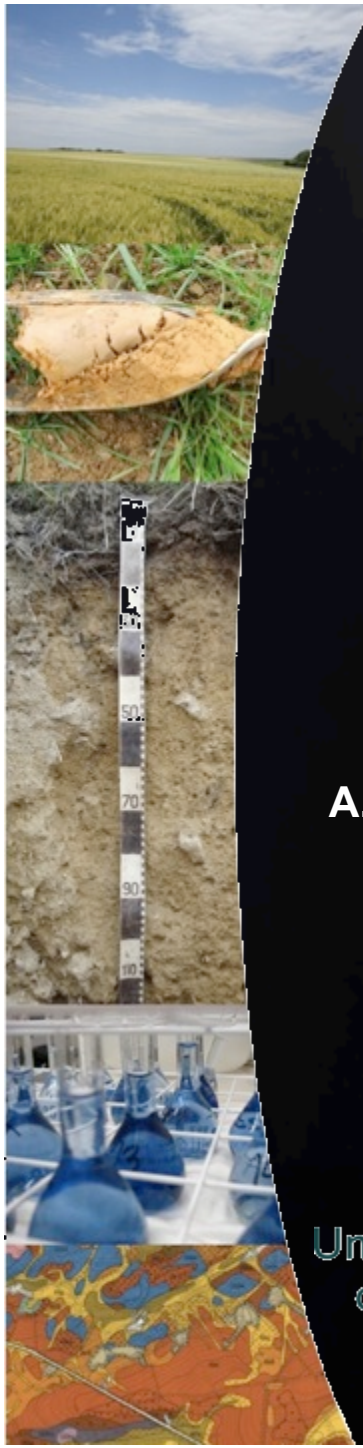

Effects of *Eisenia fetida* on metal uptake by *Vicia faba* and *Zea mays* from polluted soils

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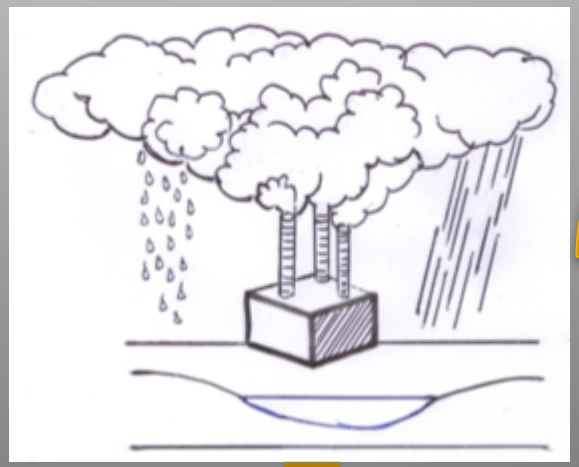
10th International Symposium on Earthworm Ecology - ISEE10
Athens, GA USA

gembloux agro bio tech

Metallurgic activities



Atmospheric fallouts

Significant heavy metal soil pollution

Effects on human health,…

Effects on plant productivity,…

Effects on soil organism behaviours and health

Conventional techniques

Physico-chemical treatment	Thermal treatment	Bioremediation
- Heavy Metals	- VOCs	- Hydrocarbons
- Organic compounds	- Oil	- Volatil compounds
- …	- …	- …

