

Plateforme Bio-DA



UR AFPA
UNITÉ DE RECHERCHE
ANIMAL
& FONCTIONNALITÉS
DES PRODUITS
ANIMAUX

Reduction of chlordecone environmental availability by soil amendment of biochars and activated carbons

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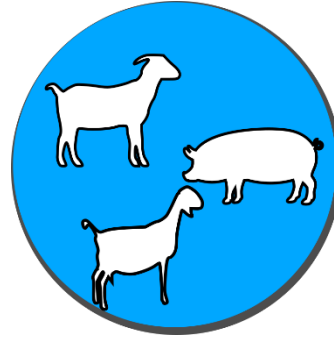
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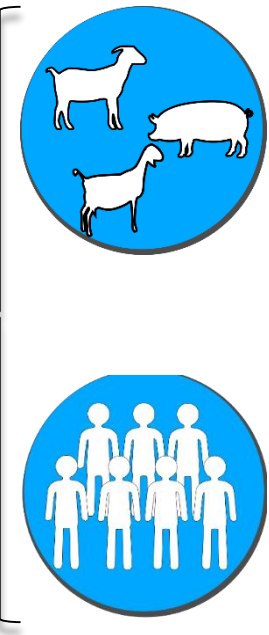
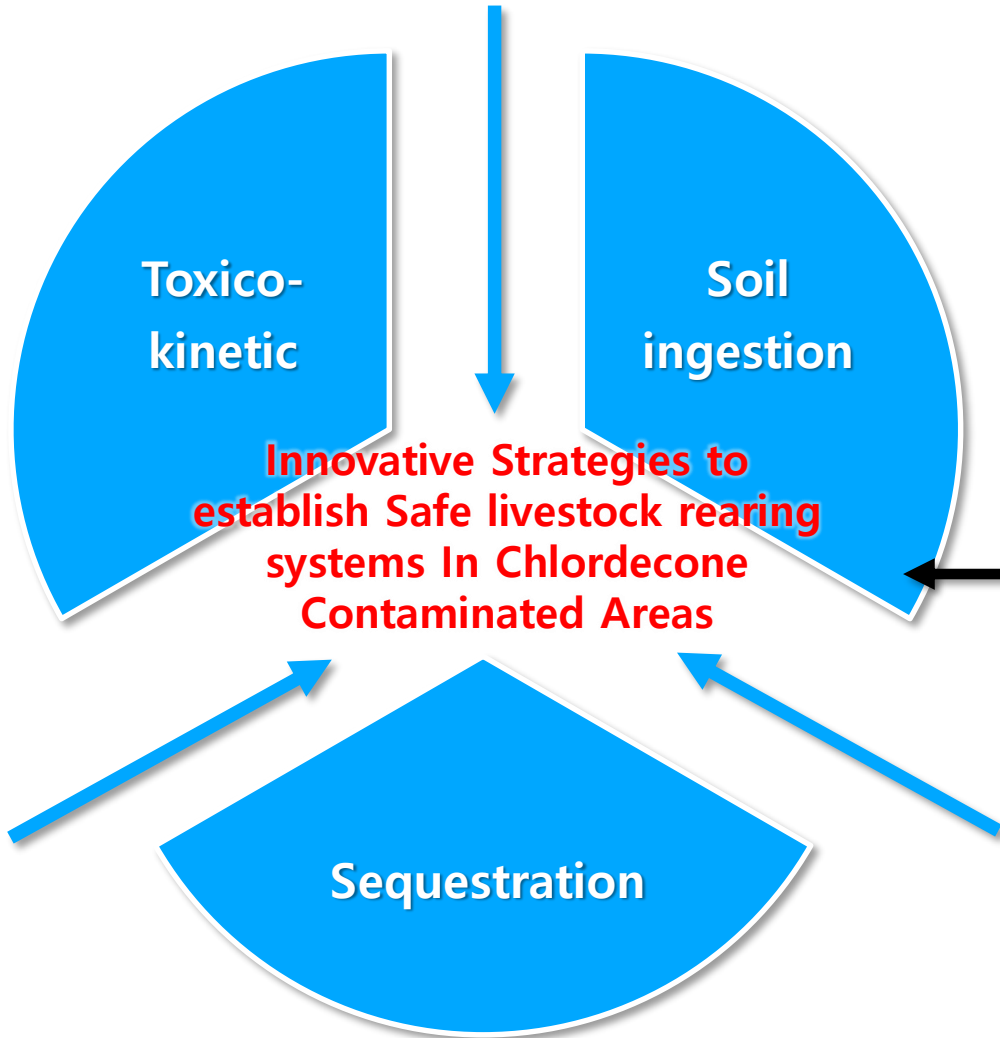
Chlordecone context



