

PCBs uptake by carrots after sludge and compost application

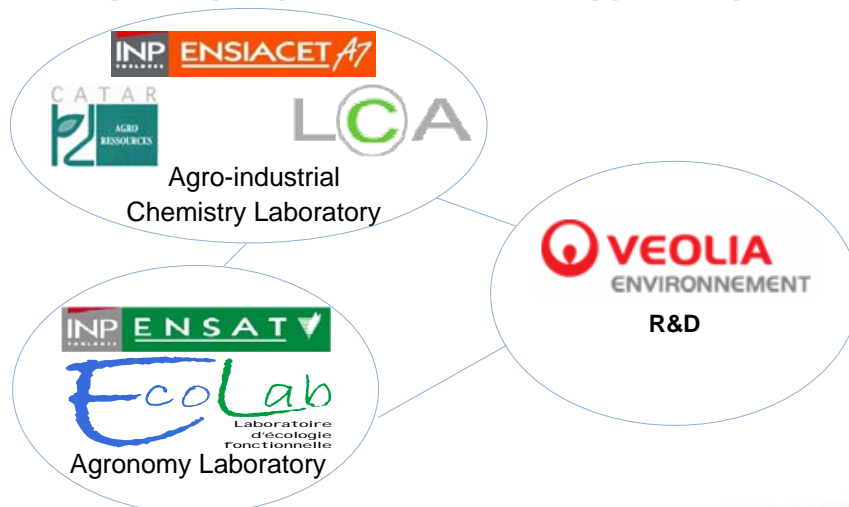
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Partnership

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Context

- PhD C. Sablayrolles, 2004
 - ➔ Uptake of selected Trace Organic Compounds from biosolids by carrots
 - ➔ Maximised conditions
 - ➔ Sludge (French ministerial 8/1/98)

- Study
 - ➔ Uptake of PCBs from compost by carrots
 - ➔ Operational practice
 - ➔ Compost (NF U 44-095)

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Objectives

Potential uptake of Trace Organic Compounds
from organic waste products into carrot plants

- Trace Organic Compounds studied :
 - Polychlorinated Biphenyls (PCBs)

- Three experiments :
 - Sludge
 - Compost
 - Amendment

- Analyses :
 - Leaves
 - Peel
 - Core

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Methodology (1): material

- Plant: carrot plants (*Daucus carota*), Amsterdam Bejo variety
 - fully developed after 2.5 months
 - dwarf : a variety grown for food consumption
 - model plant
- Type of culture:
 - Sand
 - Soil
- Conditions: greenhouse

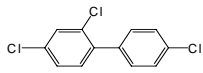
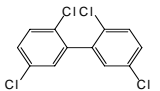
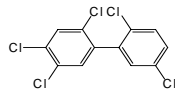
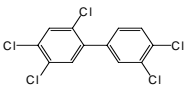
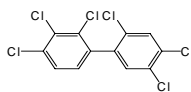
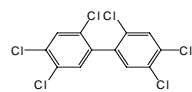
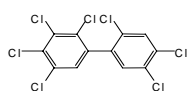


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Methodology (2): material

- Properties
 - ➔ Lipophilic
 - ➔ Semi-volatile
 - ➔ Half-life: 2-4 years
- Sources and uses
 - ➔ Appliance
 - ➔ Electrical insulator
- Toxicity
 - ➔ Chlorinated acne
 - ➔ Carcinogenic

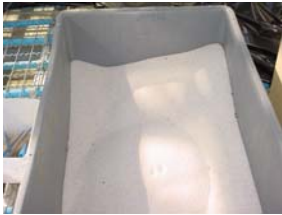

PCB 28 	PCB 52 
PCB 101 	PCB 118 
PCB 138 	PCB 153 
PCB 180 	

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Methodology(3): material

- **Sand:** quartzose used in aquarium
- **Soil:** natural market gardening

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Methodology(4): material

■ Sludge :

- Dehydrated activated biological sludge
- From the centrifuge outlet of a wastewater treatment plant (France 12 000 EI)
- Mean sample over a week



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Methodology(5): material



■ Compost :

- Crushed green waste and riddling refusal / Precedent sludge (4:1)
- 1 month in fermentation / 2 months in maturation / 2 months in storage
- Sampling according to NF EN 12579

■ Organic Amendment:

- Commercial
- Crushed woody vegetals / Poultry litter

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Methodology(7): experimental protocol

