SOPHIE

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Effect of macrofauna on soil physical properties: case study of earthworms in Technosols

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Objective of the study : Maha Deeb PHD thesis

to evaluate the validity and relevance of soil shrinkage and water retention curves for characterizing the effect of plant, earthworms and compost on Technosols physical properties

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Interactions between organisms and parent materials of a constructed Technosol shape its hydrostructural properties

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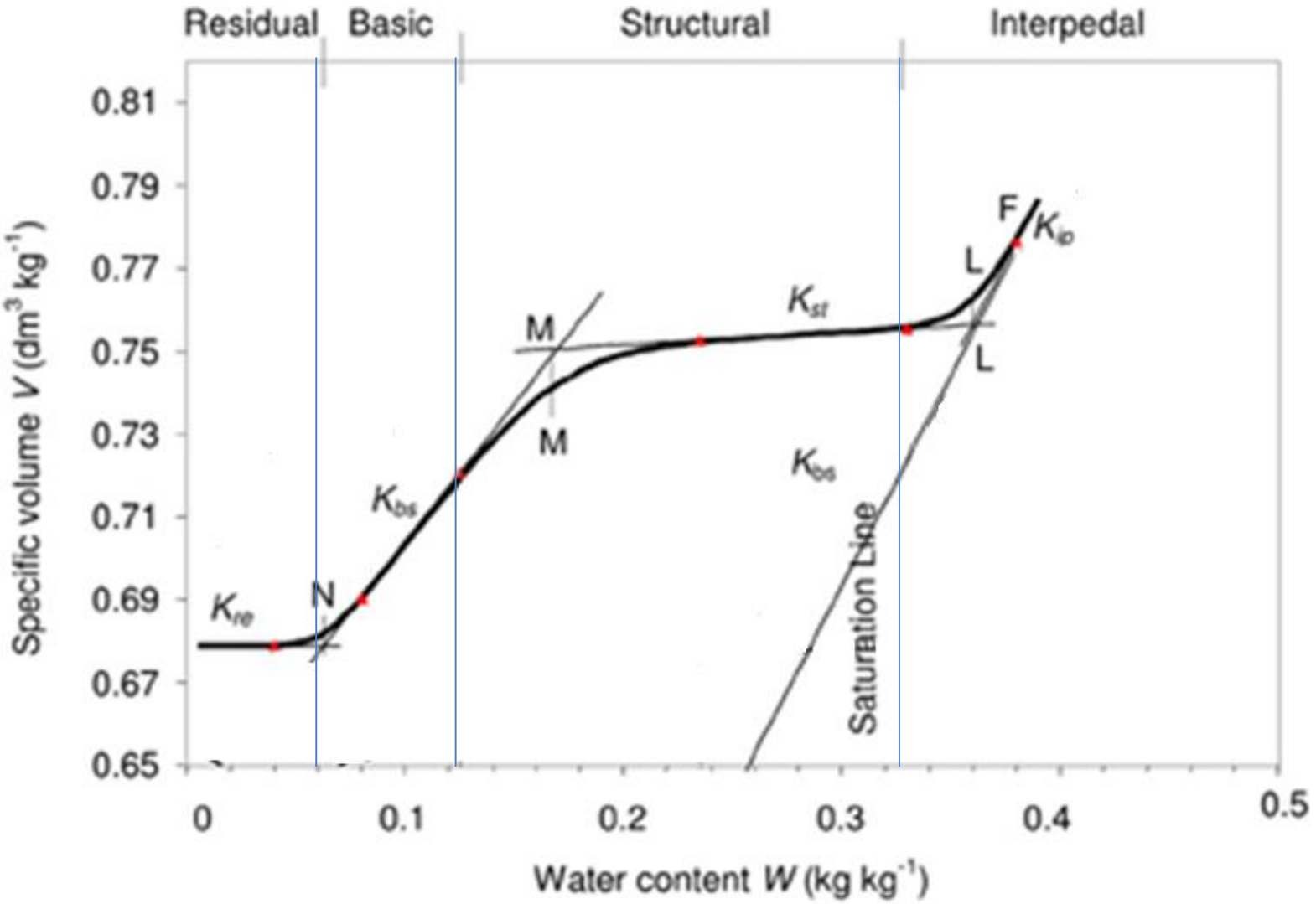
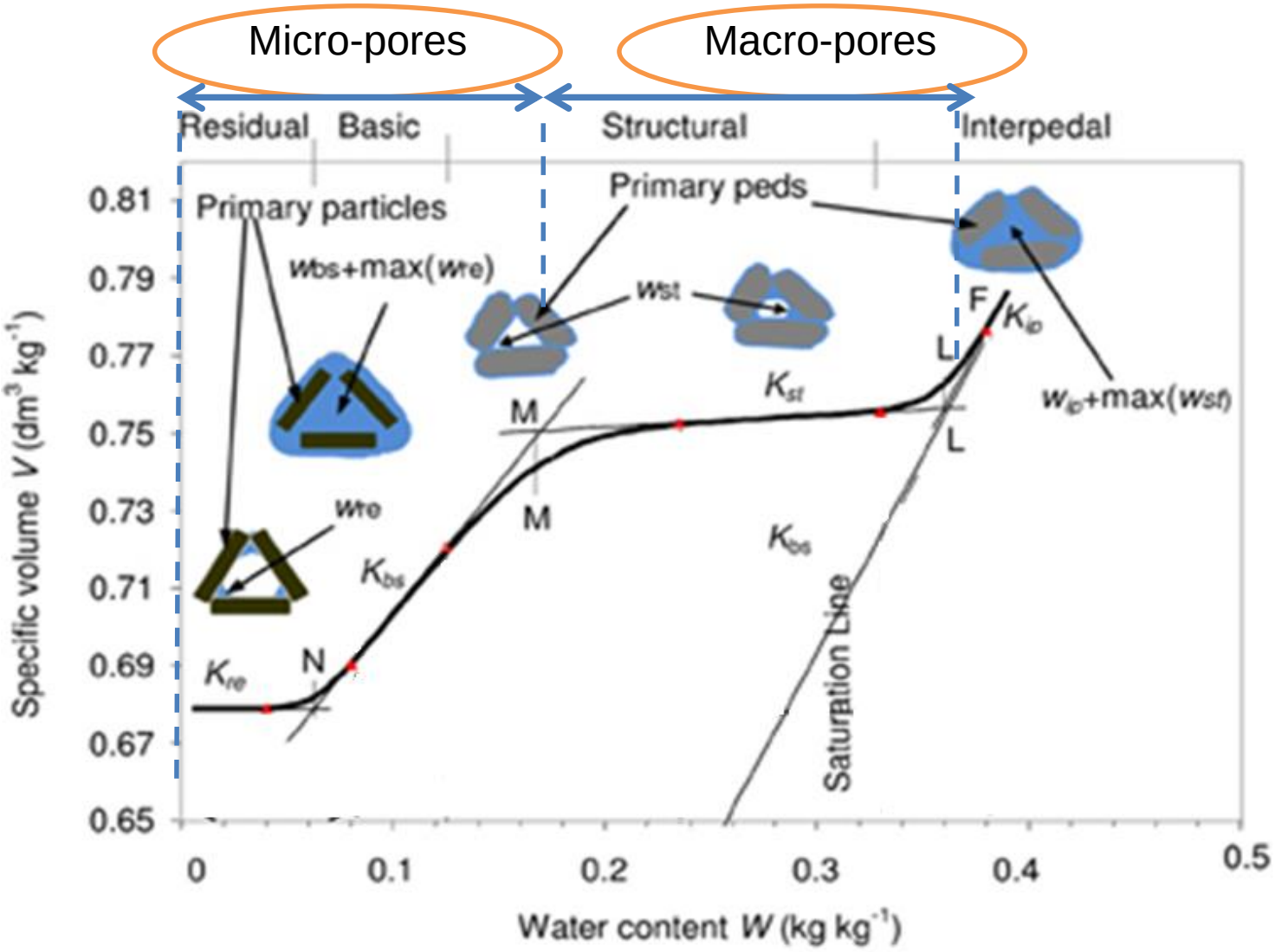
Soil shrinkage curve



