

ASSISTED-BIOREMEDIATION FOR THE DEGRADATION OF ORGANOCHLORINE COMPOUNDS

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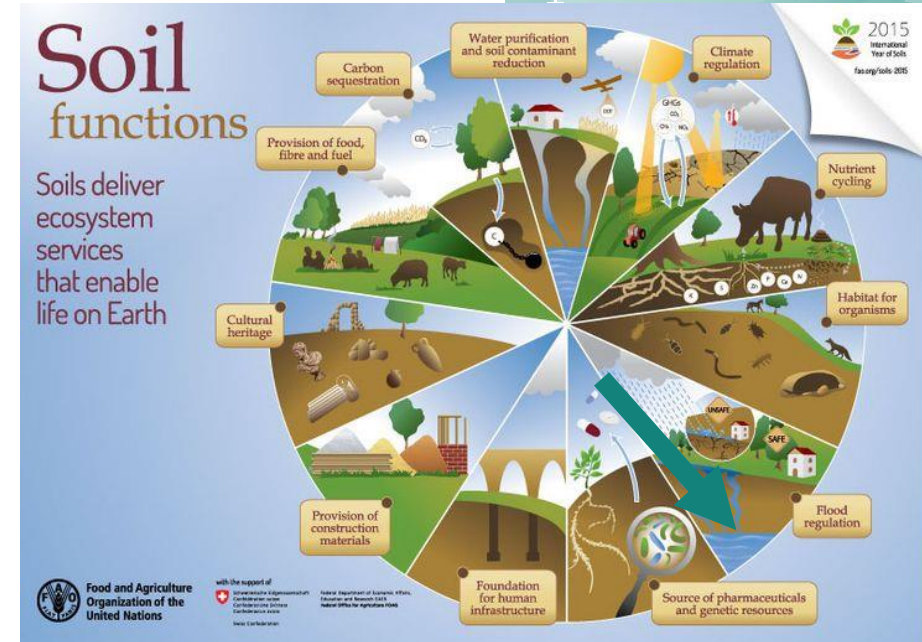
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INTRODUCTION

SOIL

- Finite
- **Non-renewable**
- Processes: **Slow** formation and regeneration
- **Buffering** capacity



Source: FAO and UNEP. 2021. Global assessment of soil pollution. Summary for policy makers. Rome, FAO

CONTAMINATION

- Environmental **disruption**.
- **Decrease** of the soil's potential capacity.
- **Inorganic** pollutants: such as heavy metals and salts.
- **Organic** pollutants: hydrocarbons, organochlorine compounds, emerging pollutants (pharmaceutical compounds, personal hygiene compounds, etc.).



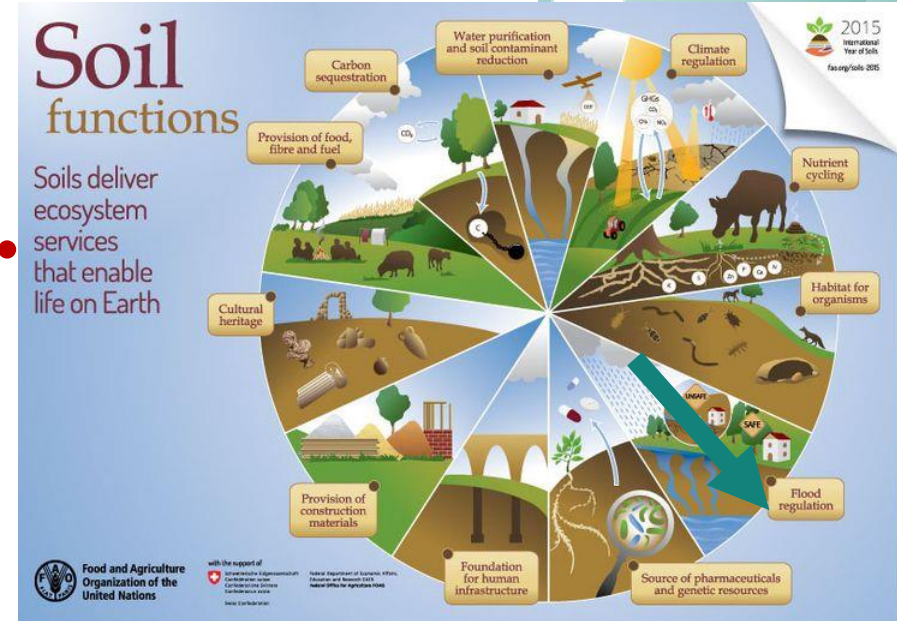
Degradation > >

Partial or total loss of productivity and functions.

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hydrocarbons, **organochlorine compounds**, emerging pollutants (pharmaceutical compounds, personal hygiene compounds, etc.).

