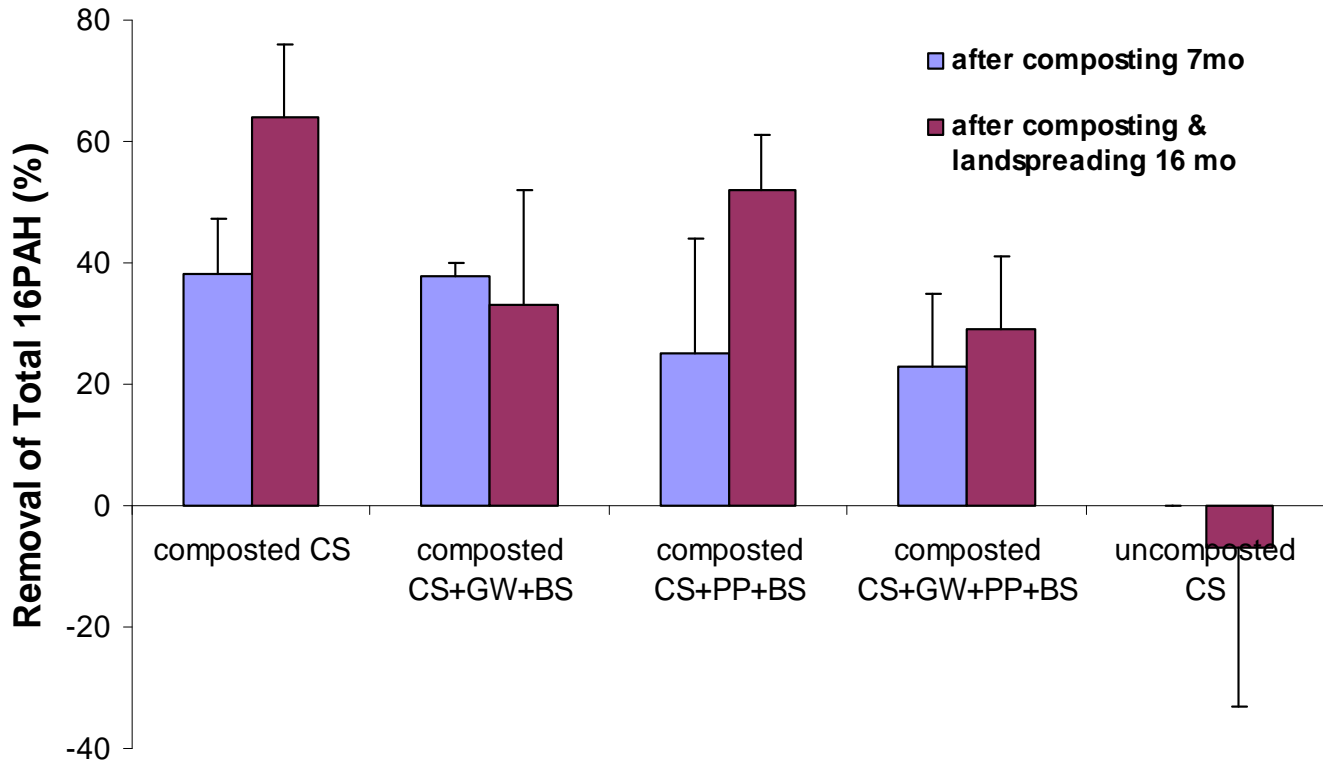
In-vessel composting with 80 d aeration, then 120 d maturation

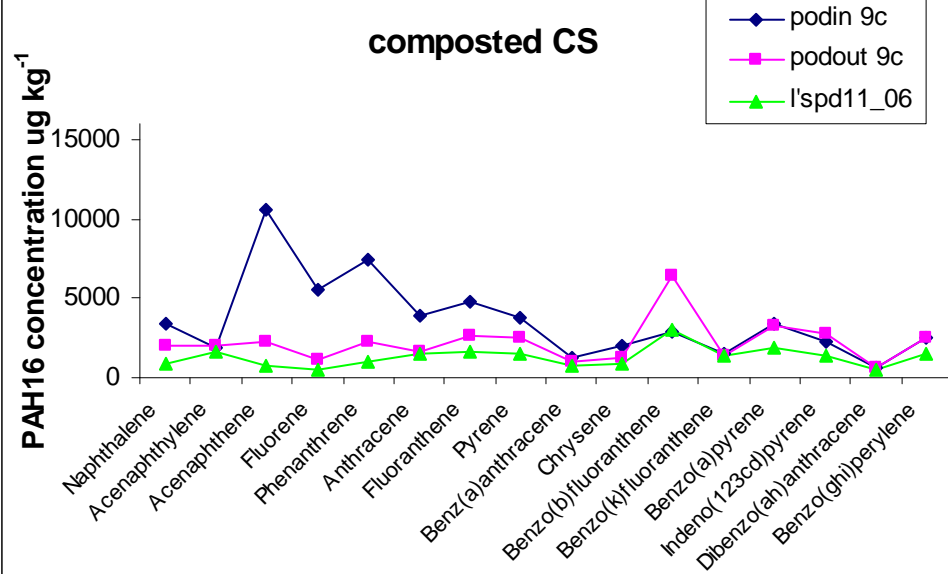
Spread directly back on contaminated land.