Treatments and controls			Number of containers
Sand	Sludge	Carrots	6
Sand	--	Carrots	3
Sand	Compost	Carrots	6
Sand	--	Carrots	3
Sand	Compost	Carrots	6
Sand	--	Carrots	3
Soil	Compost	Carrots	6
Soil	--	Carrots	3
Soil	Organic Amendment	Carrots	6
Soil	--	Carrots	3

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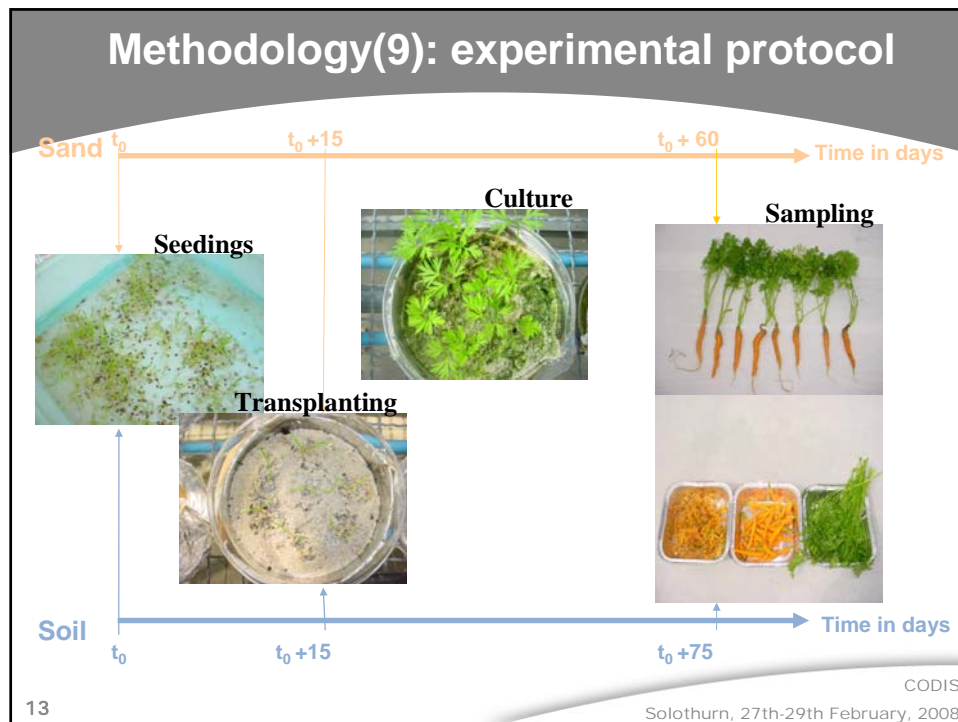
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Methodology(8): experimental protocol

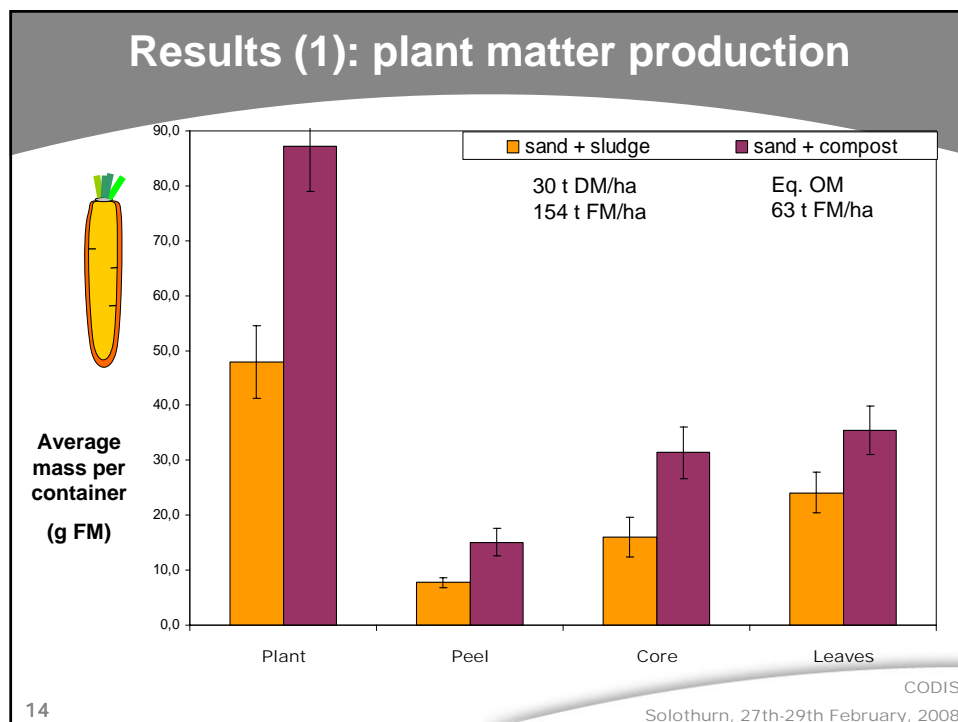
Growth medium		Organic waste product / container (g FM)	Application rate (t FM/ha)
Sludge	30 t DM/ha	sand 3,00 kg	144
Compost	Eq. OM of 30 t DM/ha of sludge		23
Compost	25 t FM/ha		59
Compost	25 t FM/ha	soil 2,04 kg	23
Organic amendment	Eq. OM of 25 t FM/ha of compost		22