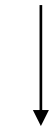
- **Soil** as a major sink of CLD
- **2 to 5** centuries of pollution.
- **1/4** of the total agricultural acreage contaminated by CLD.
- **Outdoor reared** and distinctive agricultural practices
- **Close to 100%** CLD relative bioavailability
- **6 to 9%** carcasses above MRL.
- **Alimentary route** is the main exposure pathway
- **Toxicity** of CLD : neurodevelopment and prostate cancer incidence



The INSSICCA project



Modeling efficient strategies



Ensure social acceptability

2016-2021



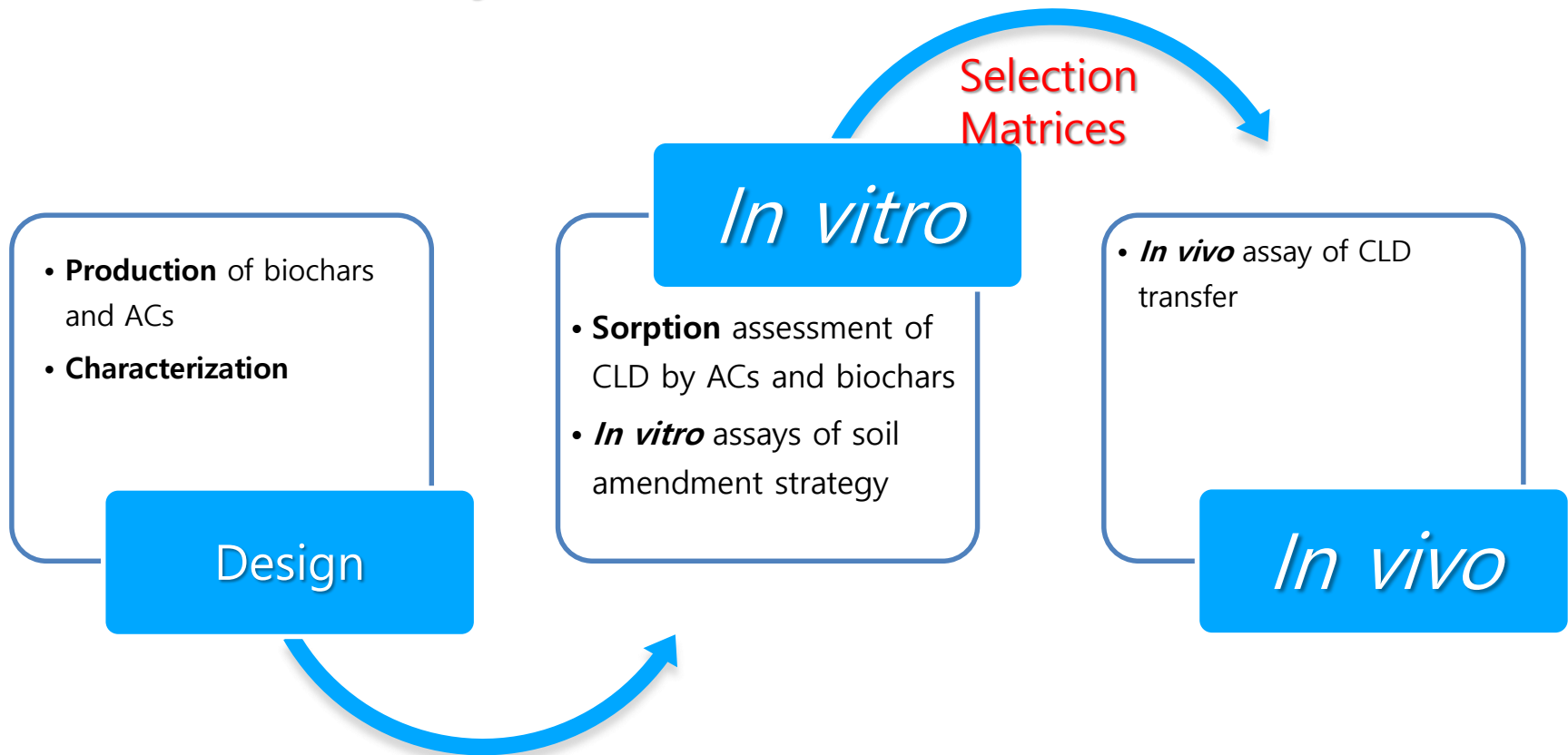
PITE Antillean funding



Sequestration of CLD



Establishing innovative strategies to bind CLD *via* dietary non absorbable substances



Objectives



- Assessing the **retention of CLD** after amendment of soils by biochars or ACs.
 - Using *in vitro* assays as a screening methodology to limit the use of animals.
 - Appreciate the usefulness of these different *in vitro* assays for this screening objective.
 - Compare *in vitro* assays to *in vivo*