Samples analysed prior to composting, at end of maturation and after landspreading (then after 9 mo and 16 mo).



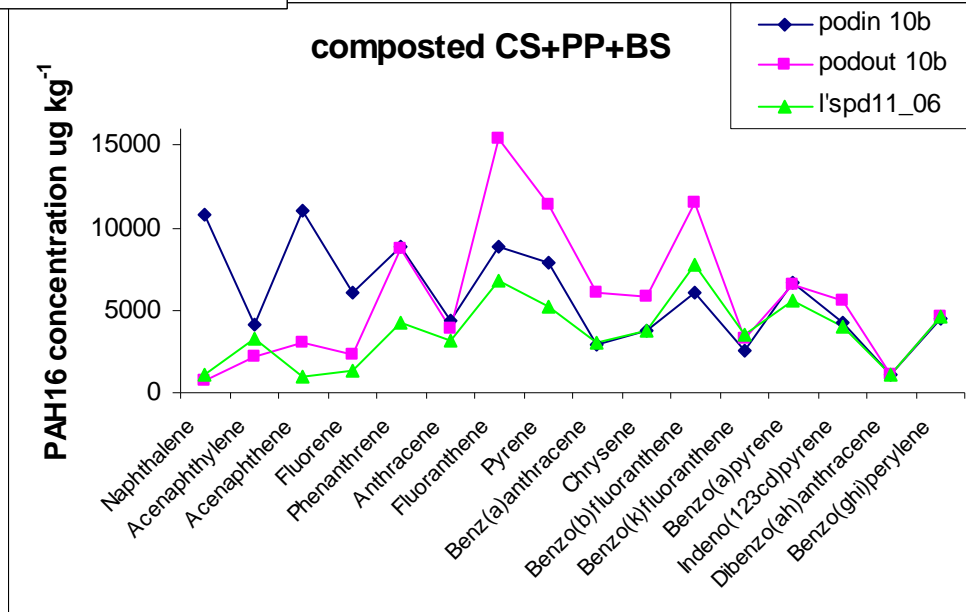
Percentage of PAH (USEPA 16) removed after composting and landspreading contaminated soil. Values represent means  $\pm$  SEM ( $n = 6$ ).