Contaminated material

Cost of transport and treatments

Phytoextraction, phytoremediation, bioremediation, …

Organisms

Food supply

Soil functions

Physical and chemical transformation

Organic matter

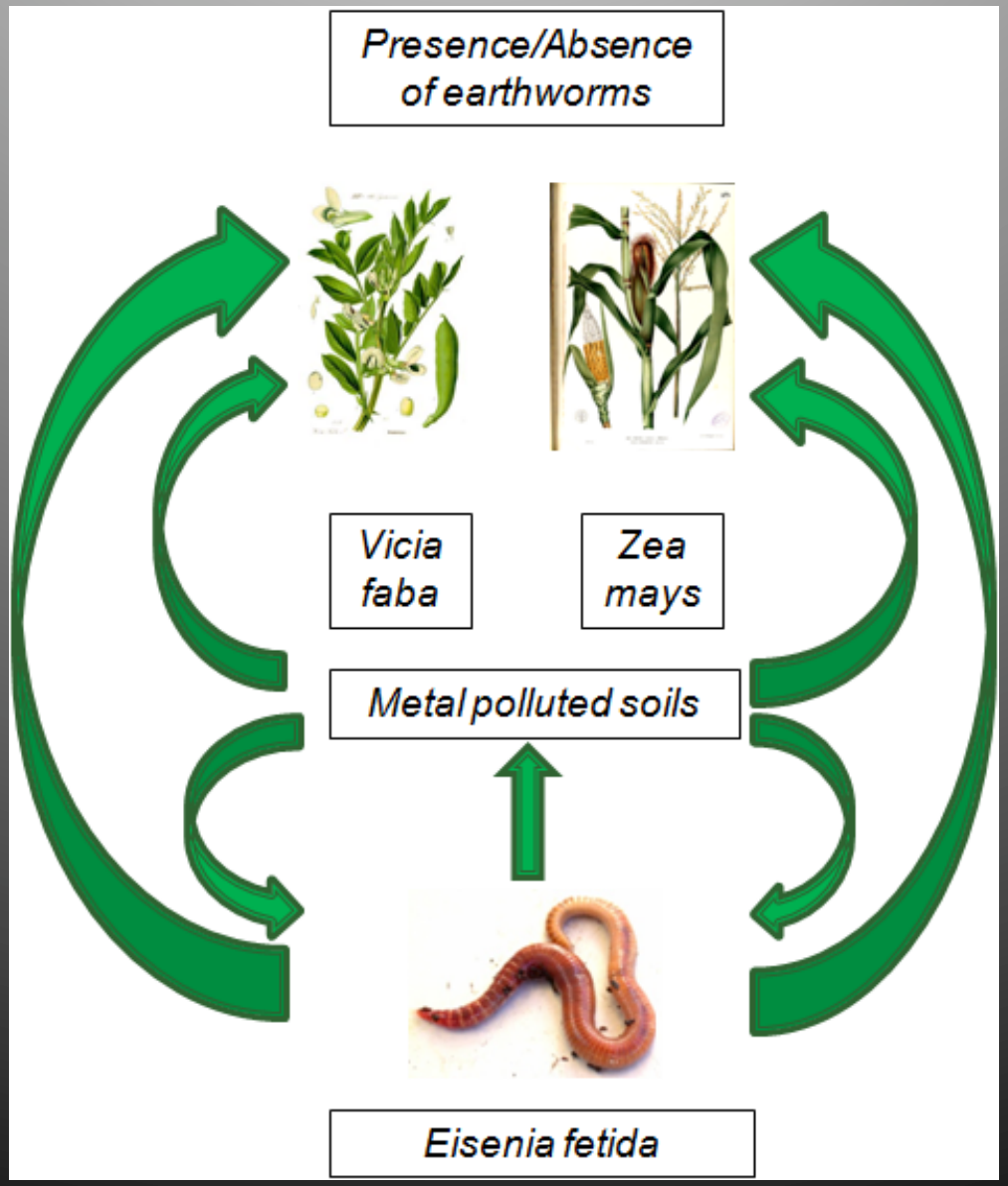
Plants

Different processes

Anthropogenic activities

Metal-polluted soils

Sustainability of soil functions ?


Presence/Absence of earthworms
Vicia faba
Zea mays
Metal polluted soils
Eisenia fetida

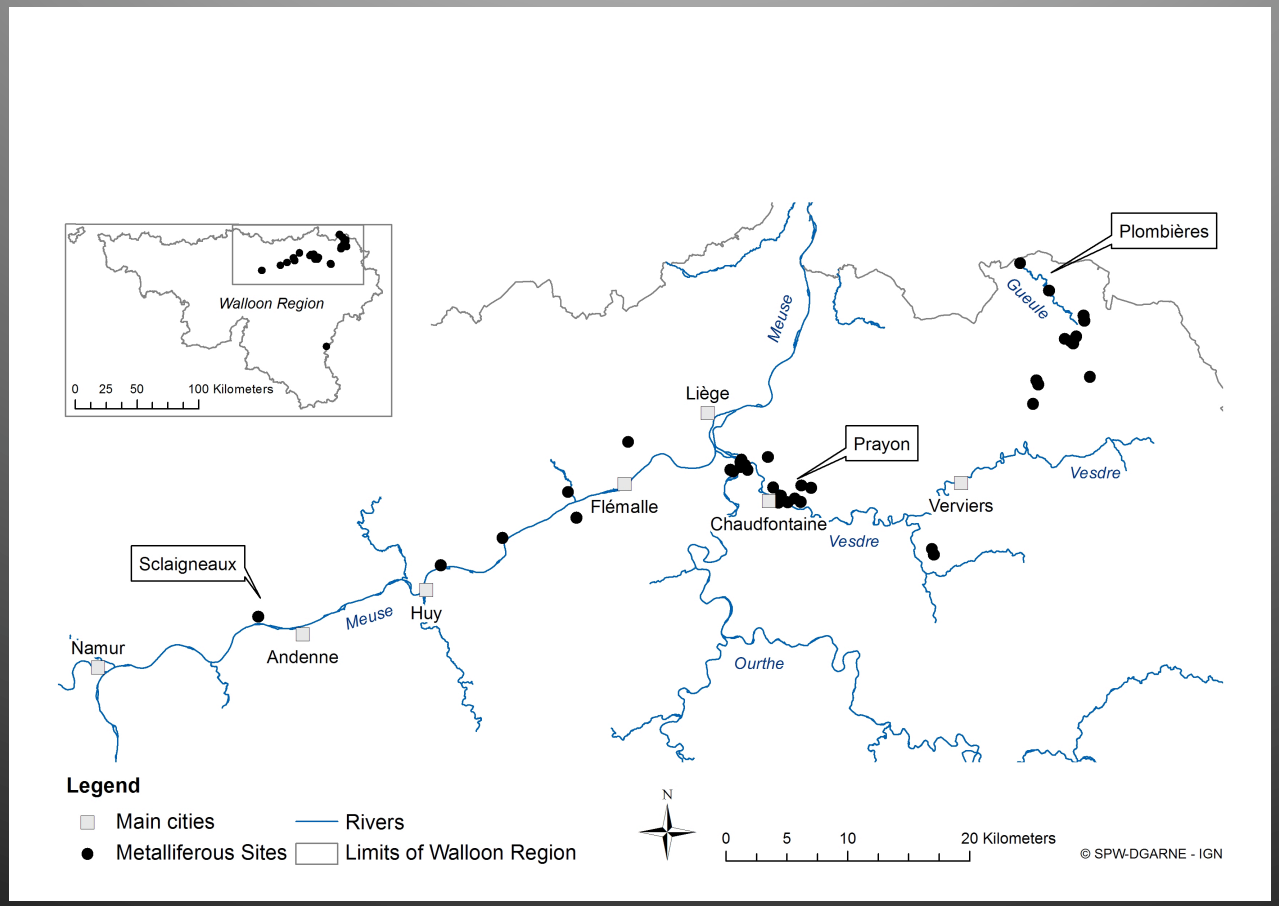
. Effects of increasing concentrations of metals on life-history traits of *E. fetida* ;

. Assess the impact of *E. fetida* activity on metal concentrations in soils ;

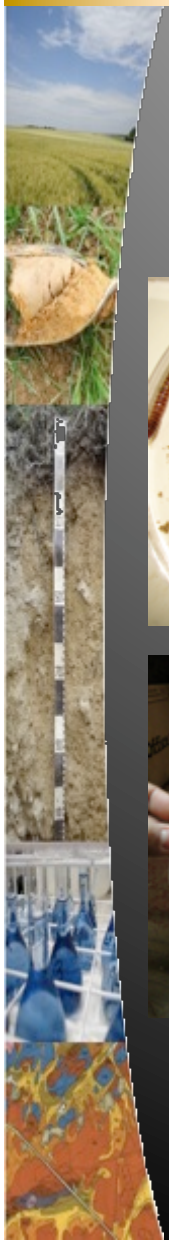
. Evaluate if the presence of *E. fetida* lead to metal accumulation in *V. faba* and *Z. mays.*

To better understand *E. fetida* role on metal uptake by plants

1. Study site



Distribution of metalliferous sites in Walloon Region (Belgium).