Soil shrinkage curve



Braudeau and al. 2005

Experimental design: 6 « abiotic » treatments

Mineral component

Regolith <4mm

Organic component

Compost <4mm

Mix

0% **10%** **20%** **30%** **40%** **50%**

6 volumic proportions of compost

Experimental design: 4 « biotic » treatments

Aporrectodea caliginosa

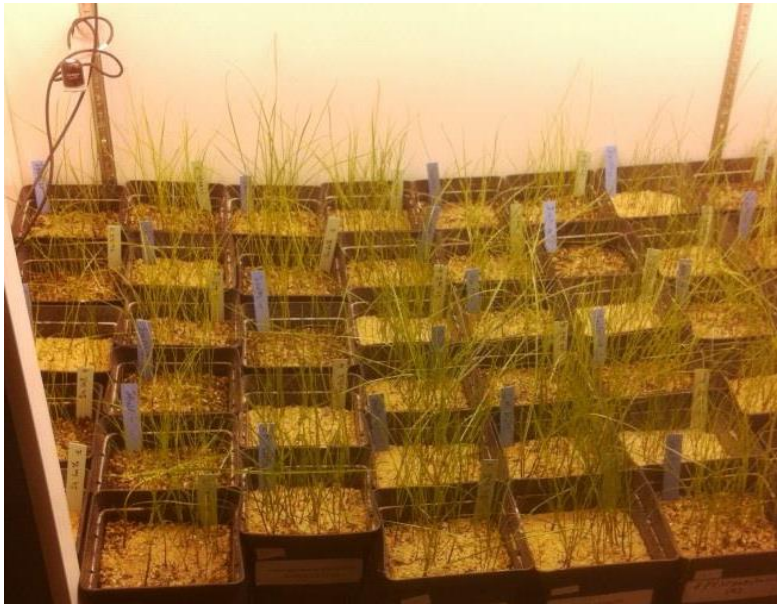
Lolium perene

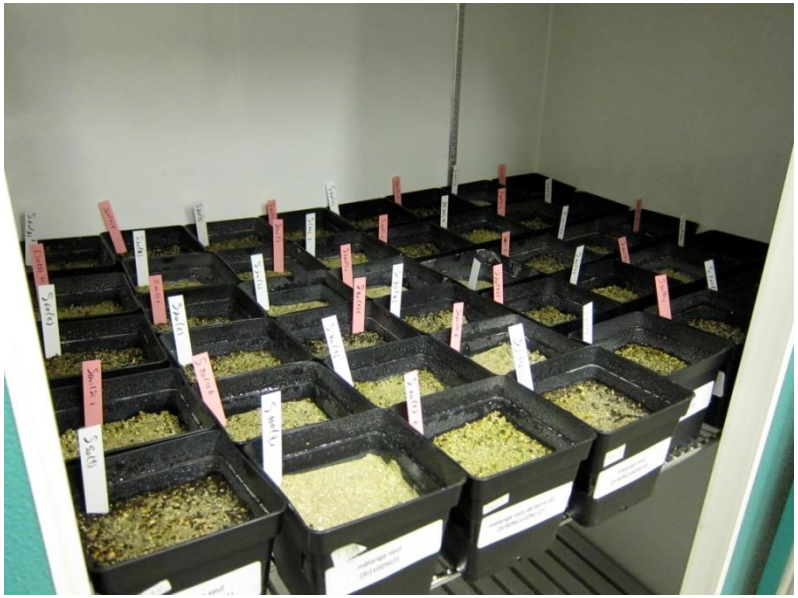
1) Control (C)
2) Earthworms (E)
3) Plants (P)
4) Earthworms and plants (EP)