Production of ACs and biochars



Sargassum fluitrans



Cocos Nucifera



Quercus ilex

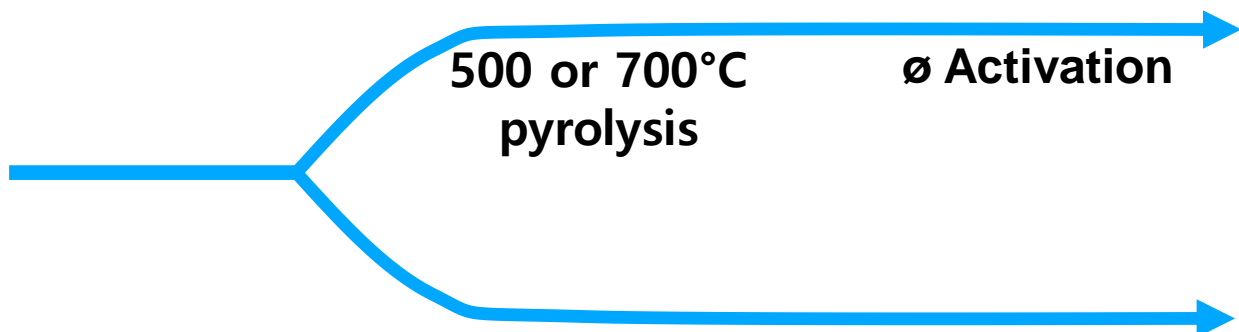


Resinous tree



*Commercial ACs
biochar*

Precursors



500 or 700°C
pyrolysis

∅ Activation

Impregnation H_3PO_4 , 24h and carbonisation (700°C)

Chemical AC



Soil preparation



Artificial Soil

OECD, 1984



Pre-existent laboratory data on CLD relative bioavailability

Antillean contaminated Nitisol

Guadeloupe



On-going experiment to assess CLD relative bioavailability

Amendment

Each soil subsample was amended with 2% of each biochars or ACs

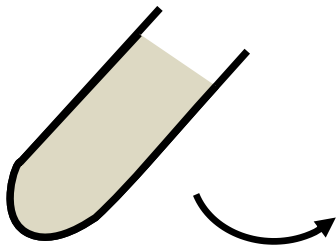
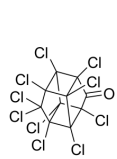
Ageing

Soils were aged 8 weeks prior assays

In vitro assays



Environmental availability

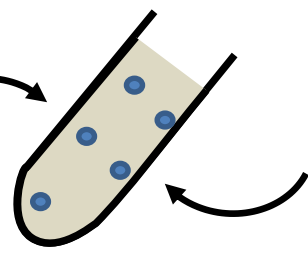
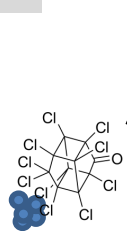


ISO/DIS 16751:2015 Part A

Petroleum ether

Bioaccessibility

TI-PBET



Physiological conditions



Li et al. 2016



In vivo assays








CLD : 10 $\mu\text{g/Kg}$ / D
10 days of exposure

% Relative Bioavailability $\frac{\text{CLD concentration in tested matrix}}{\text{CLD concentration in reference matrix}}$

Assays realized



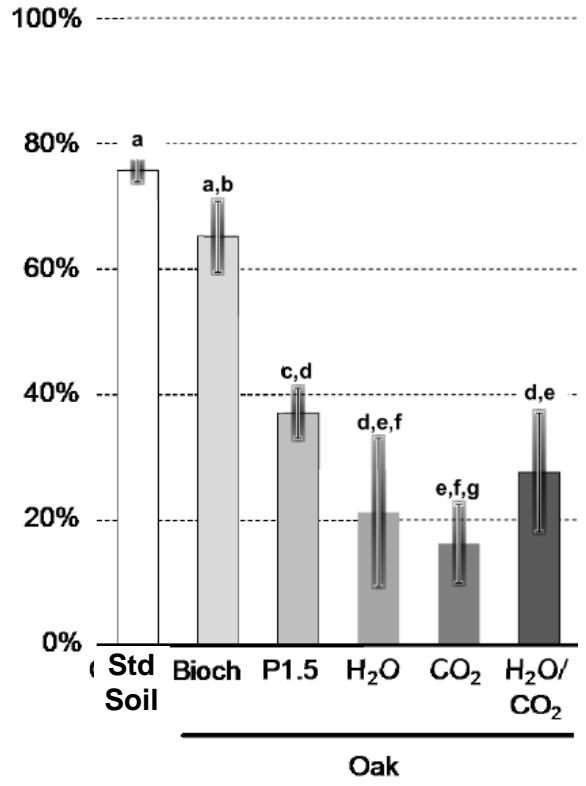
Assays

	Environ. Availability 	Bioaccessibility 	Relative Bioavailability 
 Artificial soils	X	X	X
 Nitisol	X	-	On going