Degradation >>

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INTRODUCTION

Lindane (γ -hexachlorocyclohexane)

Insecticide banned in all its chemical formulations.

Production, use and commercialization are forbidden.

Harmful to human **health** and **environment**.



Large-scale production in the 70's and 80's.



Improper manufacturing, handling and waste management practices.



Contaminated areas



**Remediation
strategies**



Bioremediation

INTRODUCTION

BIOREMEDIATION

- Microorganisms
- Plant and associated microorganisms (rhizosphere)

Pollutants Removal

ASSISTED BIOREMEDIATION

ORGANIC MATTER SOURCES

Wastewater
Treatment Plants

COMPOST

Biostimulation

Synergistic or antagonistic effect
with soil autochthonous microbial
population

- Increase soil organic matter and nutrients
- Supply exogenous microbial population

OBJETIVE

To evaluate the use of a compost from sewage sludge and pruning wastes to enhance bioremediation in a soil polluted with organochlorine compounds.

MATERIALS AND METHODS

Polluted soil from Sabiñanigo (Huesca)

67 mg/kg HCH



1,2,4-TCB
 α -HCH
 β -HCH



Treatments

NATURAL ATTENUATION (NA)

BIOSTIMULATION:

Sewage sludge and pruning waste compost (B-CP)

NPK (15:15:15) (47 kgN/ha) mineral fertilizer (B-NPK)

Soil and compost characterization

		E.C	M.O	N	P	Ca	Mg	Na	K	Pb	Cd	Cu	Ni	Zn	Cr
	pH	dS/m	%		mg/kg										
S-Z1	8,2	0,4	1,09	0,09	8	3737	146	30	187	25	0,4	14	20	154	25
CP	6,9	18,2	33,9	3,32	1067	13267	1494	765	1714	35	<LD	111	17	322	44

MATERIALS AND METHODS



Incubation test: 60 days



Temperature: 26°C
Humidity (60% of soil water holding capacity)

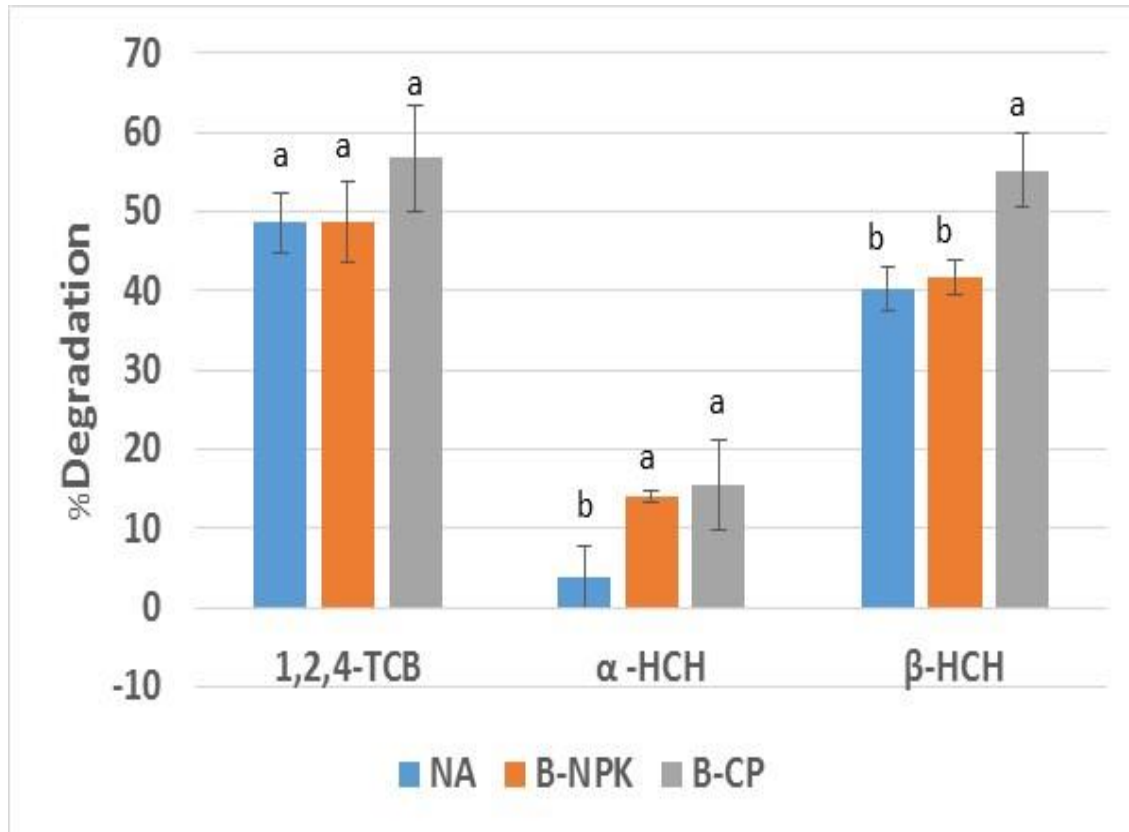
% Degradation of 1,2,4-TCB , α -HCH, β -HCH → GC/MS