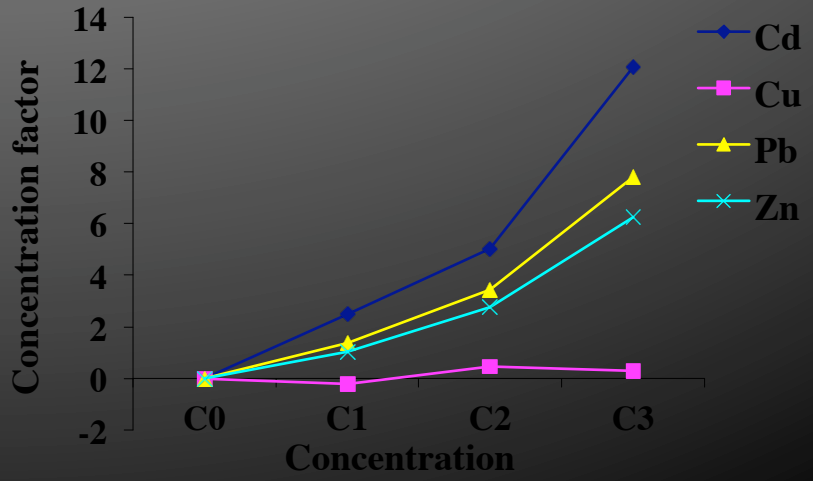
2. Experimental design

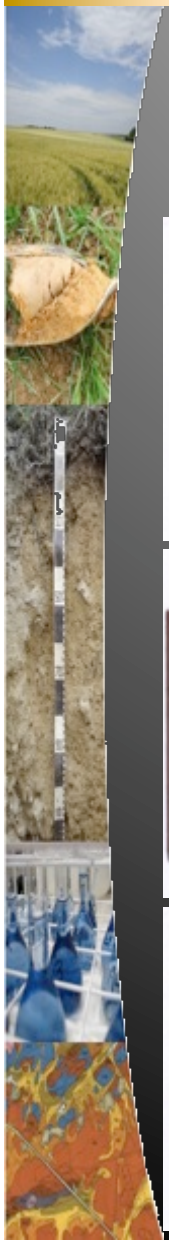
Test organisms and test soil

E. fetida; n=20

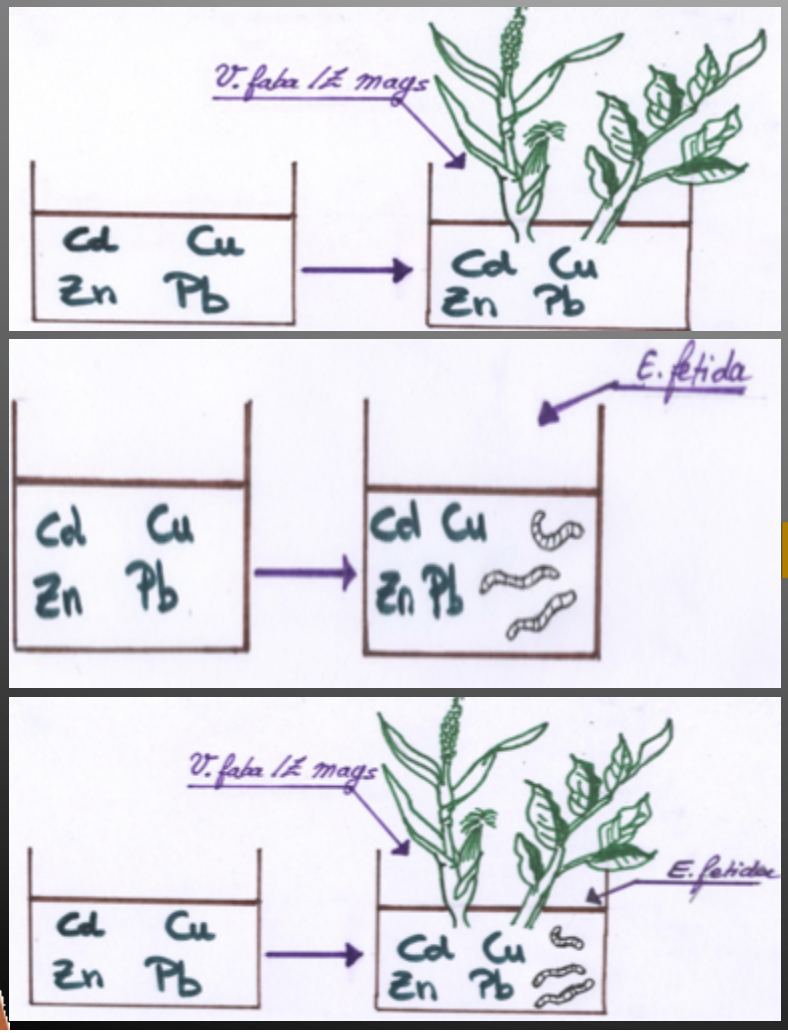
Polluted soils
0-20cm; 2.25kg

Z. Mays and *V. faba; 10 grains*





2. Experimental design



After 42 days

Soil

- Soil bioavailable fractions

E. fetida

- Mortality
- Weight
- Reproduction
- Metal accumulation

V. faba / Z. mays

- Metal accumulation

1. Soil pH and available concentrations

Treatments							
Soil parameter	Concentration	Control soil (E0, P0, F0)	Soil with *E. fetida* (E1, P0, F1)	Soil with *V. faba* (E0, P1, F0)	Soil with *Z. mays* (E0, P2, F0)	Soil with *E. fetida* + *V. faba* (E1, P1, F1)	Soil with *E. fetida* + *Z. mays* (E1, P1, F1)
pH	C0	7,2	7,2	7,2	7,1	7,1	7,1
	C1	6,4	6,4	6,4	6,5	4,9	6,6
	C2	6,4	6,4	6,3	6,4	6,4	6,6
	C3	7,1	7,1	7,1	7,1	7	7
Cd	C0	0,85%	1,13%	0,00%	0,00%	0,42%	0,00%
	C1	1,49%	1,49%	1,21%	1,01%	1,37%	3,15%
	C2	0,98%	1,71%	1,66%	1,22%	1,52%	1,38%
	C3	0,45%	0,41%	0,54%	0,32%	0,65%	0,65%
Cu	C0	0,07%	0,00%	0,13%	0,27%	0,00%	1,00%
	C1	0,14%	0,14%	0,09%	0,00%	0,00%	0,15%
	C2	0,07%	0,00%	0,08%	0,00%	0,38%	1,08%
	C3	0,00%	0,00%	0,00%	0,00%	0,00%	0,47%
Pb	C0	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
	C1	0,03%	0,00%	0,00%	0,02%	0,03%	0,03%
	C2	0,01%	0,00%	0,07%	0,04%	0,01%	0,07%
	C3	0,03%	0,02%	0,03%	0,05%	0,02%	0,04%
Zn	C0	0,06%	0,12%	0,00%	0,00%	0,00%	0,00%
	C1	0,02%	0,22%	0,21%	0,18%	0,15%	0,14%
	C2	0,20%	0,26%	0,37%	0,22%	0,22%	0,23%