Environmental availability

Environmental availability : Artificial soil

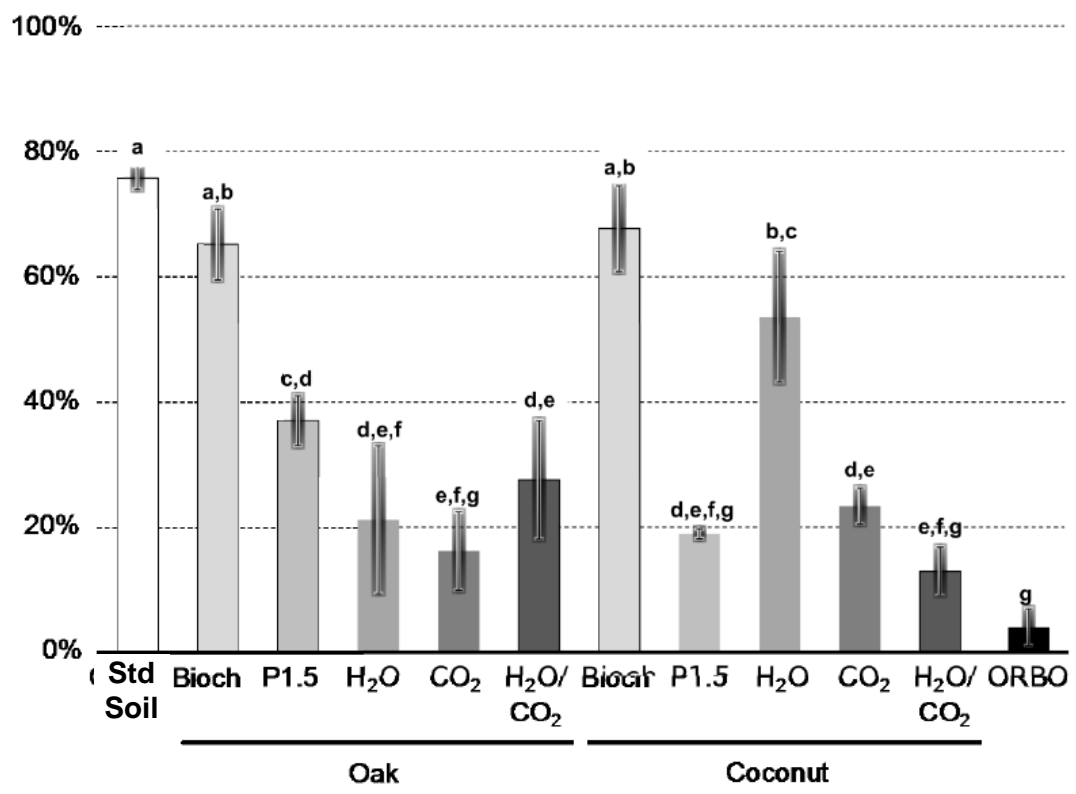
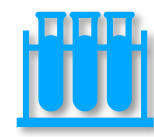


- **Highest CLD** values in standard soil
- No statistical difference between **biochar soils and standard soil**
- Activated carbons amendment lead to a **significant reduction of environmental availability**



Environmental availability

Environmental availability : Artificial soil



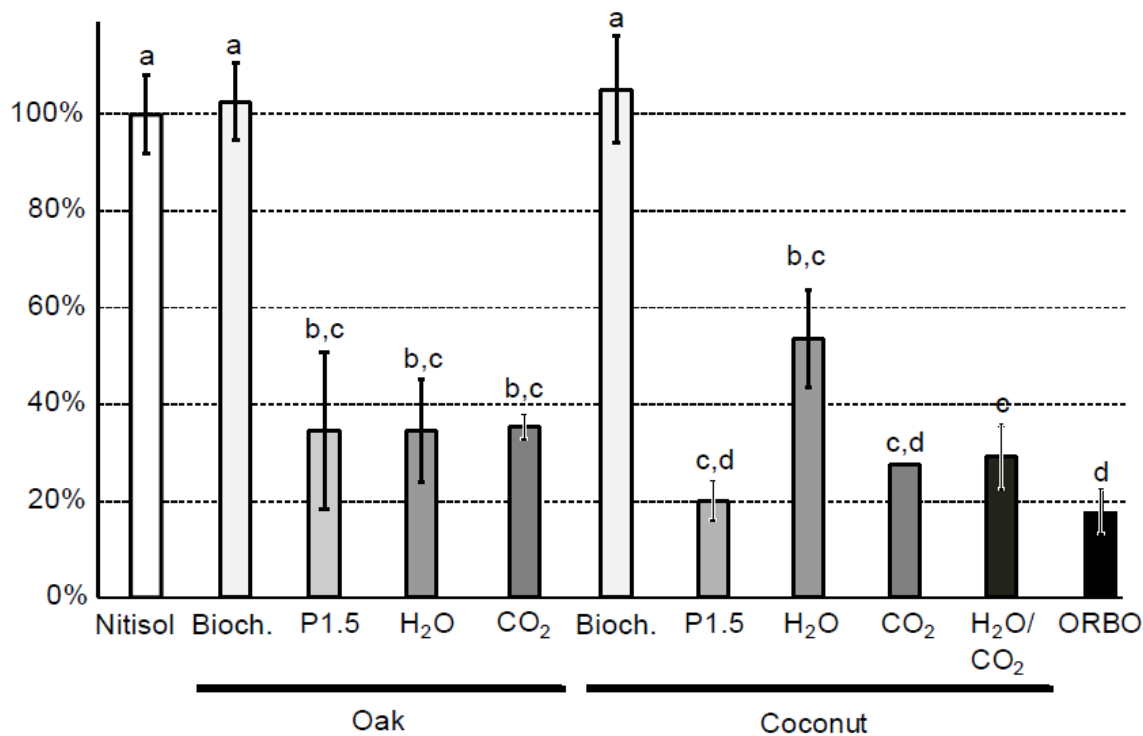
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Figure 7 : CLD availability in OECD soils.