➡ **4 replicates**

➡ **Total : 96 mesocosmes**

Experimental design: Incubations



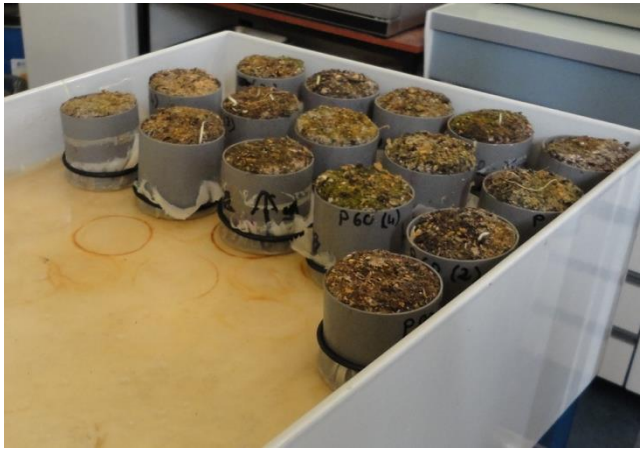


Incubations (phytotrons) : 5 months

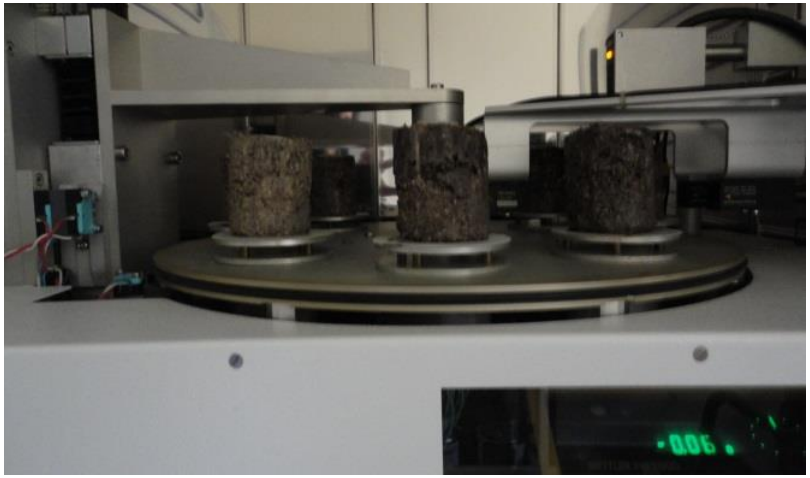
- Photoperiode 12h (500 µmol photons.m^{-2}.$s^{-1)}$
- Temperature 22/20°C day/night, Air: 75 H%
- H% soil : 80% of the WHC