	C3	0,05%	0,03%	0,05%	0,04%	0,05%	0,08%

. Presence of *E. fetida* + *Z. mays* or *Z. mays* :

- ↗ of Pb, Zn, and Cd concentrations

Treatments							
Soil parameter	Concentration	Control soil (E0, P0, F0)	Soil with *E. fetida* (E1, P0, F1)	Soil with *V. faba* (E0, P1, F0)	Soil with *Z. mays* (E0, P2, F0)	Soil with *E. fetida* + *V. faba* (E1, P1, F1)	Soil with *E. fetida* + *Z. mays* (E1, P1, F1)
pH	C0	7,2	7,2	7,2	7,1	7,1	7,1
	C1	6,4	6,4	6,4	6,5	4,9	6,6
	C2	6,4	6,4	6,3	6,4	6,4	6,6
	C3	7,1	7,1	7,1	7,1	7	7
Cd	C0	0,85%	1,13%	0,00%	0,00%	0,42%	0,00%
	C1	1,49%	1,49%	1,21%	1,01%	1,37%	3,15%
	C2	0,98%	1,71%	1,66%	1,22%	1,52%	1,38%
	C3	0,45%	0,41%	0,54%	0,32%	0,65%	0,65%
Cu	C0	0,07%	0,00%	0,13%	0,27%	0,00%	1,00%
	C1	0,14%	0,14%	0,09%	0,00%	0,00%	0,15%
	C2	0,07%	0,00%	0,08%	0,00%	0,38%	1,08%
	C3	0,00%	0,00%	0,00%	0,00%	0,00%	0,47%
Pb	C0	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
	C1	0,03%	0,00%	0,00%	0,02%	0,03%	0,03%
	C2	0,01%	0,00%	0,07%	0,04%	0,01%	0,07%
	C3	0,03%	0,02%	0,03%	0,05%	0,02%	0,04%
Zn	C0	0,06%	0,12%	0,00%	0,00%	0,00%	0,00%
	C1	0,02%	0,22%	0,21%	0,18%	0,15%	0,14%
	C2	0,20%	0,26%	0,37%	0,22%	0,22%	0,23%
	C3	0,05%	0,03%	0,05%	0,04%	0,05%	0,08%

. pH decrease after 42 days exposure in all treatments (no significant differences)

. Presence of *E. fetida* :

- ↘ of Pb concentrations and ↗ of Zn and Cd concentrations

. Presence of *E. fetida* + *V. faba* or *V. faba* :

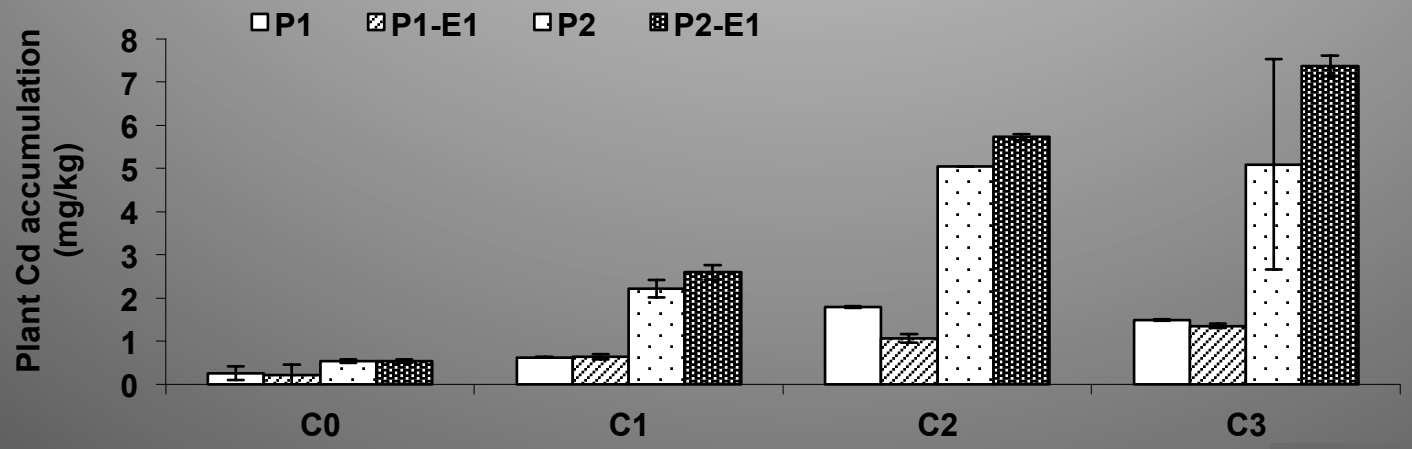
- ↘ of Pb concentrations and ↗ of Zn and Cd concentrations