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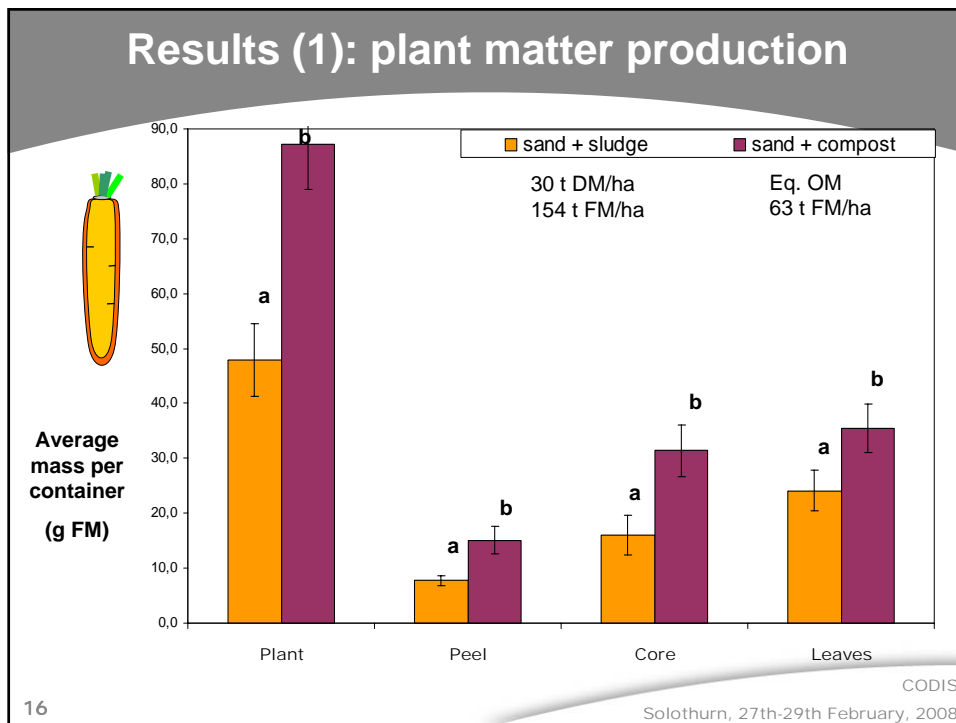
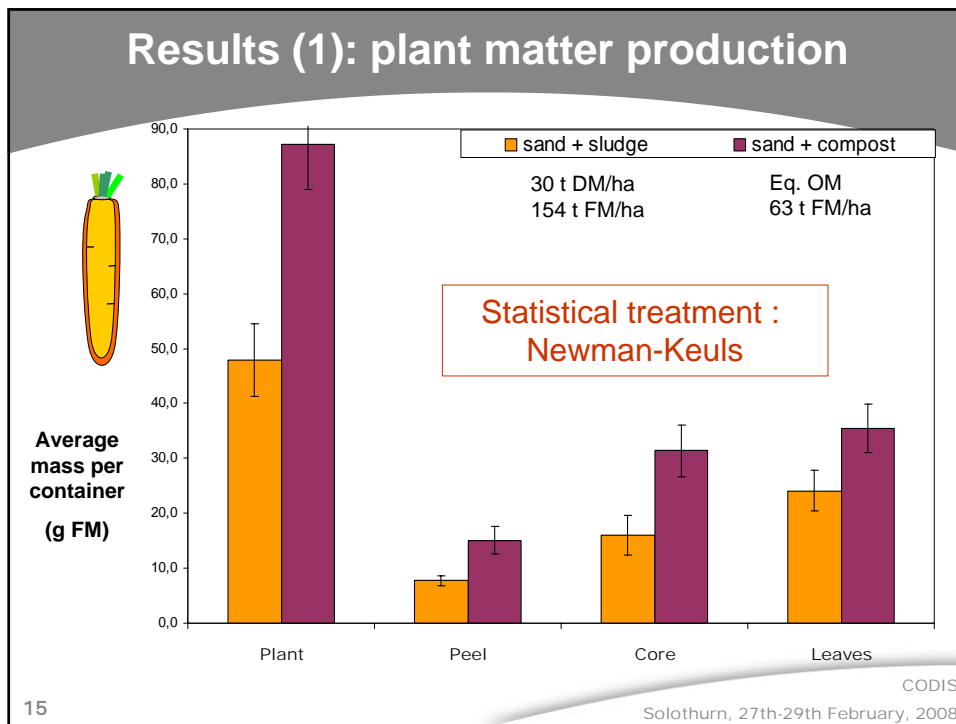