Hydro-structural measurements

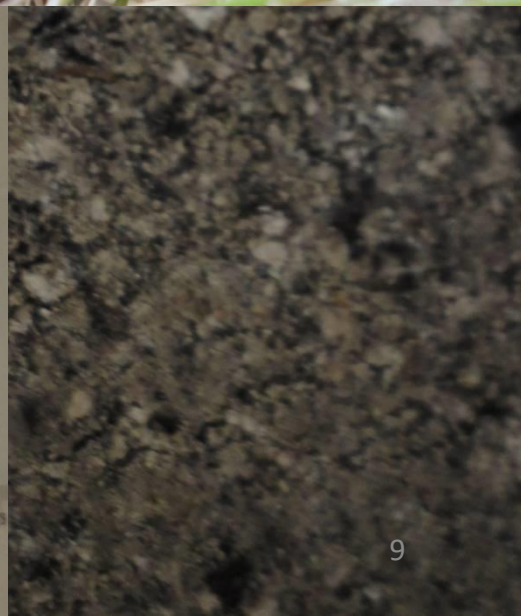
1) Extraction of the soil cylinders



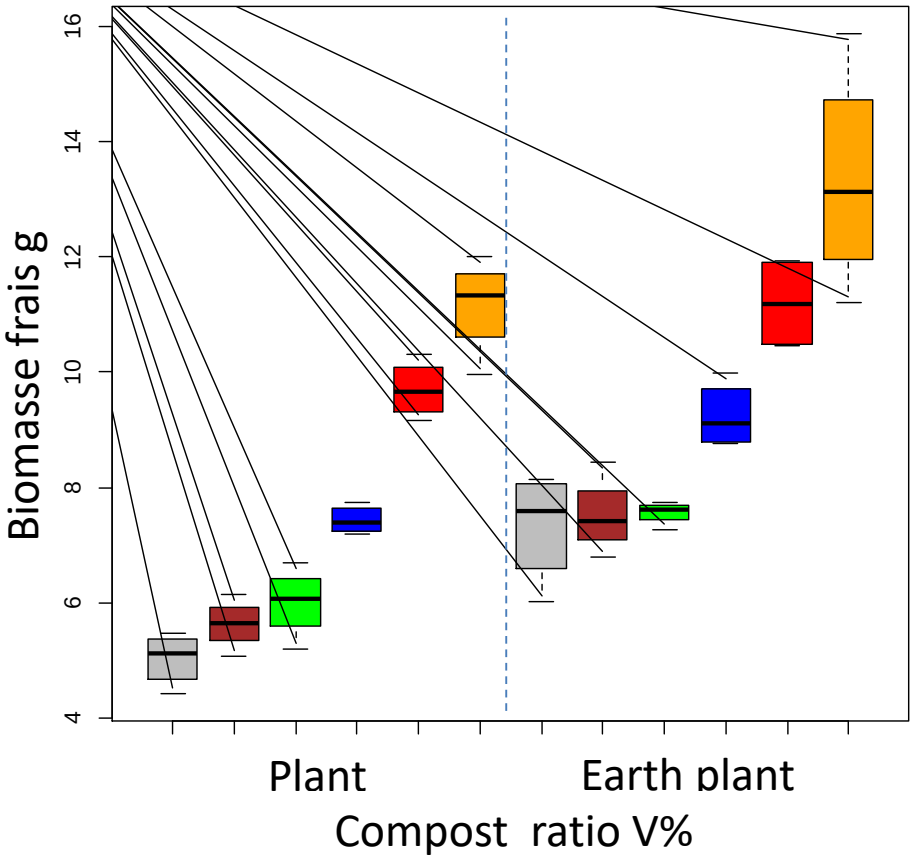
2) Saturation à la table de succion

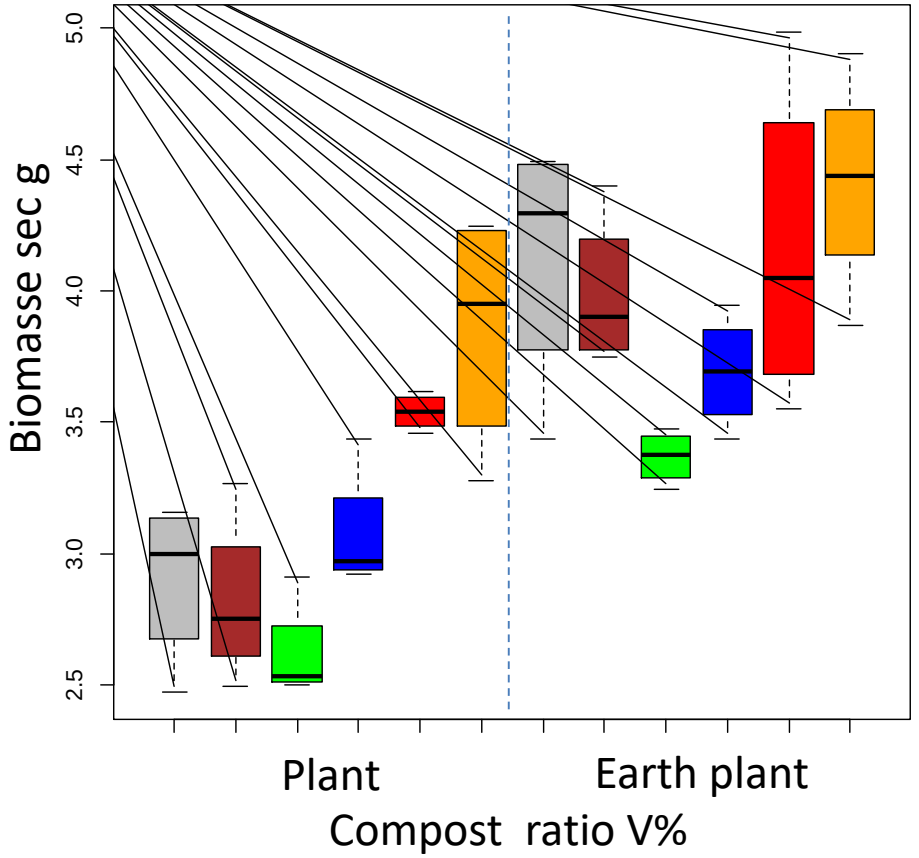


3) Retractometer measurements

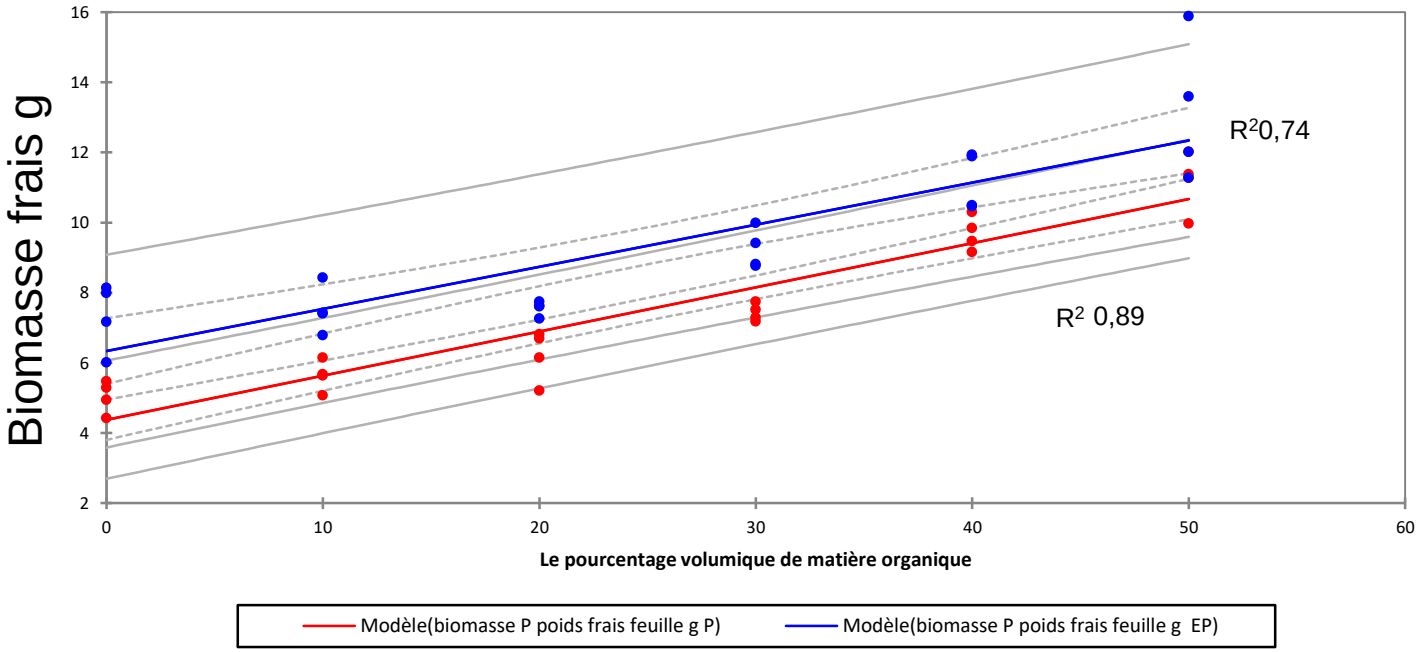


Plant biomass :





