

# Effects of tillage practices and crop residue exportation on earthworm communities and soil physico-chemical properties in silt loam arable soil (Belgium)

A. Lemtiri, G. Colinet, T. Alabi, B. Bodson, D. Cluzeau, Y. Brostaux, C. Olivier, J. Pierreux, E. Haubruge & F. Francis



University of Liege – Gembloux Agro-Bio Tech  
Soil and Water Systems Unit - Functional & evolutionary Entomology Unit  
Passage des Déportés, 2. B-5030 Gembloux  
alemtiri@doct.ulg.ac.be



## Study context

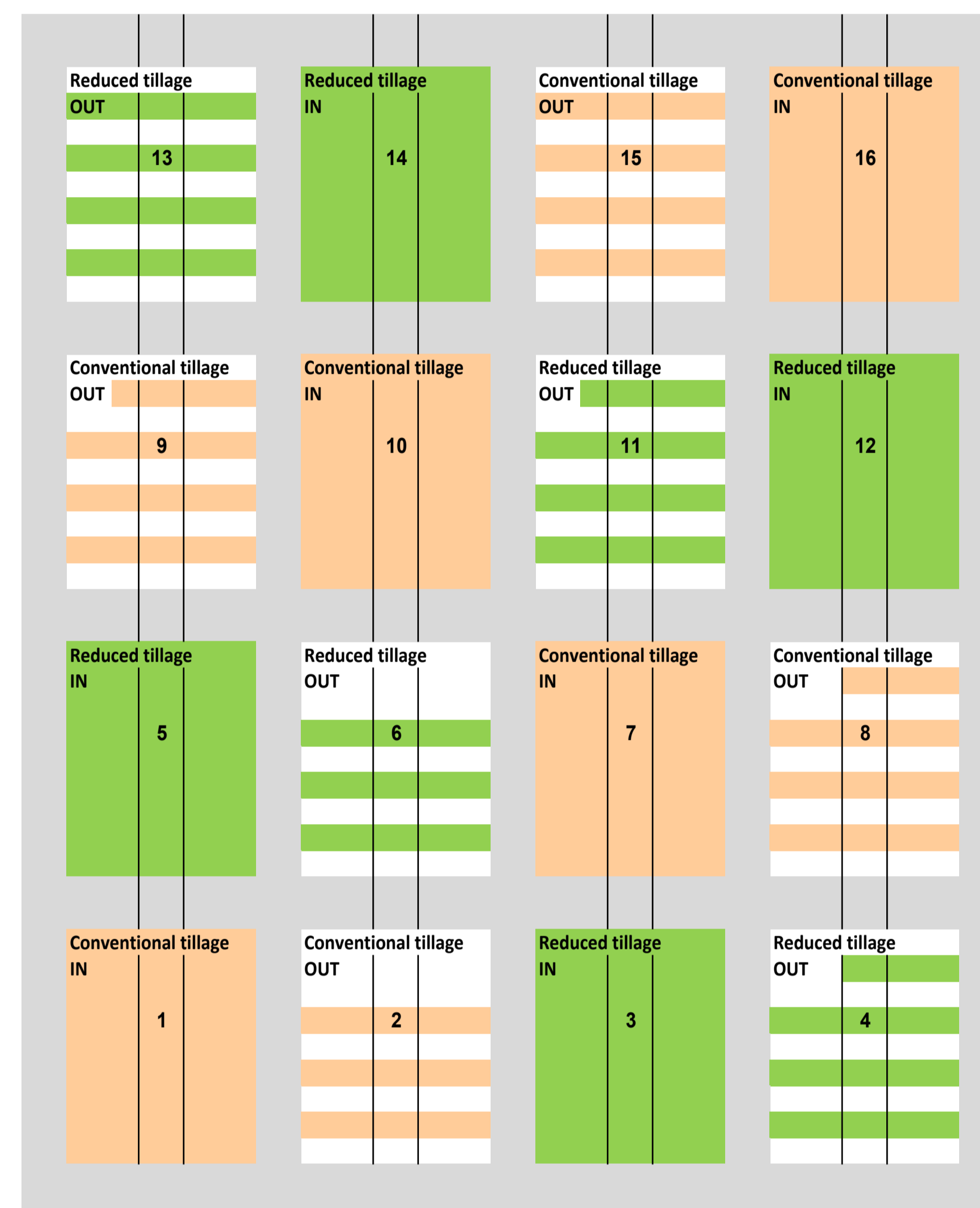
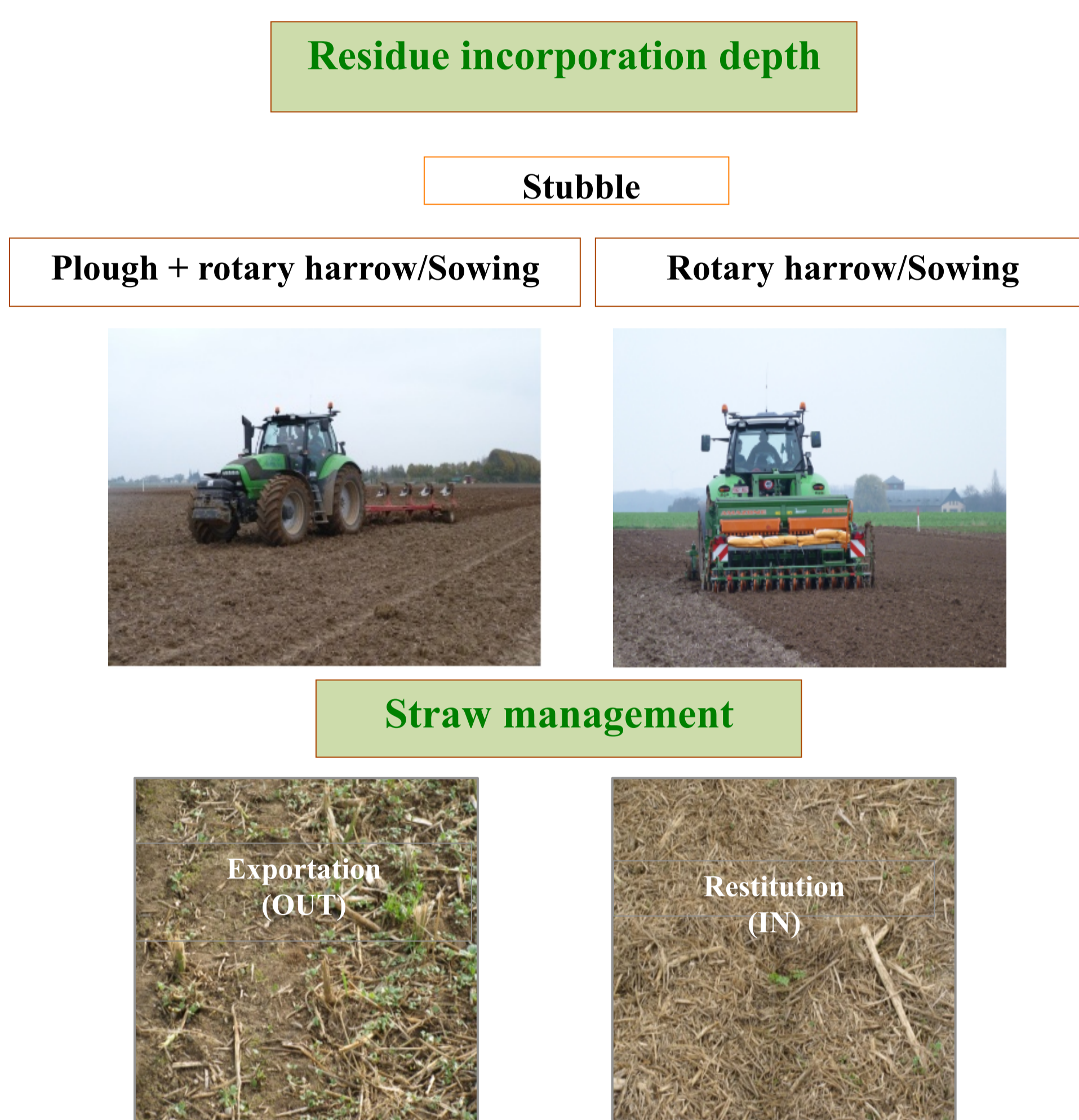
Earthworms constitute a major proportion of the macrofauna biomass in arable soils and have a pivotal role to play in maintaining soil health. They can be considered the most important « ecosystem engineers » in arable soil, due to their casting effects on soil physical and bio-chemical properties. Earthworms have been suggested as potential indicators of the sustainability of agricultural practices that a farmer might use thereby optimising different farming systems. Agricultural production systems have a marked effect on earthworm populations, because mechanical disturbances change the environment in which they live.