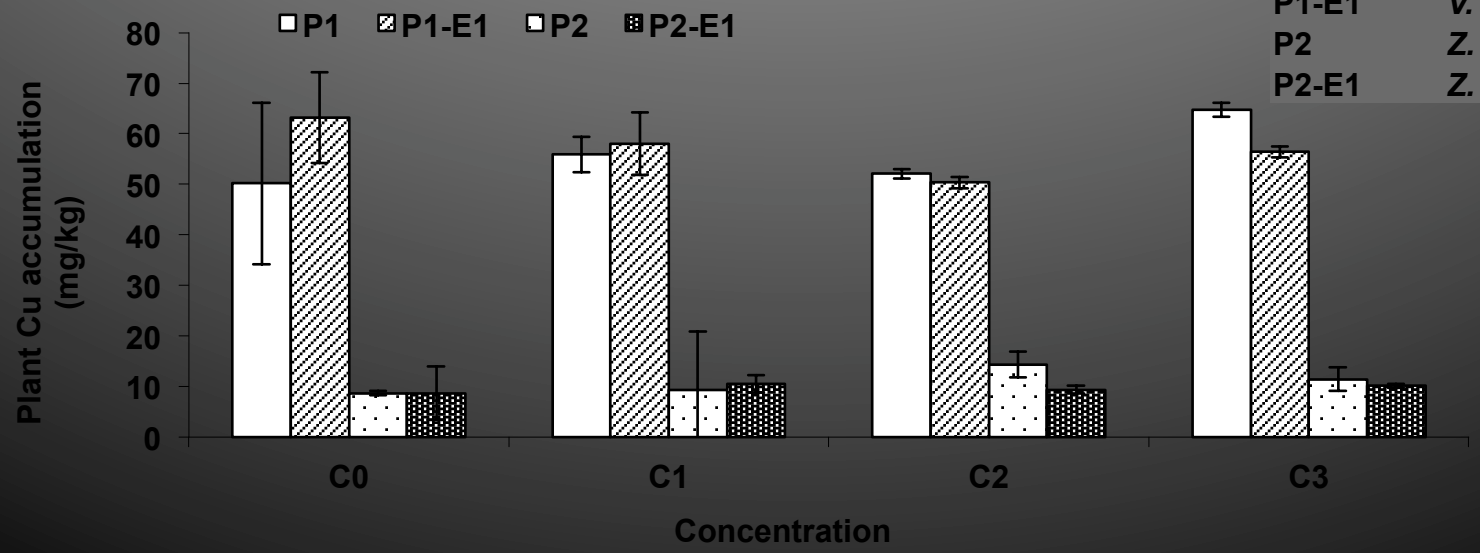
2. Earthworm life-history

- No effects (conc, plants) on earthworm survive;
- No effects (Conc, plants) on earthworm weights;
- No effect (Conc) on earthworm reproduction;
- Plant addition (P1 or P2) increases cocoon production and decreases cocoon weight.

Energy has been allocated to the production of earthworm cocoons.