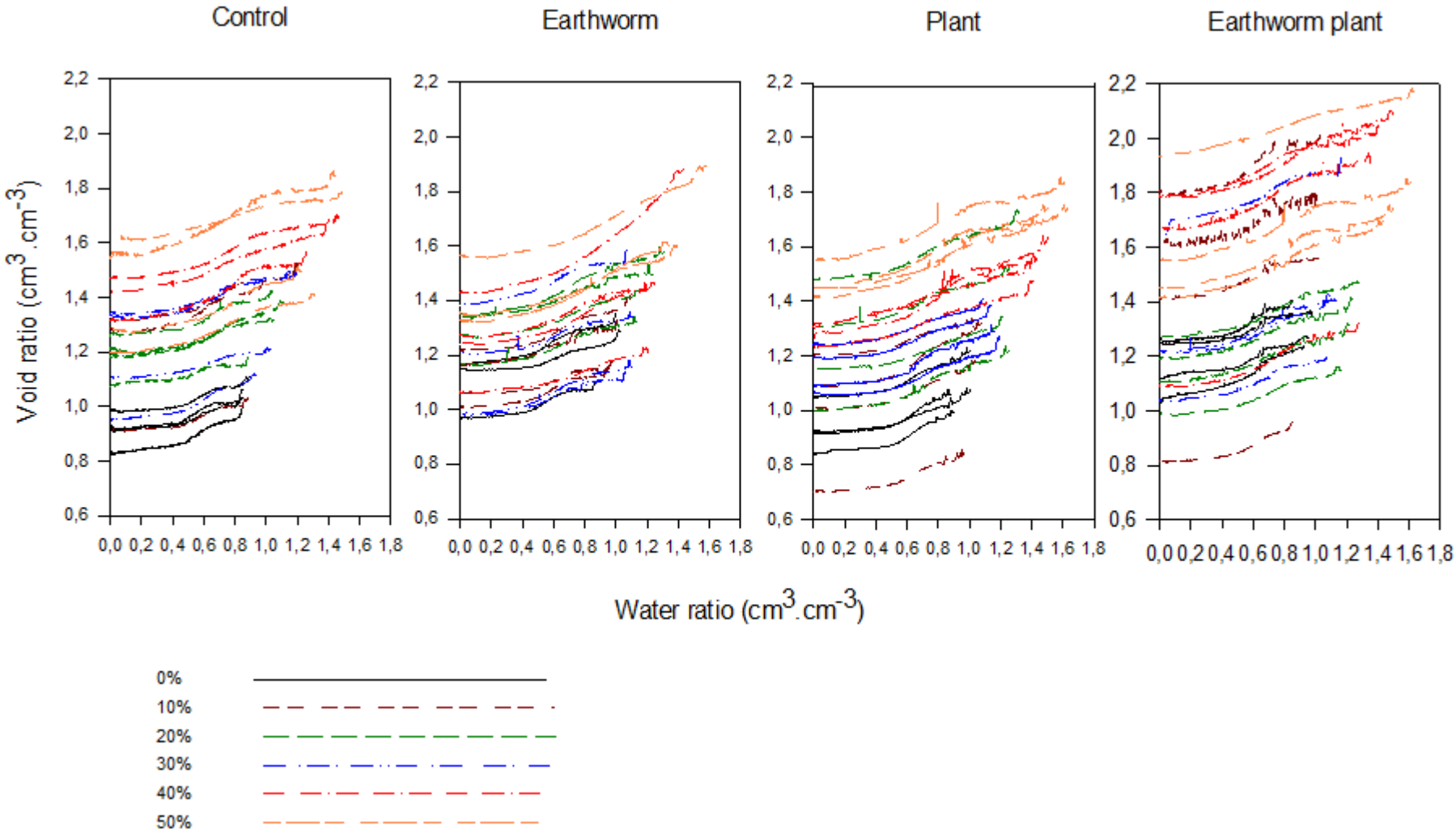
Plant biomass



Biomasse P frais g = 4,4+0,12*%Mo

Biomasse EP frais g = 6,3+0,12*%Mo

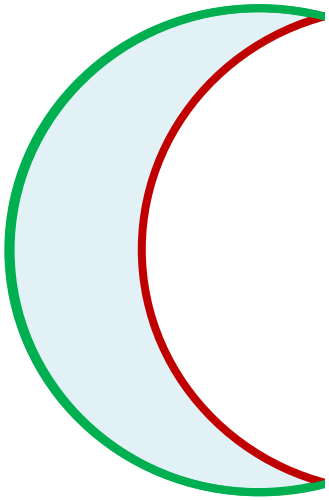
Shrinkage curves of the 4 treatments representing all the combinations of the presence/absence earthworm, plant with different ratio of compost.



Impacts of OM and/or organisms

Variance explained : 72% (*p* = 0,005)

Compost : 14%
(*p* = 0,005)



Impacts de la MO et des organismes

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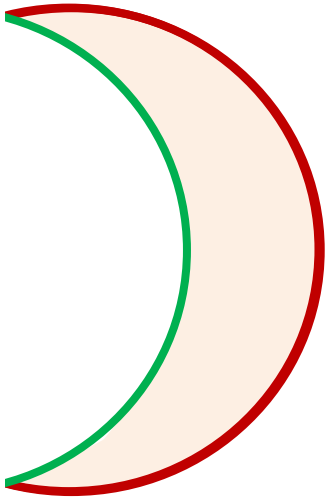

Organisms : 19%
(*p* = 0,005)