The current study assessed the effects of two agricultural practices and two straw management modalities on earthworm community changes and soil physico-chemical properties.

## Material and methods

### Site and experimental design



Soil samples were collected at 3 depths:

- a: 0-10 cm
- b: 10-20 cm
- c: 20-30 cm

Earthworms were sampled using formaldehyde and hand sorting method (Bouché, 1972).

### Methods

#### Studied parameters

#### Physico-chemical soil properties

- Bulk density (BD)
- Penetration resistance (PR)
- Electrical conductivity (EC)
- Hot Water Carbon (HWC)
- Residual humidity (RH)
- Water extractable (Ca, Mg, Na, K, P)

#### Earthworm community

- Abundance
- Biomass
- Species diversity

## Results and discussion

### Soil physico-chemical properties

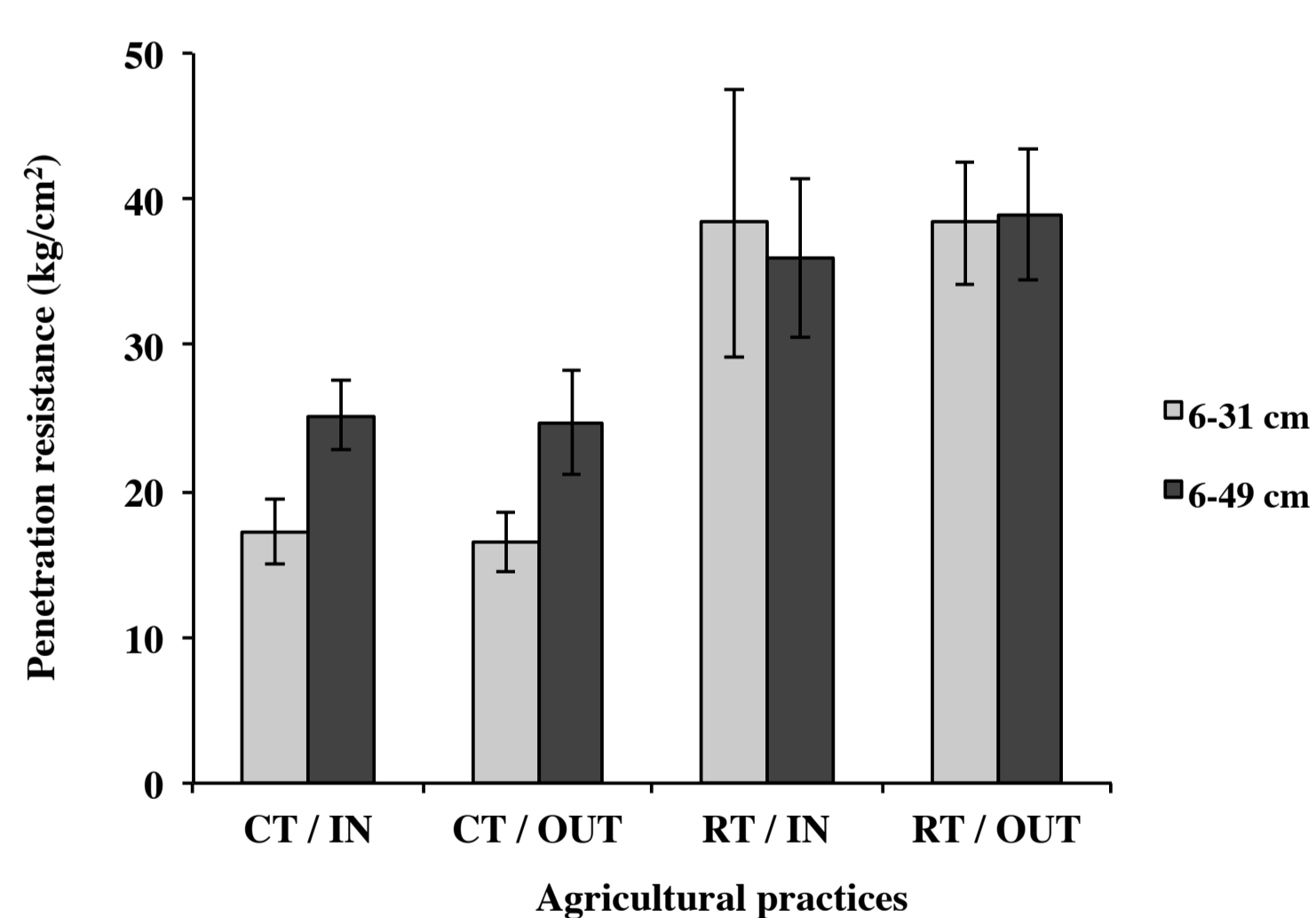


Figure 1. Mean penetration resistance measured as a function of two depths (cm) under agricultural practices.