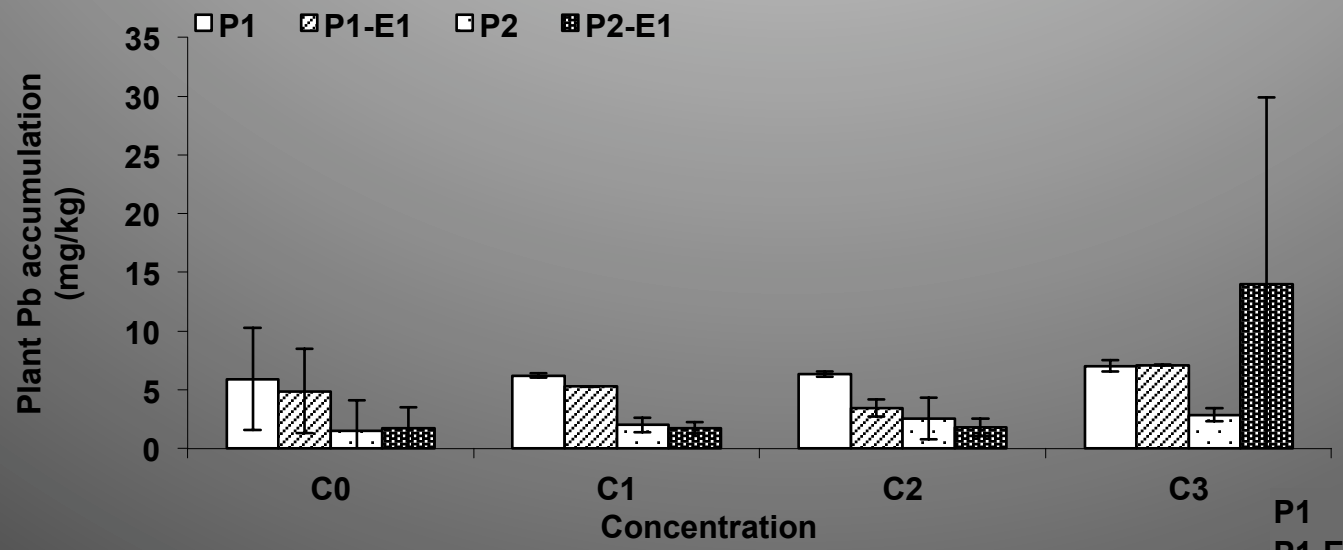
3. Metal plant accumulation

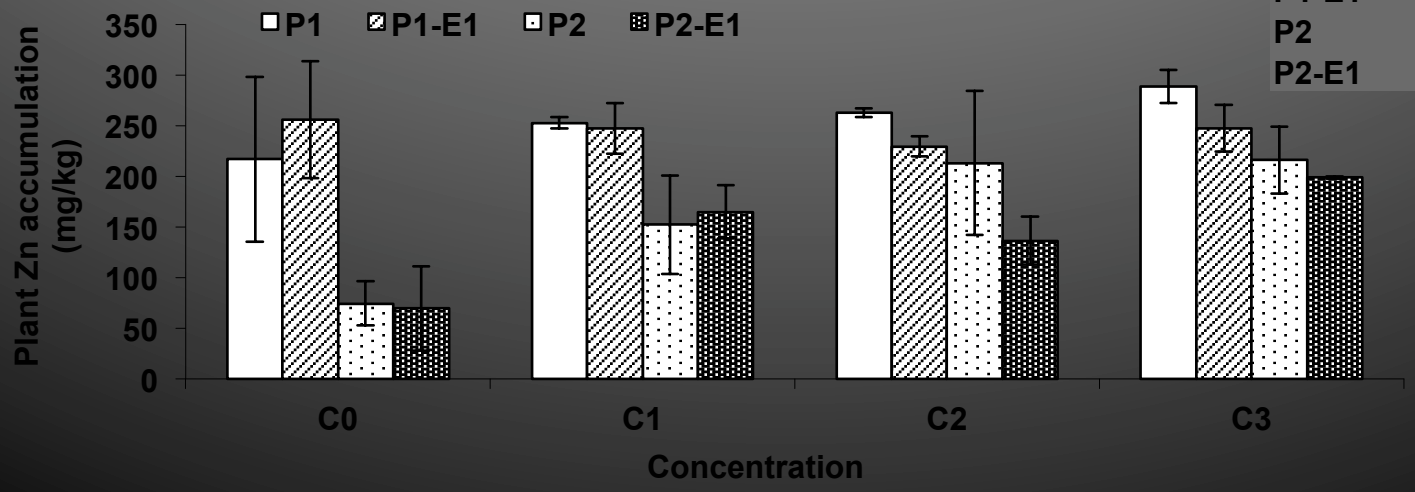




P1	*V. faba*
P1-E1	*V. faba + E. fetida*
P2	*Z. mays*
P2-E1	*Z. mays + E. fetida*