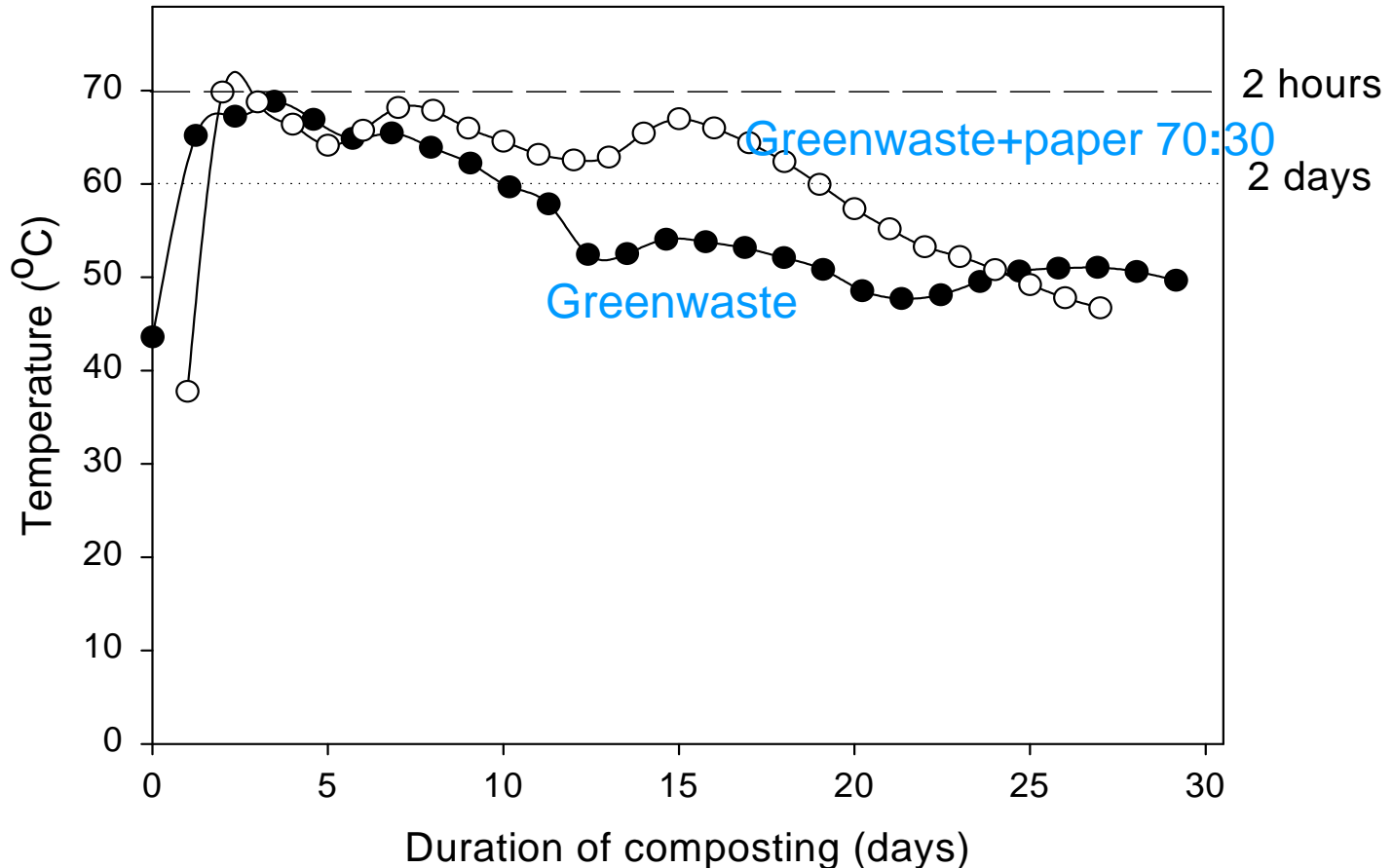
# Concentrations of 16 PAH species after composting and landspreading contaminated soil.

CS contaminated soil  
 PP paper fibre waste  
 BS biosolids (digested sewage cake)





**Why paper fibre may slow PAH dissipation in compost:**  
adding paper fibre (high in labile carbon) to greenwaste results in better composting because it stimulates microbial activity.