### Earthworm abundance and biomass

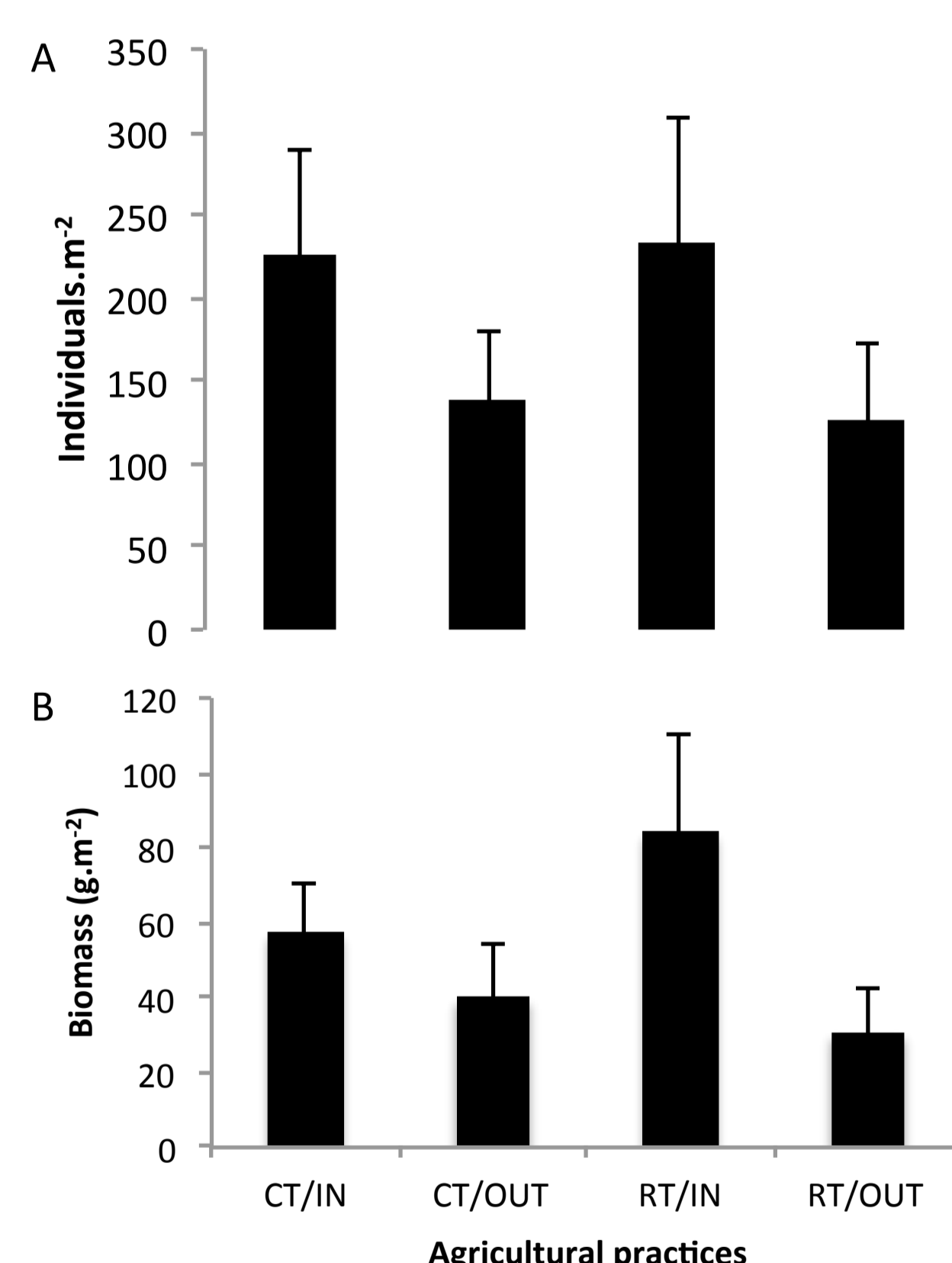


Figure 2. Earthworm abundance and biomass (+Standard deviation) measured in the four agricultural practices.