Impacts de la MO et des organismes

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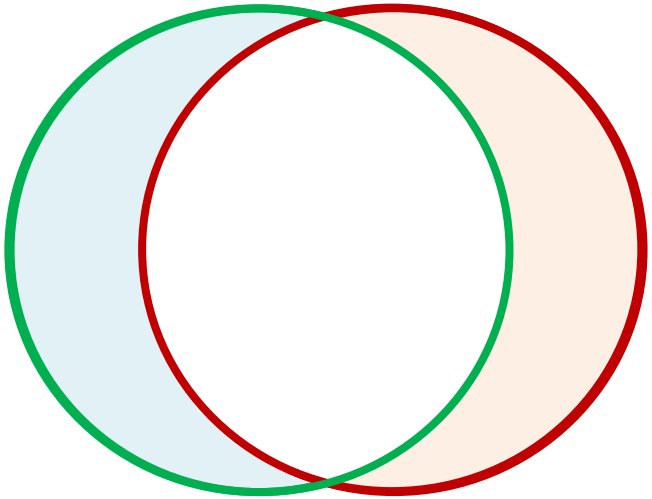
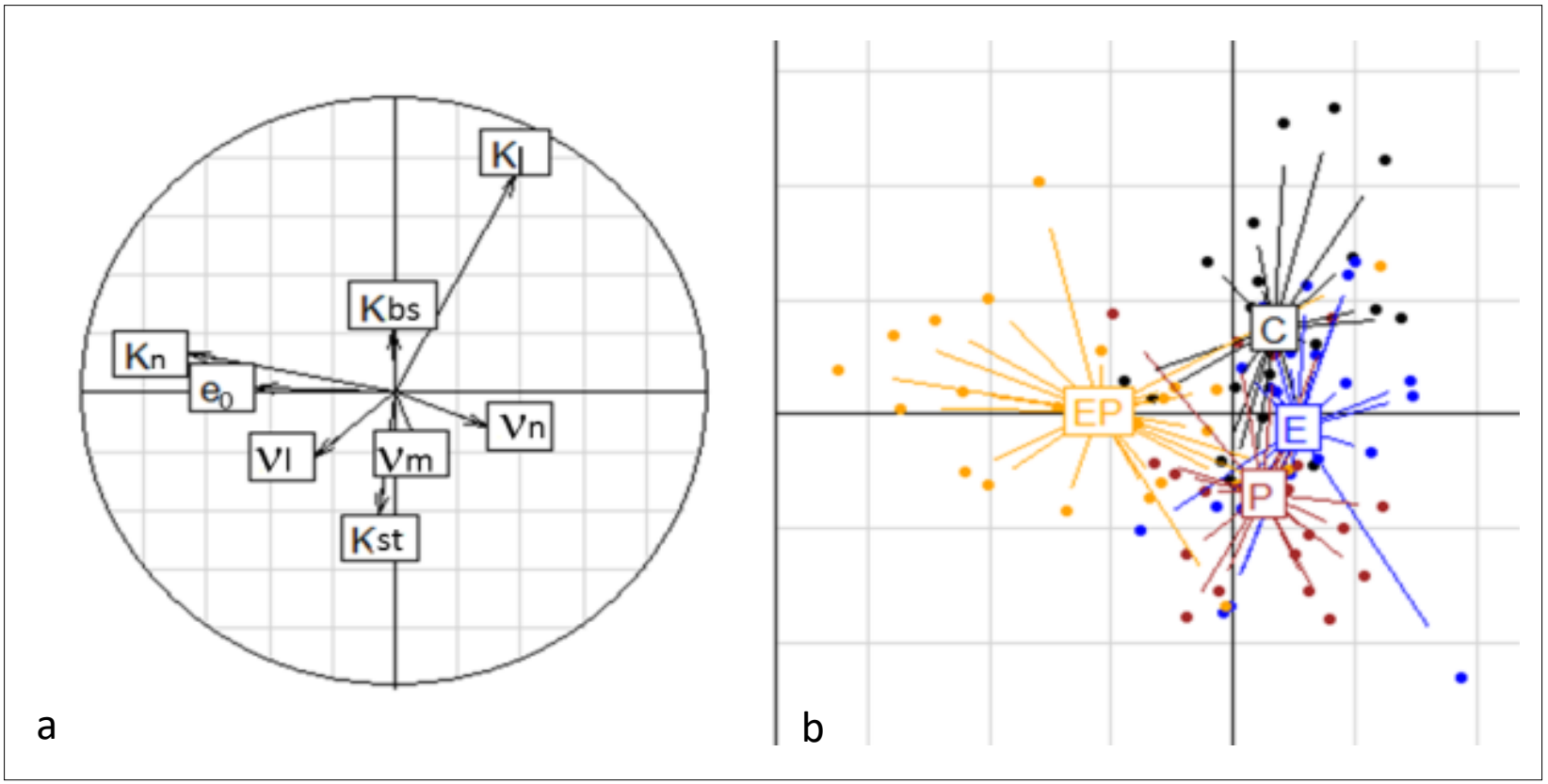


Organisms : 19%
(*p* = 0,005)