Environmental availability

Environmental availability : Antillean soil

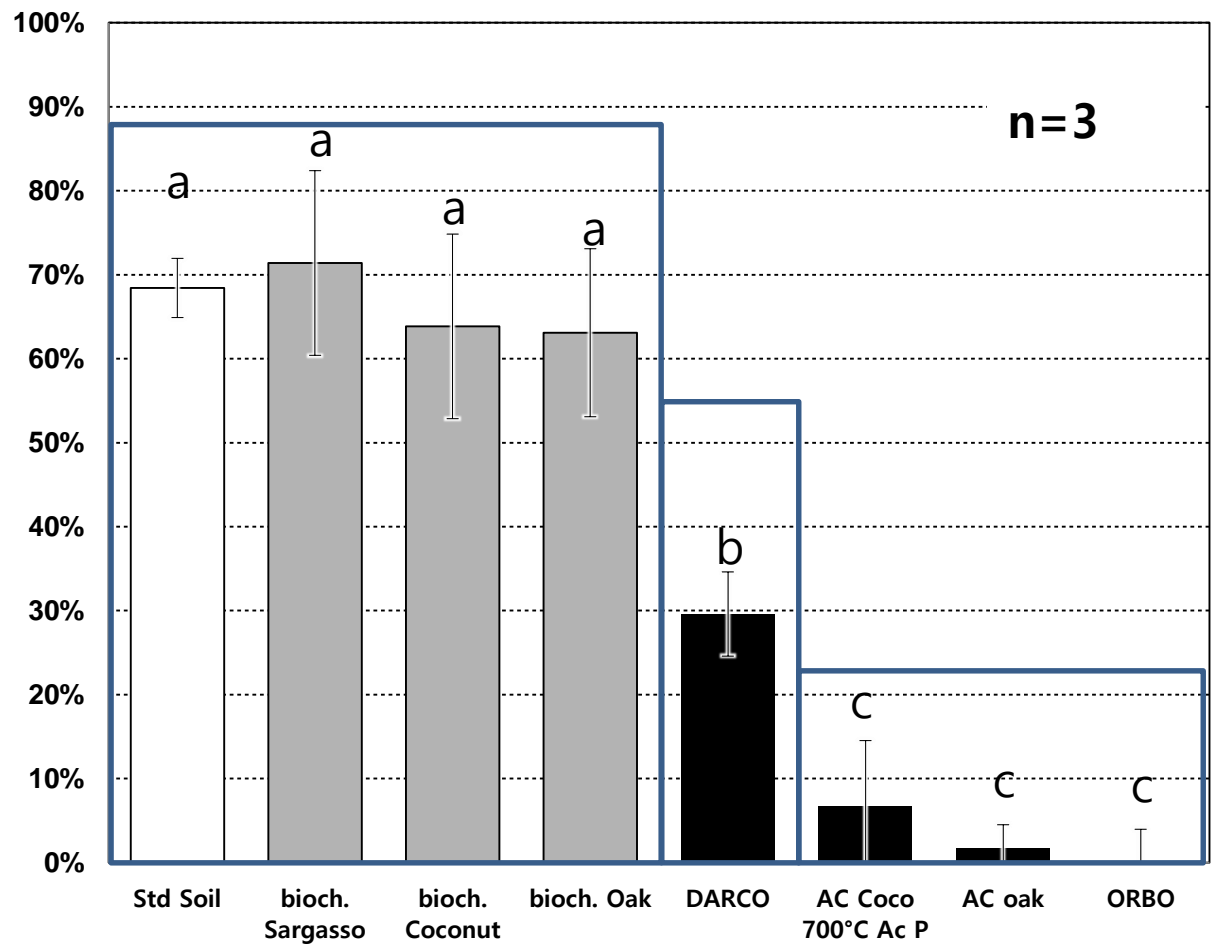


- **Highest CLD** values in standard soil
- No statistical difference between **biochar soils and standard soil**
- Activated carbons amendment lead to a **significant reduction of environmental availability**