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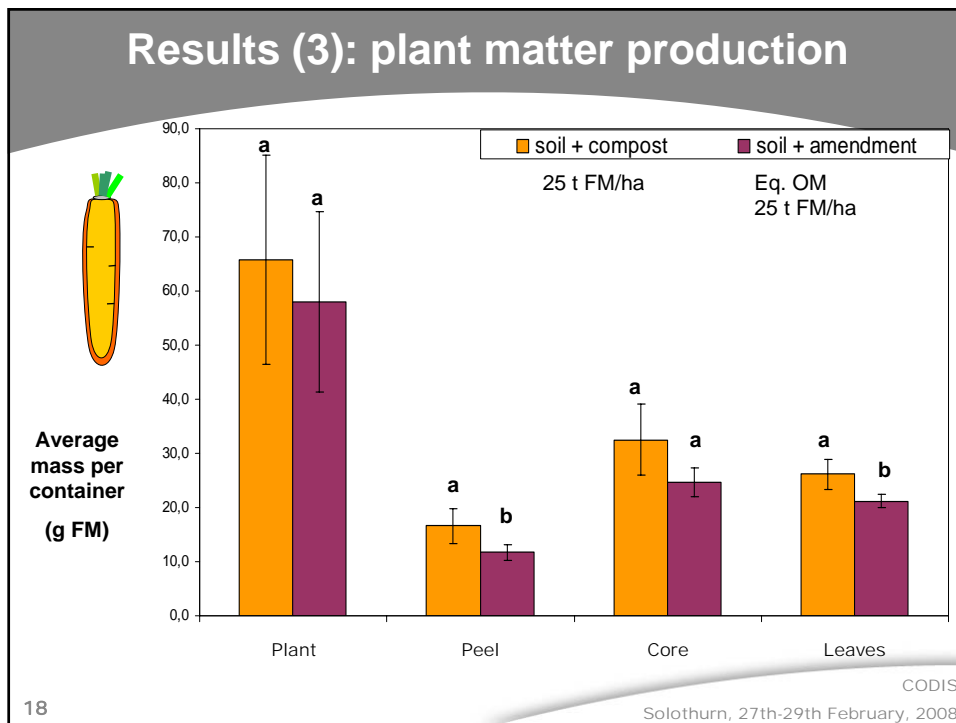
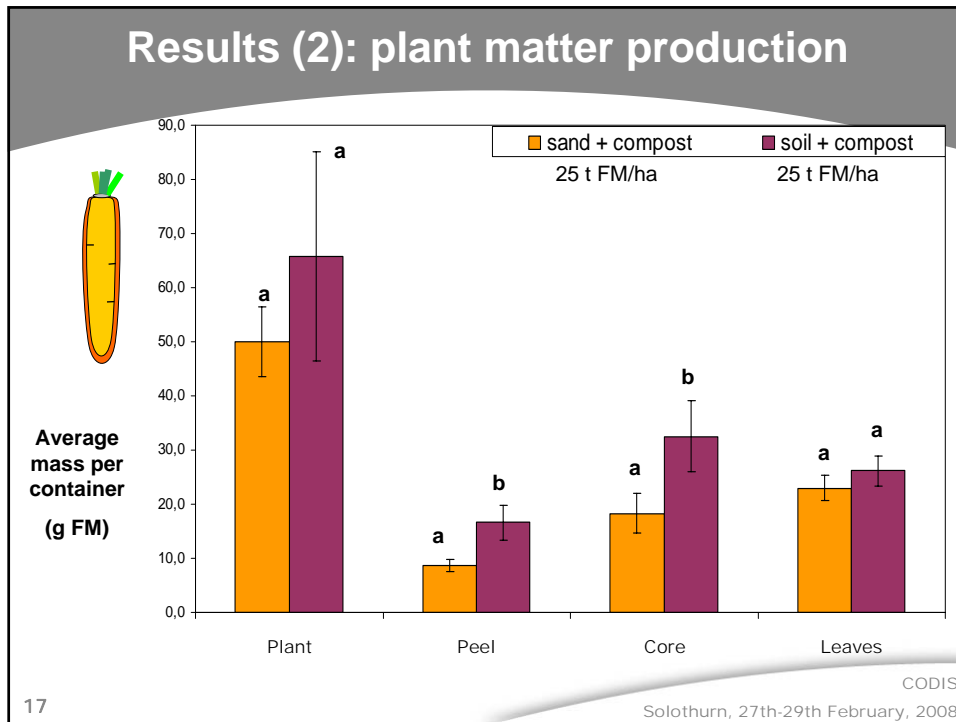