# 'Polishing' by Phytoremediation



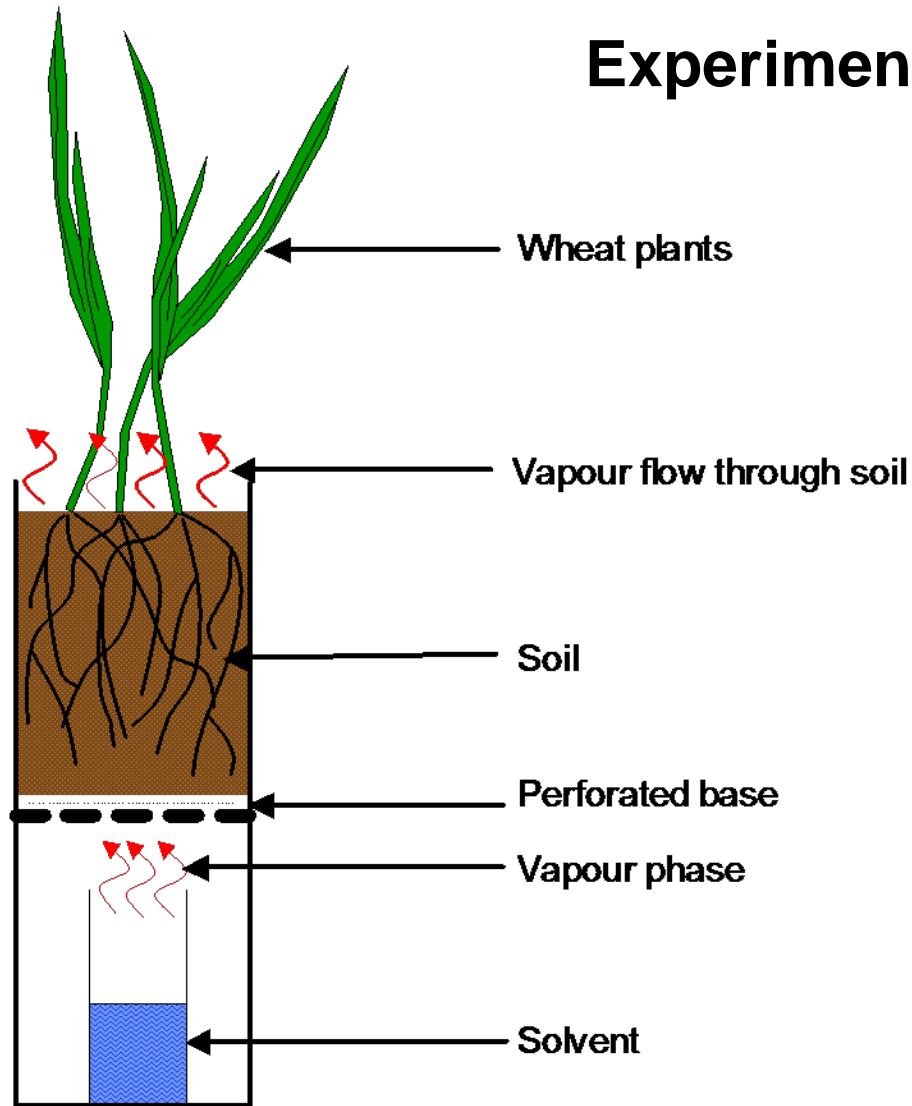
Experiments to test whether *Populus nigra* and mesotrophic grassland can further polish co-composted soil after landspreading.

# Effects of upward movement of VOCs through soil on plants and soil microbes

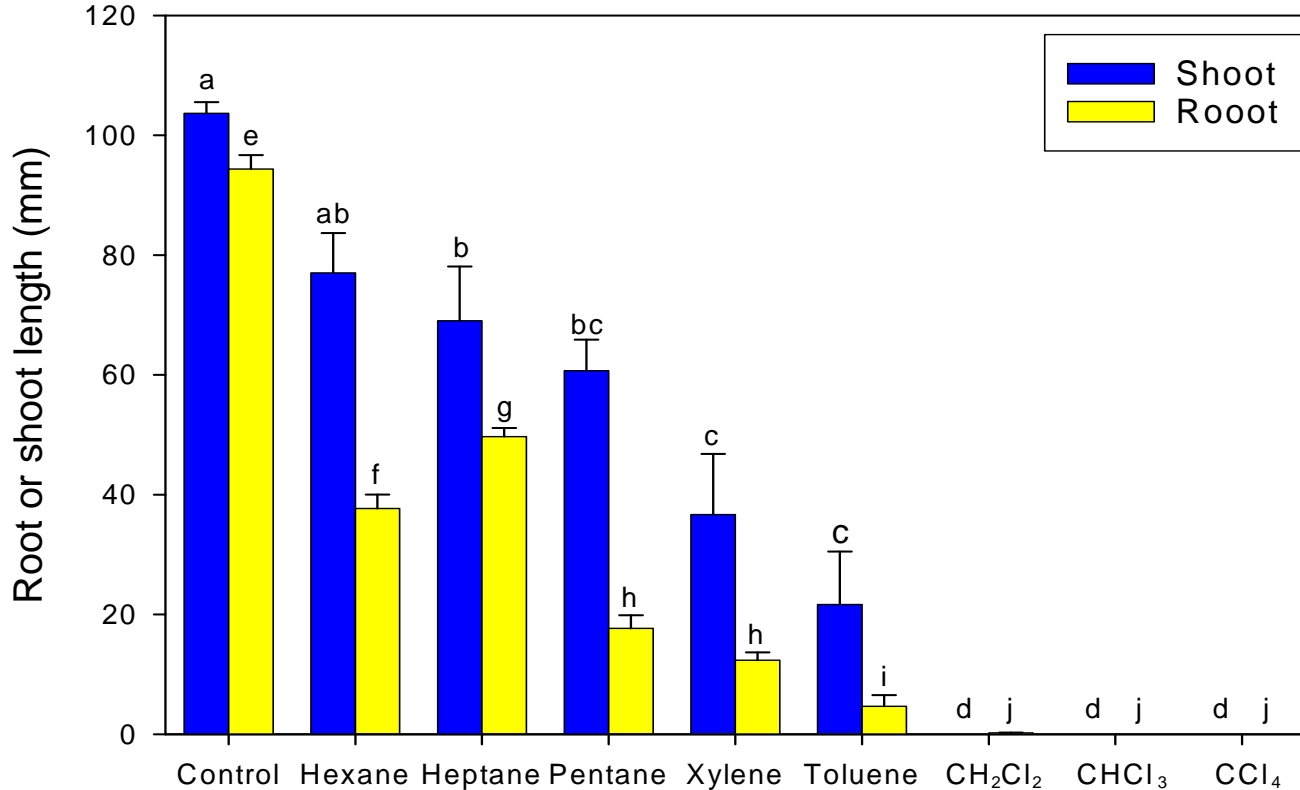
**EXPT 1.** Effects of 8 solvents on seed germination, wheat shoot and root growth, soil microbial activity on 10 cm soil cores;