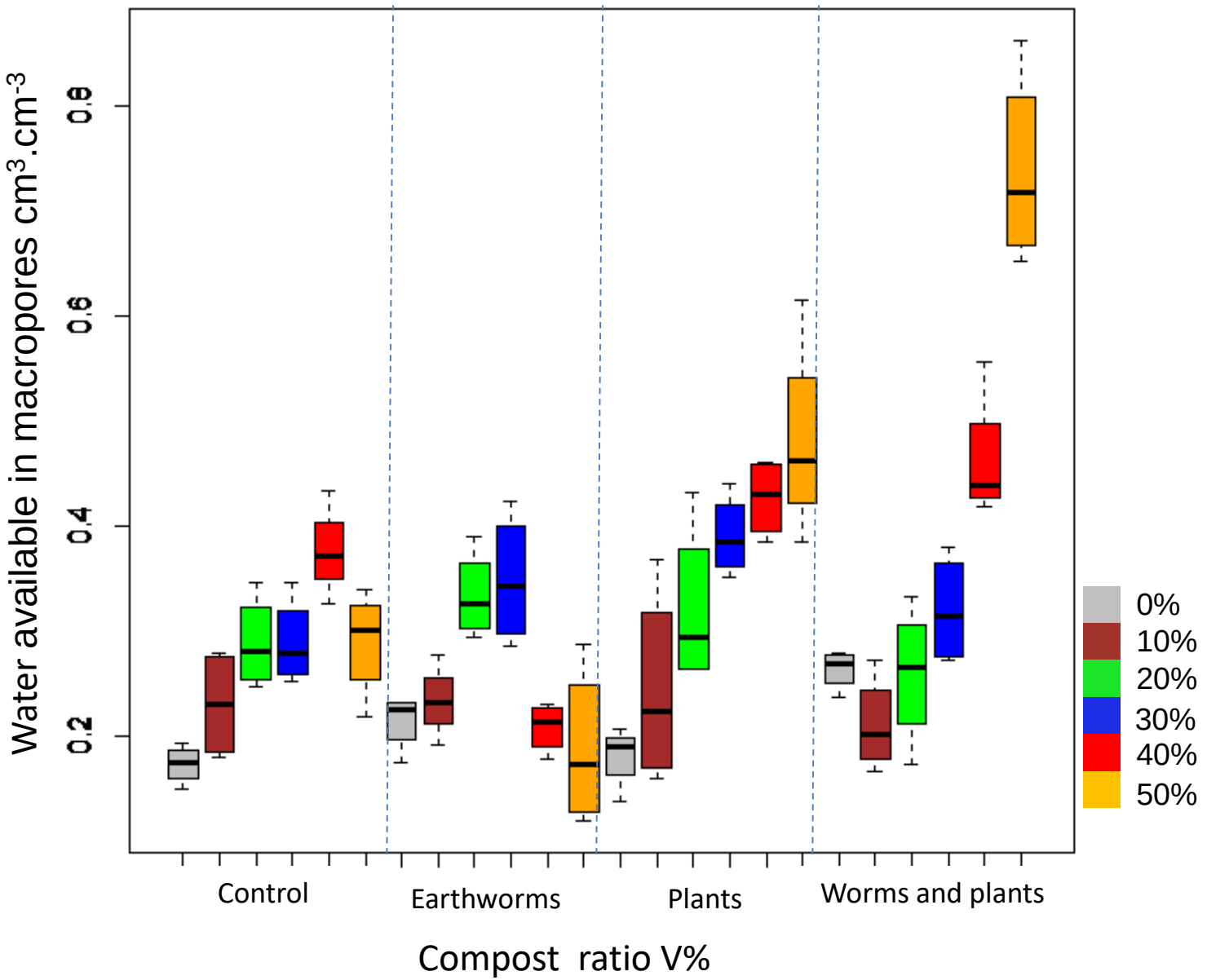
Interaction: 39%

Impact on hydrostructural parameters

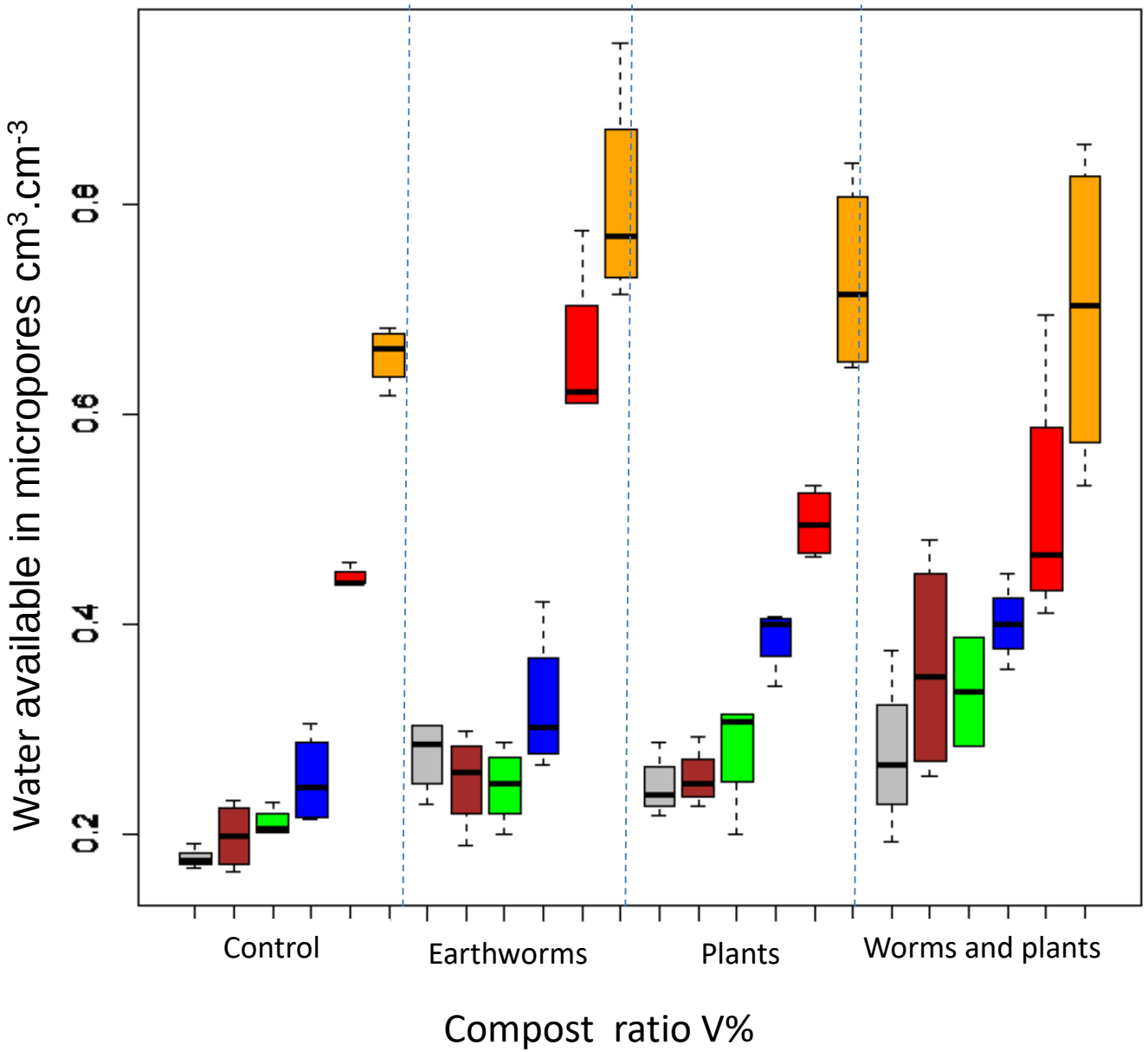


Linear discriminant analysis (LDA) the effect of the organisms (C: control, E: earthworms, P: plants, EP: earthworms and plants) on hydro-structural parameters; F1: 42%, F2: 26%