Bioaccessibility results

Bioaccessibility : assessment of the methodology

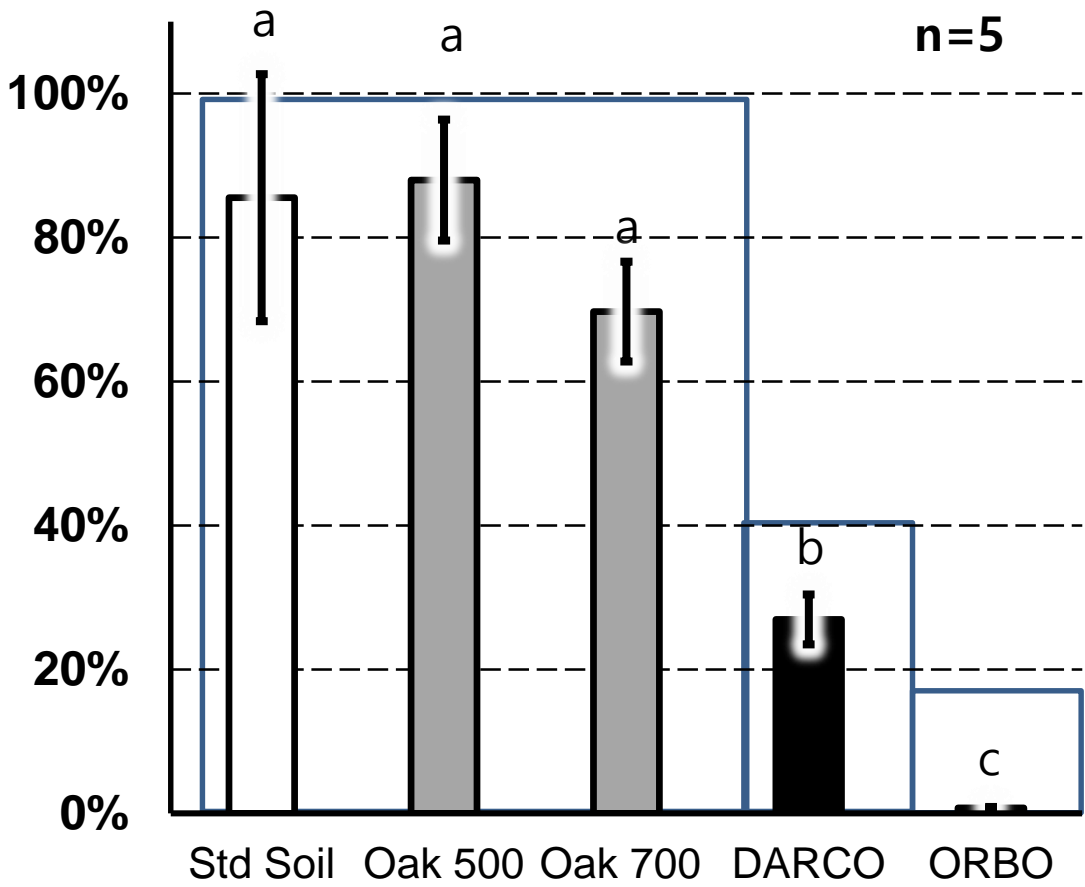
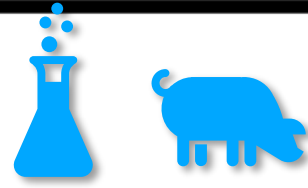


- **Highest bioaccessibility** values in standard soil
- No statistical difference between **biochar soils and standard soil**
- Both produced and commercialized activated carbons amendment lead to a **significant reduction of bioaccessibility**