**EXPT 2.** Effects of selected solvents on shoot & root growth and microbial activity on soil cores 10, 25, 50 and 75 cm deep.

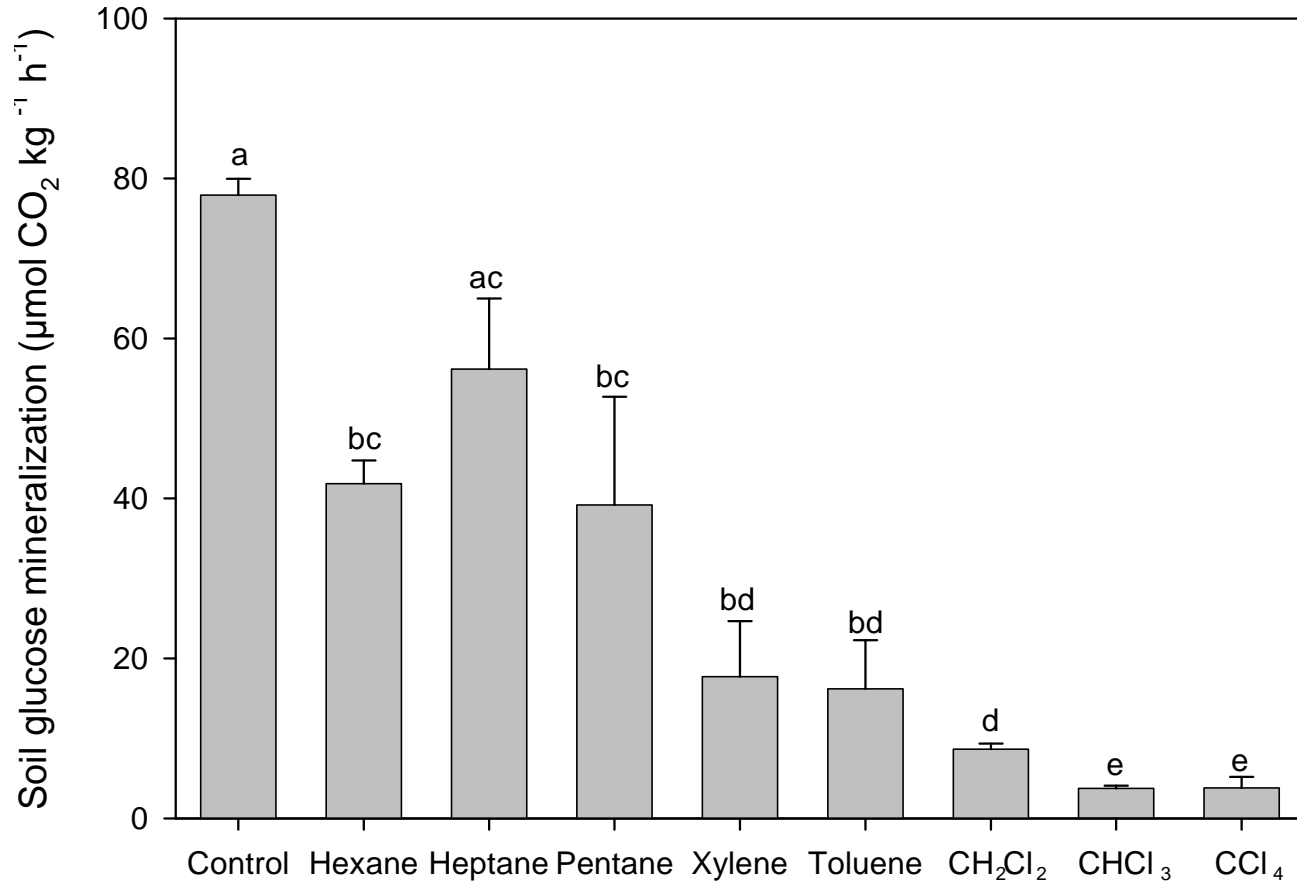
# Experimental set-up



**Exp.1.** Effect of vapour phase solvent flow through soil on plant root and shoot length. Values represent means  $\pm$  SEM ( $n = 3$ ).