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Results (4): PCBs analyses

- Number of samples analyzed: 75
 - ➔ Plant (60)
 - 3 samples / compartment / treatment
 - 2 samples / compartment / control
 - ➔ Organic waste products (15)
 - 3 repetitions / product

- Analytical method
(Research Institut of Chromatography, Belgium)
 - ➔ Liquid extraction procedure with cyclohexane
 - ➔ GC-MS in SIM mode

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Results (5): PCBs analyses

		Sludge	Sludge Compost	Organic Amendment
pH		8.7 ± 0.0	8.3 ± 0.0	8.7 ± 0.0
Dry matter (% FM)		19.7 ± 1.0	68.8 ± 0.0	82.9 ± 1.0
Organic matter (g/kg DM)		772 ± 10	538 ± 26	463 ± 4
2-Cl	PCB 28 (µg/kg FM)	<1	<1	<1
4-Cl	PCB 52 (µg/kg FM)	<1	4.1 ± 1.7	<1
5-Cl	PCB 101 (µg/kg FM)	<1	6.4 ± 2.5	<1
	PCB 118 (µg/kg FM)	<1	5.6 ± 5.9	<1
6-Cl	PCB 153 (µg/kg FM)	<1	8.5 ± 3.6	<1
	PCB 138 (µg/kg FM)	<1	10.0 ± 2.7	<1
7-Cl	PCB 180 (µg/kg FM)	<1	1.7 ± 2.0	<1

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Results (5): PCBs analyses

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2-Cl PCB 28 (µg/kg FM)	<1	<1	<1
4-Cl PCB 52 (µg/kg FM)	<1	4.1 ± 1.7	<1
5-Cl	PCB 101 (µg/kg FM)	6.4 ± 2.5	<1
	PCB 118 (µg/kg FM)	5.6 ± 5.9	<1
6-Cl	PCB 153 (µg/kg FM)	8.5 ± 3.6	<1
	PCB 138 (µg/kg FM)	10.0 ± 2.7	<1
7-Cl PCB 180 (µg/kg FM)	<1	1.7 ± 2.0	<1