### Earthworm diversity

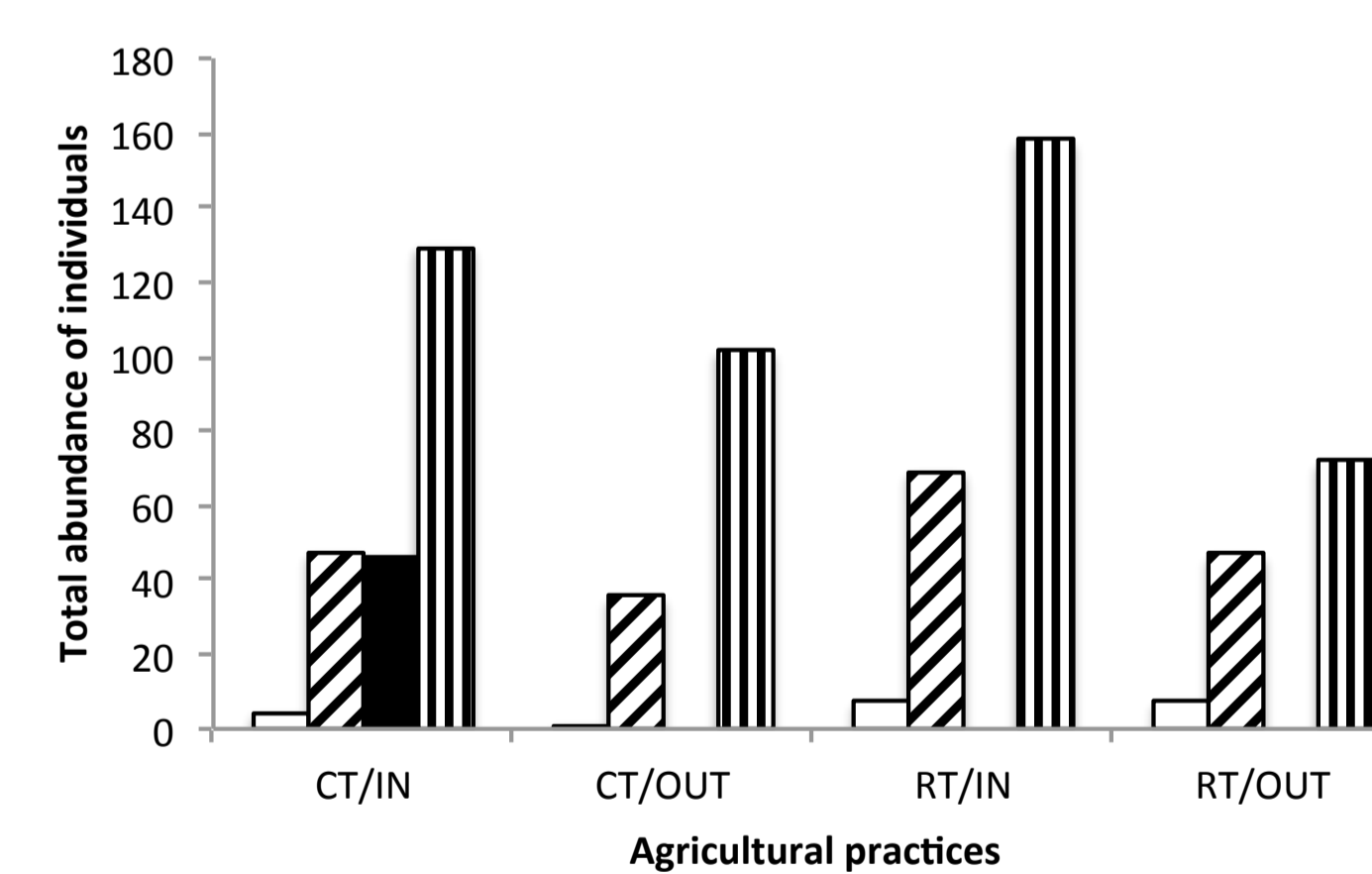


Figure 3. Total abundance of earthworm ecological category under agricultural practices.

Table 2. Proportion (%) of earthworm species and ecological category recorded at Belgian sites in 2012.

Species	Ecological category	CT/IN	CT/OUT	RT/IN	RT/OUT
<i>Dendrobaena mammalis</i>	Epigeic	1.8			
<i>L. castaneus</i>	Epigeic	0.1	0.4	3.1	5.8
<i>L. terrestris</i>	Epi-aneic	20.8	25.8	29.5	37.2
<i>Nicodrilus. c. meridionalis</i>	Anecic	20.3			
<i>Nicodrilus. c. caliginosus</i>	Endogeic	42.9	64.4	63.9	56.5
<i>Allolobophora. c. chlorotica</i>	Endogeic	5.3	3.1		
<i>typica</i>					
<i>Allolobophora. r. rosea</i>	Endogeic	8.6	6.4	3.5	0.6
<i>Octolasion Cyaneum</i>	Endogeic	0.2			

Table 1. Mean of soil physical and chemical properties among the four agricultural practices.

Parameter/Treatment	EC	RH	HWC	P	K	Mg	Na	Ca
Depth a	S.m <sup>-1</sup>		Mg.kg <sup>-1</sup>					
CT/IN	81.5	16.3	411	4.2 a	16.5 ac	3.7	26.2	54
CT/OUT	79.2	16.3	448.3	4.2 a	14.5 a	3.7	32.3	52.3
RT/IN	76.5	17.3	463	5.8 b	21.7 b	3.6	22.4	48.8
RT/OUT	73.7	16.8	443.1	4.9 ab	18.5 bc	3.4	22.6	47.3
Depth b								
CT/IN	68.8	17.7	433.6	3.8 a	13.2 a	3.4	24.5	50.3