**Exp.1.** Effect of vapour phase solvent flow through soil on microbial activity. Values represent means  $\pm$  SEM ( $n = 3$ ).

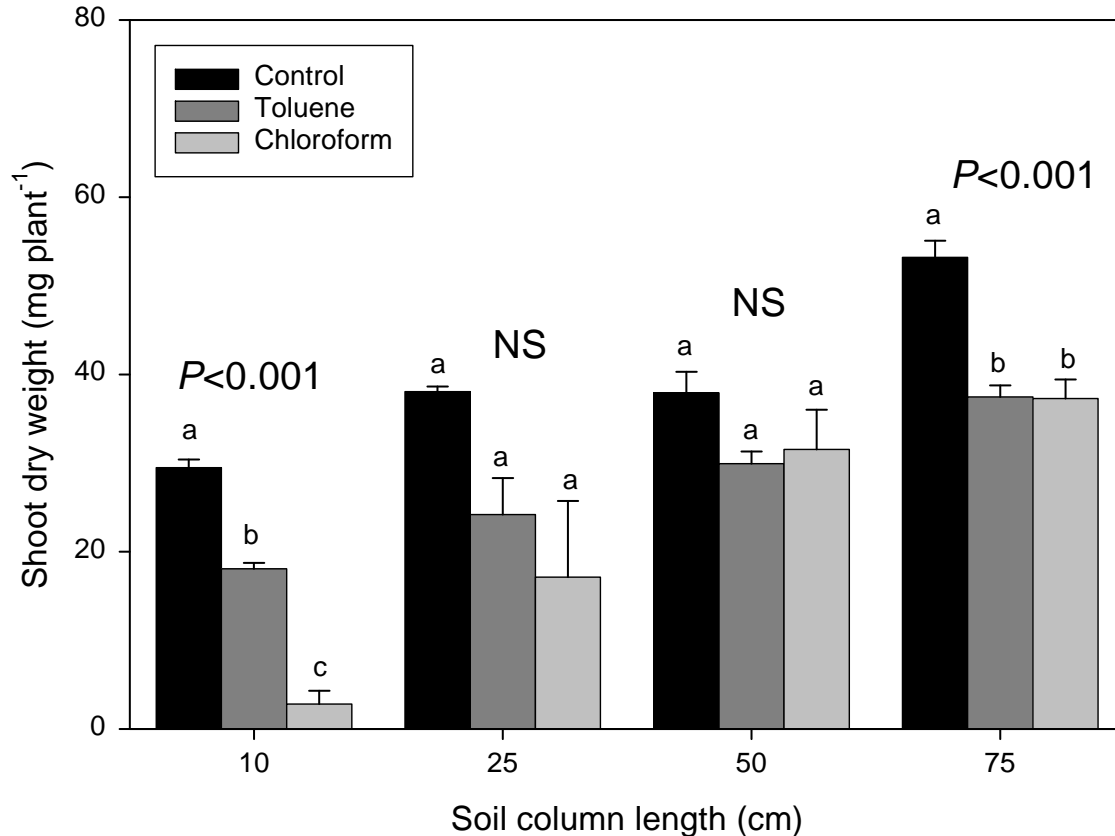


## Exp.1. Correlation results

	$r^2$	$P$ value
Shoots and $K_{ow}$	0.896	0.003
Roots and $K_{ow}$	0.874	0.005
Microbes and $K_{ow}$	0.873	0.005