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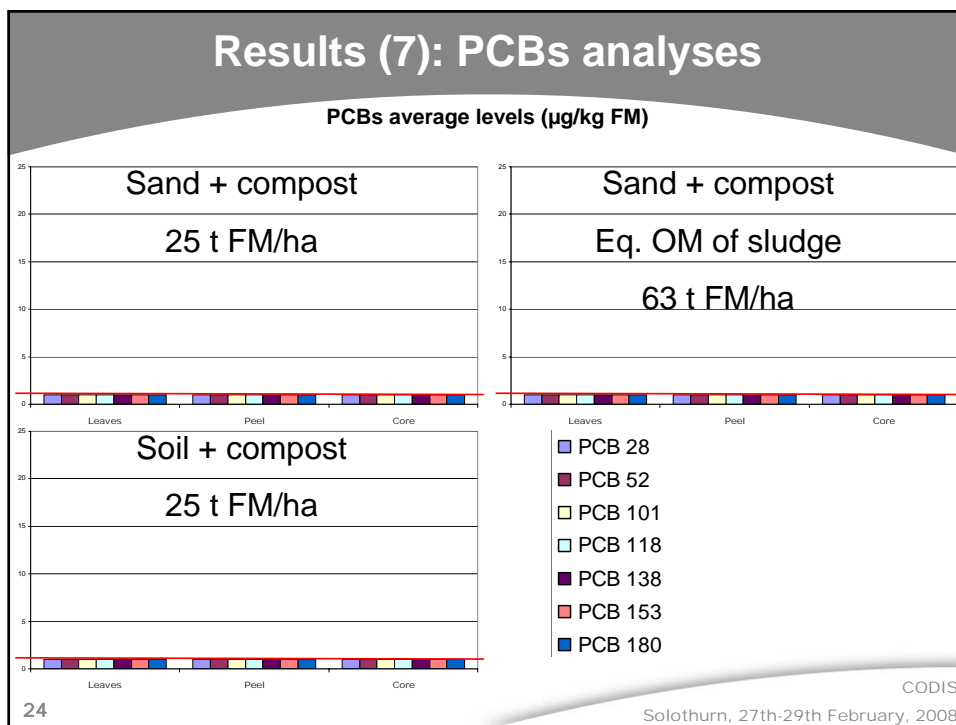
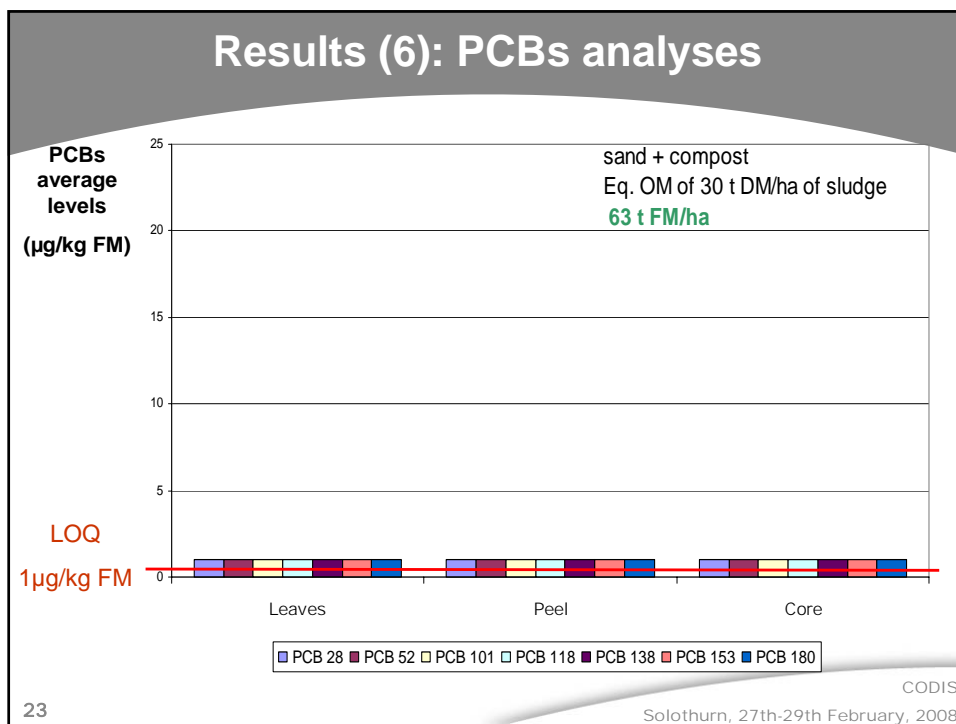
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Results (5): PCBs analyses

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	PCB 138 (µg/kg FM)	10.0 ± 2.7	<1
7-Cl PCB 180 (µg/kg FM)	<1	1.7 ± 2.0	<1

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Conclusions (1)

Growth medium		Application rate	Uptake by carrots	Conclusions
Sludge compost <i>Eq. OM of sludge</i>	Sand	63 t FM/ha	0 % (level<LOQ)	Decrease in biomass production No uptake
Sludge compost	Sand	25 t FM/ha	0 % (level<LOQ)	
Sludge	Sand	30 t DM/ha	0 % (level<LOQ)	
Sludge compost	Soil	25 t FM/ha	0 % (level<LOQ)	Better yield in biomass No uptake
Organic Amendment <i>Eq. OM of compost</i>	Soil	25 t FM/ha	0 % (level<LOQ)	

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- ### Conclusions (2)
- Absorption of PCBs by carrots
 - ➔ Sand: theoretically optimized results
 - No transfer
 - ➔ Soil: closer to real conditions for land application
 - No transfer
 - Perspectives
 - ➔ Other organic compounds
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Thank you for your attention



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