2. Metal plant accumulation



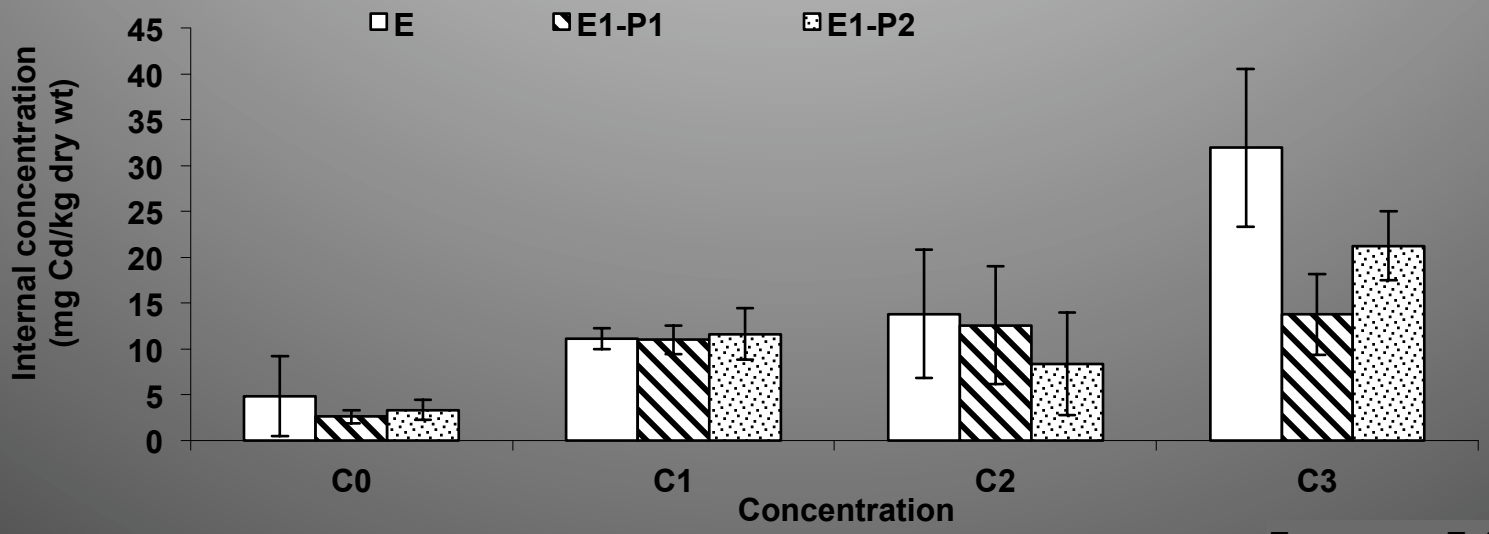


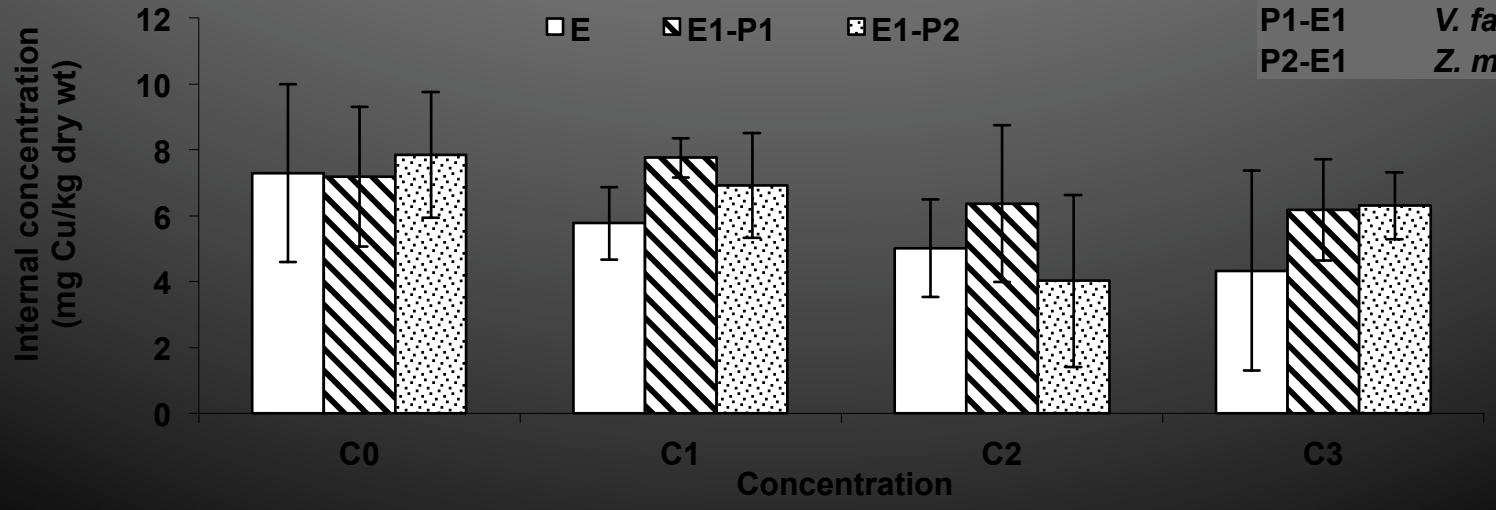
P1	*V. faba*
P1-E1	*V. faba + E. fetida*
P2	*Z. mays*
P2-E1	*Z. mays + E. fetida*

2. Metal plant accumulation

- High Zn and Cd accumulation by *Z. mays* / *V. faba* ;
- Pb concentrations exhibited slight differences between *Z. mays* and *V. faba*
- High Cd accumulation by *Z. mays* after addition of *E. fetida* (C2, C3) ;
- High Cu accumulation by *V. faba* and *V. faba* + *E. fetida*