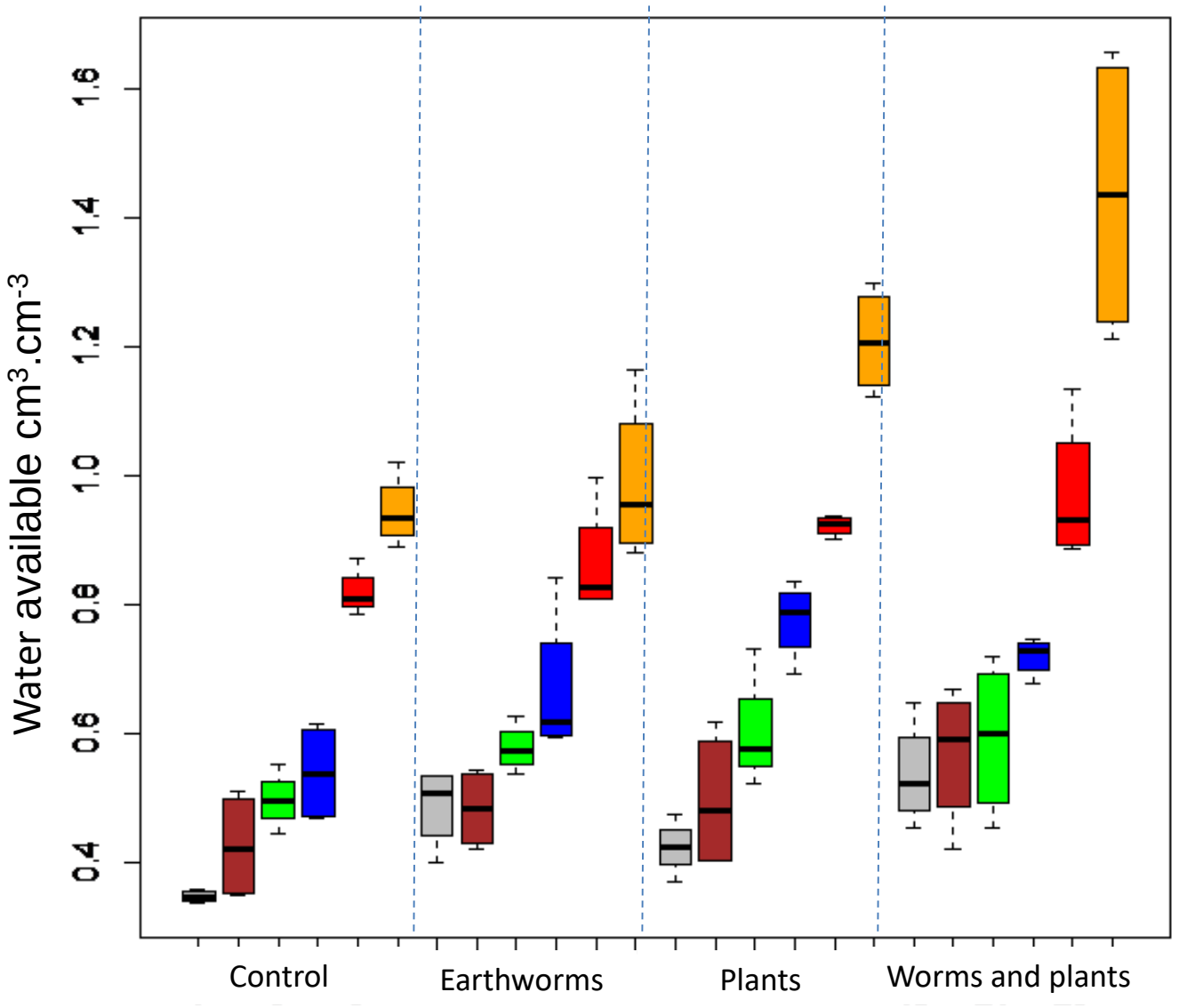
The effect of organisms on the macro available water



The effect of organisms on the micro available water



The effect of organisms on the total available water



Results

- The results show that **shrinkage analysis was useful to determine the effect of biota**. In addition, it was able to give full description of small concomitant physical properties changes.

- Compost and plants play a positive role in macroporosity and microporosity in Technosols, while **earthworms affect mainly microporosity**.

- The complex **interactions between compost, earthworms and plants have more impact** on the hydrostructural properties **than every factor alone**.

- In general, we found that the trend of compost reducing the macro porosity in large doses is no longer observable in the presence of organisms. Conversely, **non-additive and very positive effects** on macroporosity can be observed when earthworms and plants are present simultaneously. Therefore, the interaction between earthworms and plant can replace the high ratio of compost, which is in general considered a costly material.

Main agronomic properties of technogenic materials used to make different technosols. BLM ballast lime material ; GWC: green waste compost

	BLM	GWC
pH_{H2O}	8.3	7.9
pH_{KCL}	8.1	7.5
Organic carbon (C) g/kg	0.38	21.41
Total nitrogen (N) g/kg	0.03	1.47
Organic matter g/kg	14.20	45.34
Particle density $g.cm^{-3}$	2.75	2.06
Bulk density $g.cm^{-3}$	1.33	0.61