In vivo relative bioavailability



In vivo data



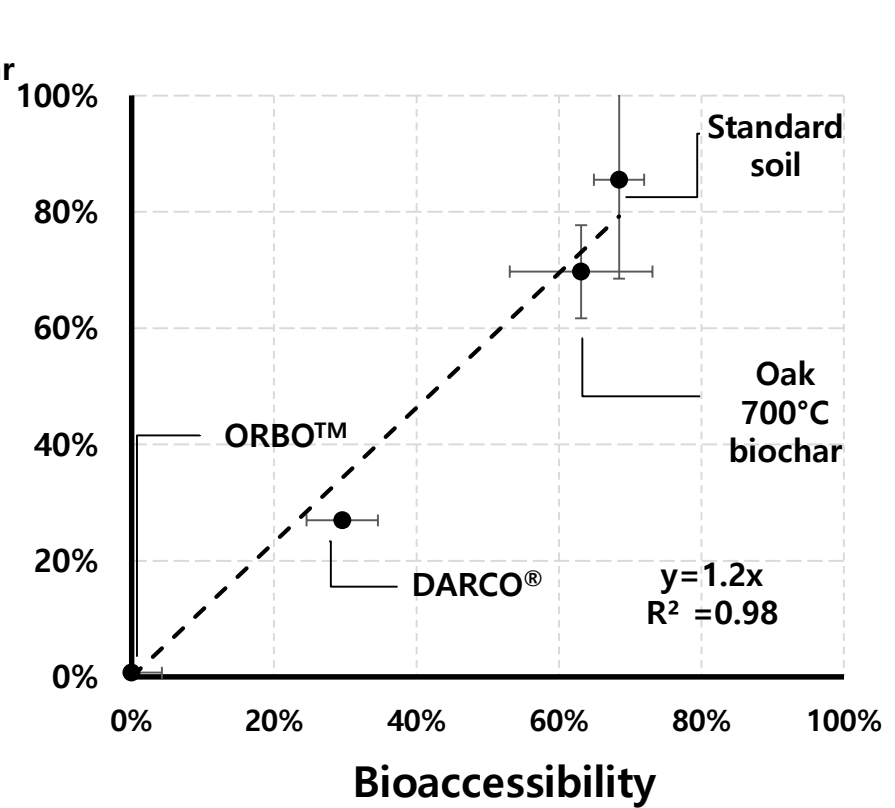
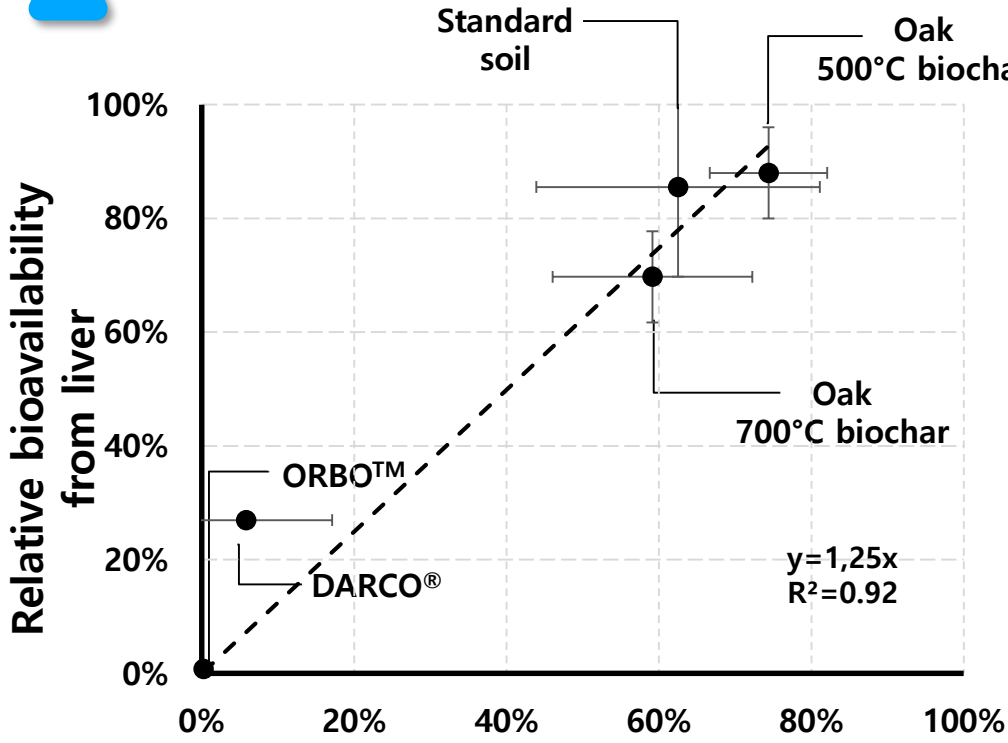
- **Highest CLD** values in standard soil
- No statistical difference between **biochar soils and standard soil**
- No significant pyrolysis-temperature effect
- Commercialized activated carbons amendment lead to a **significant reduction of bioavailability**