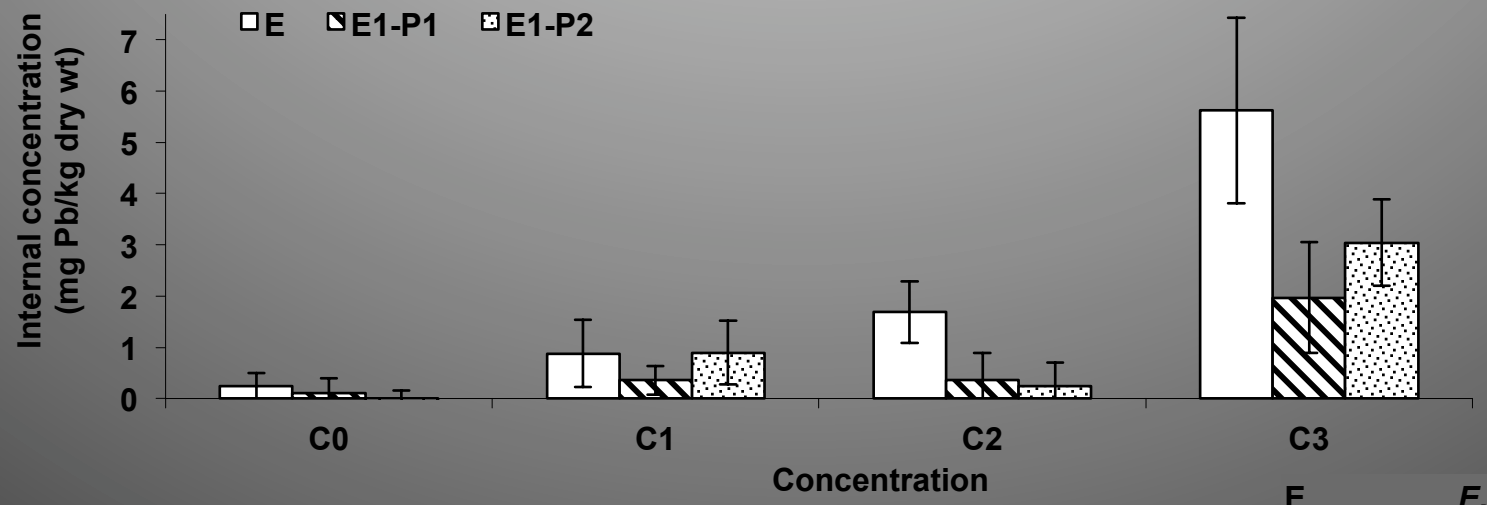
3. Metal earthworm accumulation

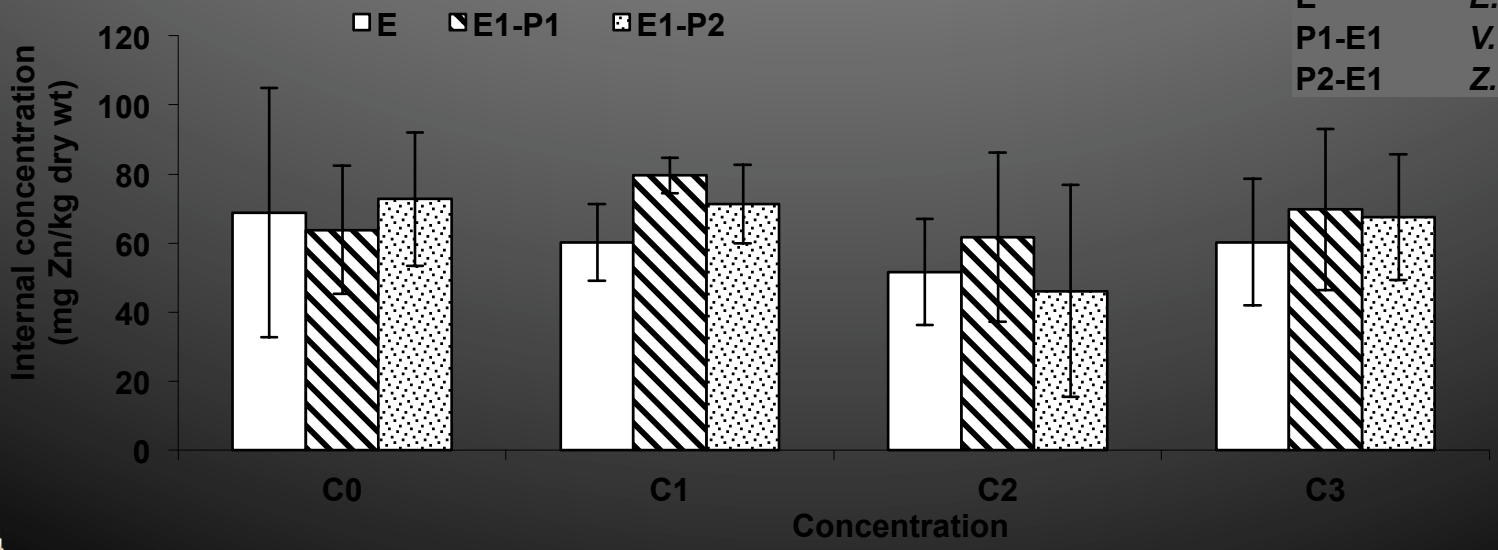




E	*E. fetida*
P1-E1	*V. faba* + *E. fetida*
P2-E1	*Z. mays* + *E. fetida*

3. Metal earthworm accumulation

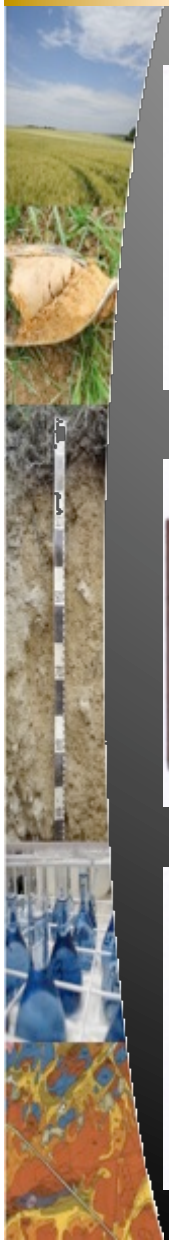


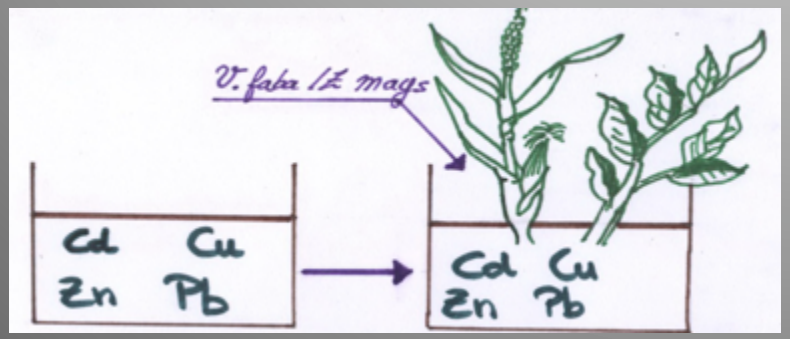


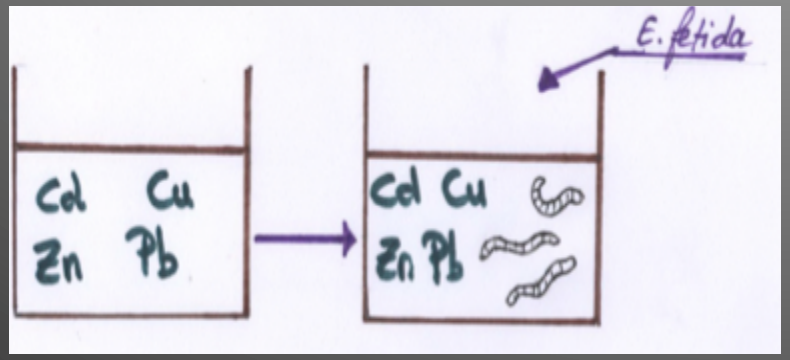
E	*E. fetida*
P1-E1	*V. faba + E. fetida*
P2-E1	*Z. mays + E. fetida*

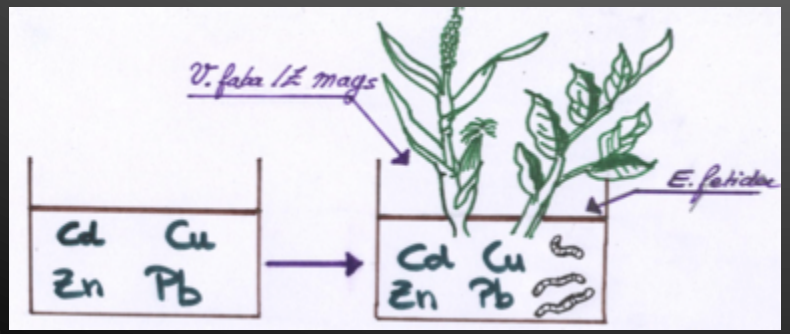
2. Metal earthworm accumulation

- Low Pb and Cd accumulation by *E. fetida* after addition of plants (P1, P2);
- Pb and Cd accumulations in E. fetida increase continuously according to total soil concentrations;
- Earthworm regulation Zn and Cu uptake at the concentration tested.









- **Accumulation capacity depends on the metal elements and plant species**

➢ ***Z. mays*: Cd ; *V. faba*: Cu**

- **High Pb and Cdearthworm accumulation of in the absence of plants**

- **The combination of *E. fetida* and *Z. mays* can increase Cd and Pb plant accumulation**

Complex interaction between the metal soil concentrations and organism accumulation.

Acknowledgments

. University of Liege – Gembloux Agro-Bio Tech

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. Université de Rennes - UMR CNRS EcoBio, Station Biologique de Paimpont, France ;

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Thank you for your attention…