CT/OUT	69.1	17.6	402.8	3.8 a	12.1 a	3.3	22.3	47.8
RT/IN	71	17.4	387.7	3.9 b	11.6 b	3.3	21.5	52.1
RT/OUT	66.7	17	397.2	3.7 ab	9.1 b	3.1	20.8	45.8
Depth c								
CT/IN	68.5 a	18.2 a	384.4	4 a	14.9 a	3.4 ab	23.5	50.2 ab
CT/OUT	67.6 a	18.2 a	378.4	4.1 a	14.8 a	3.1 a	23	44.3 a
RT/IN	84.5 b	17.1 ab	380.5	3.3 b	14.1 ab	4.1 b	21.7	58.5 b
RT/OUT	77.4 ab	17 b	382.4	3.2 b	12.3 b	3.7 ab	21.5	52.9 ab

## Key facts

- Soil compaction was significantly higher in RT compared with CT up to a depth of 6–49 cm (Fig.1) ;
- For each depth, measures of soil physico-chemical properties showed significant differences among treatments (Table 1) ;
- Mean earthworm abundance and biomass was similarly not significantly different between CT and RT (Fig. 2) ;
- Significant increased earthworm abundance and biomass when crop residues were remained in the fields (Fig.2) ;
- Earthworm community in fields was dominated by epi-aneic and endogeic categories (Fig.3) ;
- Earthworm community was dominated by *N. c. caliginosus*, *L. terrestris* and *A. r. rosea* species (Table 2) ;
- No clear associations between the groups of physico-chemical and biological variables.