Correlation results



Comparison between environmental availability data and in vivo ones

Comparison between bioaccessibility data and in vivo ones

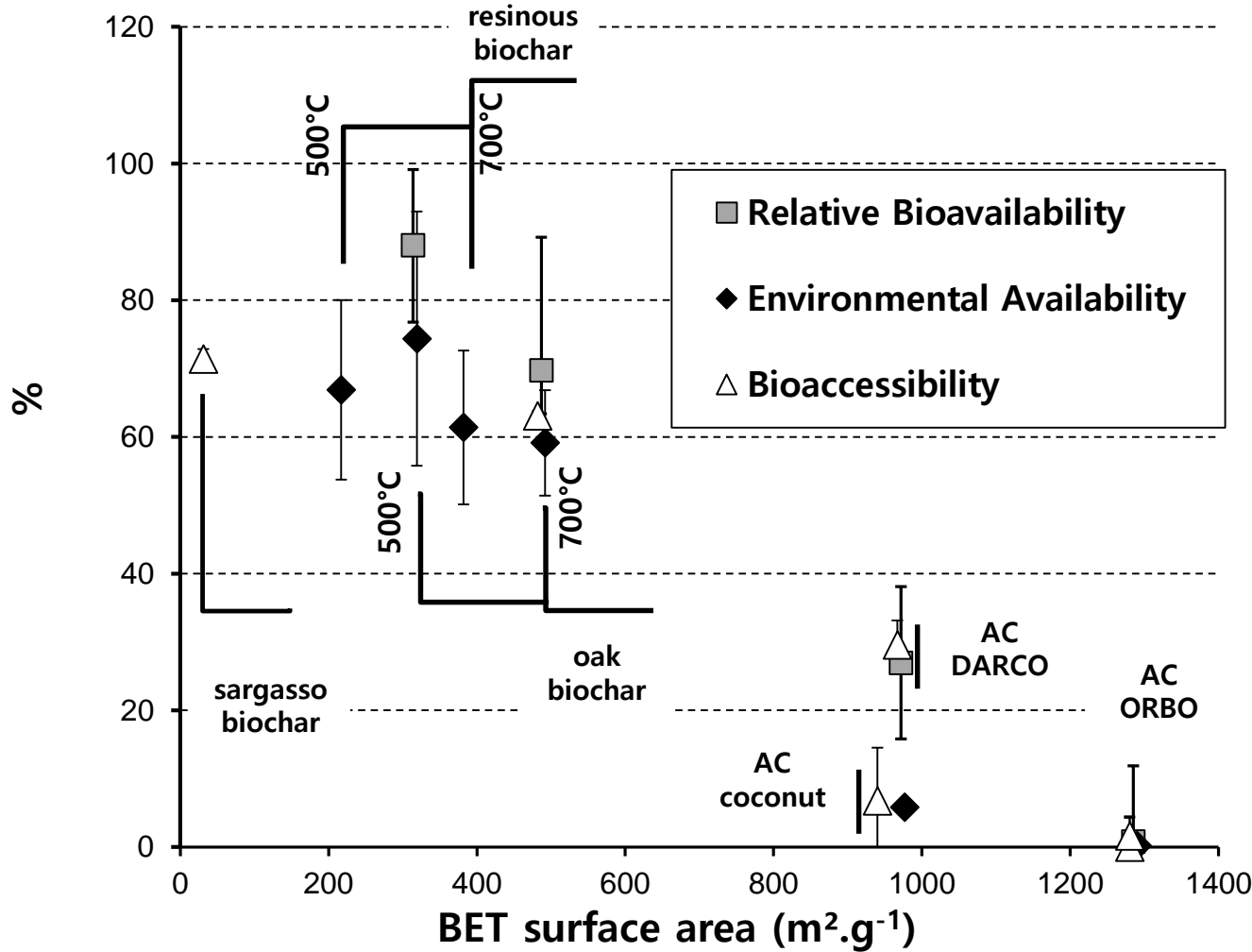


First results show a **promising correlation** between both *in vitro* tests and *in vivo* results.

Discussion



Relative bioavailability, environmental availability and bioaccessibility against BET surface areas



Discussion



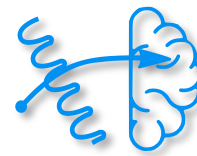
Pros and cons of each methodology

	Simplicity	Costs	Normalisation	Physiologically based	Validation against <i>in vivo</i>	Recognized validation
Bioaccessibility Te-PBET	+ / -	++	-	+	+ / -	+ / -
Environmental availability ISO/DIS 16751	++	+	+(draft ISO)	-	-	-

Conclusion



- **ACs** introduced in CLD contaminated standard soil **highly reduce CLD environ. availability, bioaccessibility and bioavailability**
- Tested biochars showed no reduction of transfer
- Environ. availability and bioaccessibility tests could be **useful screening tests** in order to select the appropriate biochar or AC.
- Further validation appears needed to validate consistently each *in vitro* methodology against *in vivo*.



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Thank you for your attention



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