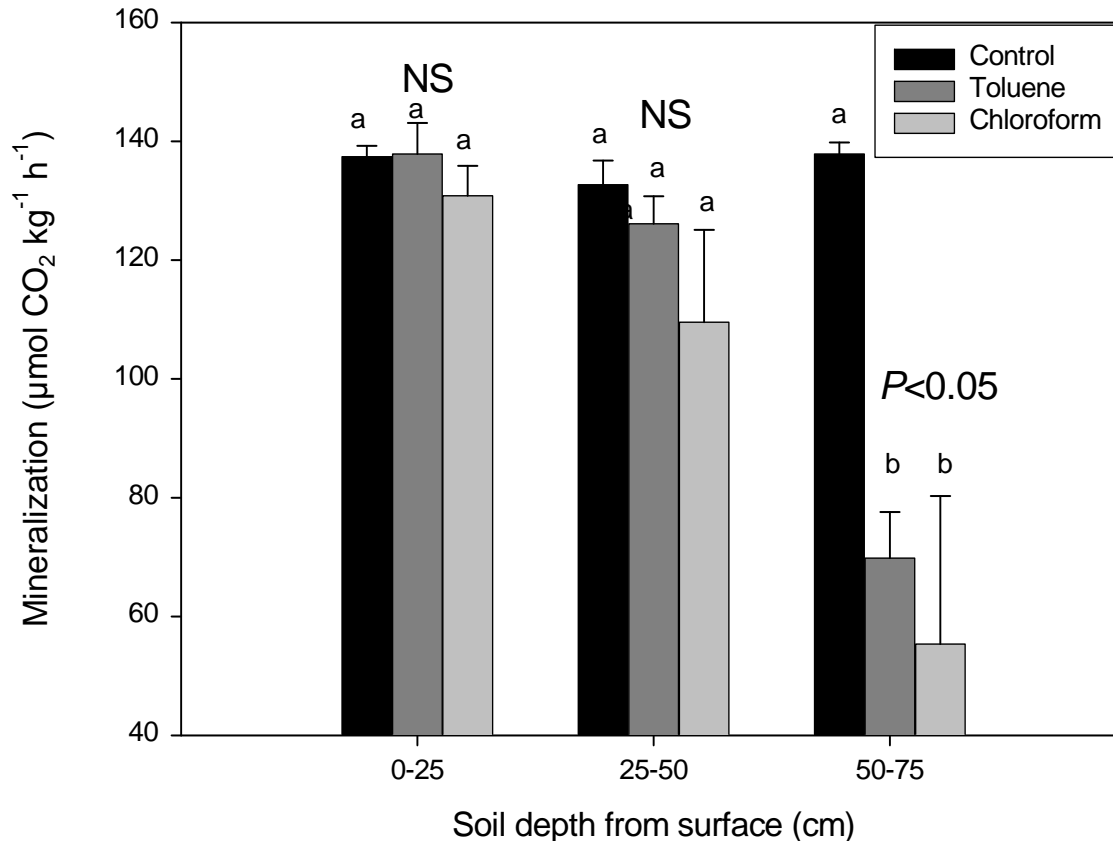
	$r^2$	$P$ value
Shoots and Henry Law constant	0.945	0.001
Roots and Henry Law constant	0.907	0.002
Microbes and Henry Law constant	0.954	0.001

**Exp.2.** Effect of vapour phase solvent flow through soil on plant shoot mass in soil columns of differing depths. Values represent means  $\pm$  SEM ( $n = 3$ ).





**Exp.2.** Effect of vapour phase solvent flow through soil on microbial activity in the top, middle and bottom 25 cm-sections of 75 cm soil columns. Values represent means  $\pm$  SEM ( $n = 3$ ).



# Summary

- ❑ Covering land polluted with volatile organic compounds may not be sufficient to block the source-receptor pathway;
- ❑ Vertical migration of vapour phase solvents through the soil profile is harmful to soil microbial and plant biomass;
- ❑ Composting and landspreading processes both resulted in dissipation of PAHs;
- ❑ Co-composting contaminated soil with organic material may initially occlude PAHs from dissipation;
- ❑ Microbial mineralization studies will evaluate whether organic material facilitates PAH biodegradation in the medium-term.

# **Co-workers gratefully acknowledged**

Prof John Farrar, Prof Davey Jones, Dr John Healey

Drs Sue Tandy, Mark Nason, Tunde Akinola

Rhidian Jones, Jon Holmberg

Mark Farrell