Soil quality → Soil enzymatic activities (ISO 20130, 2018)

Soil phytotoxicity : Germination test (Zucconi et al., 1985)

RESULTS AND DISCUSSION

Incubation test



Degradation of organochlorine compounds

60 days

1,2,4-TCB

β-HCH

B-CP higher degradation values

AN ≈ B-NPK

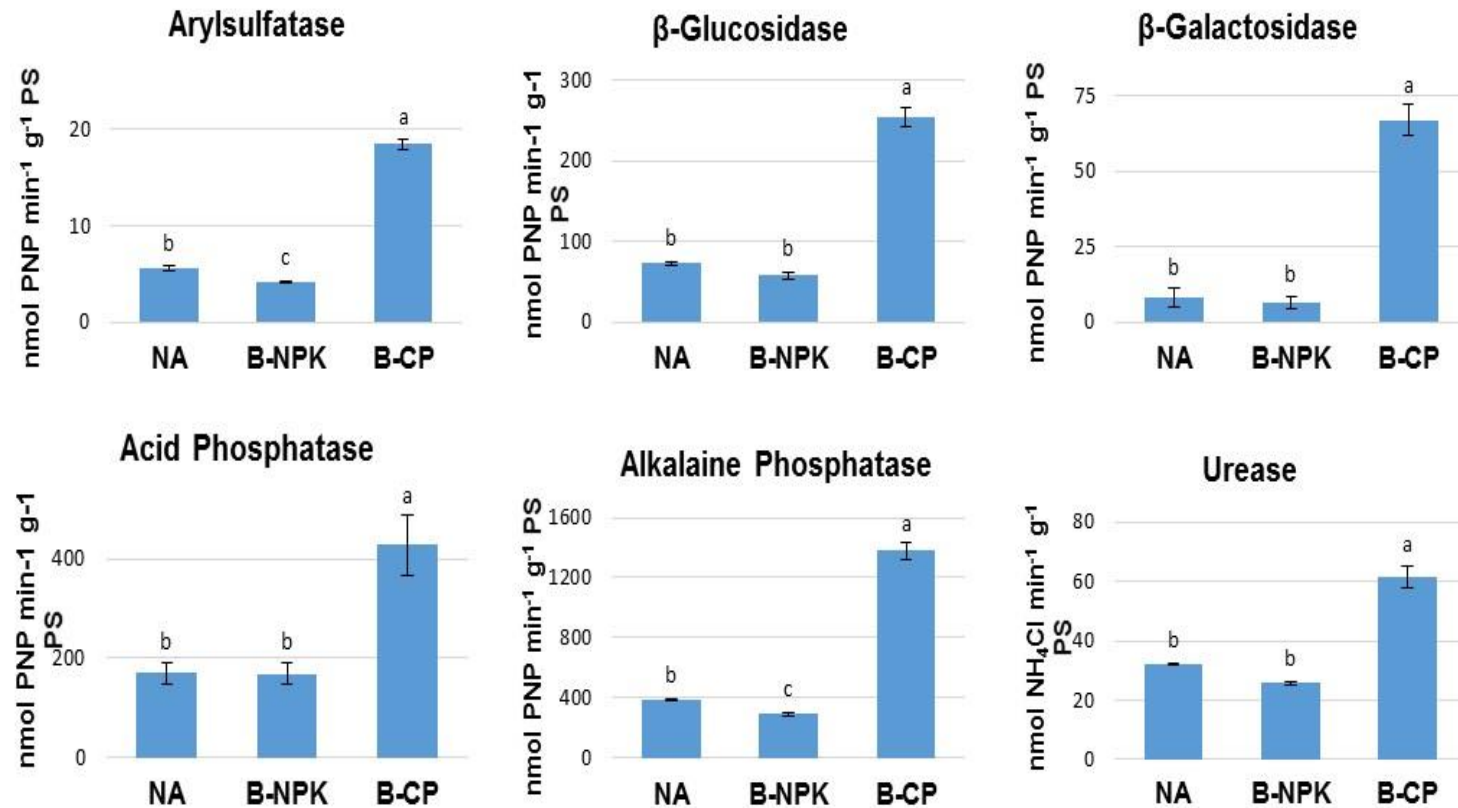
α-HCH

Low biodegradation

B-NPK ≈ B-CP > NA

RESULTS AND DISCUSSION

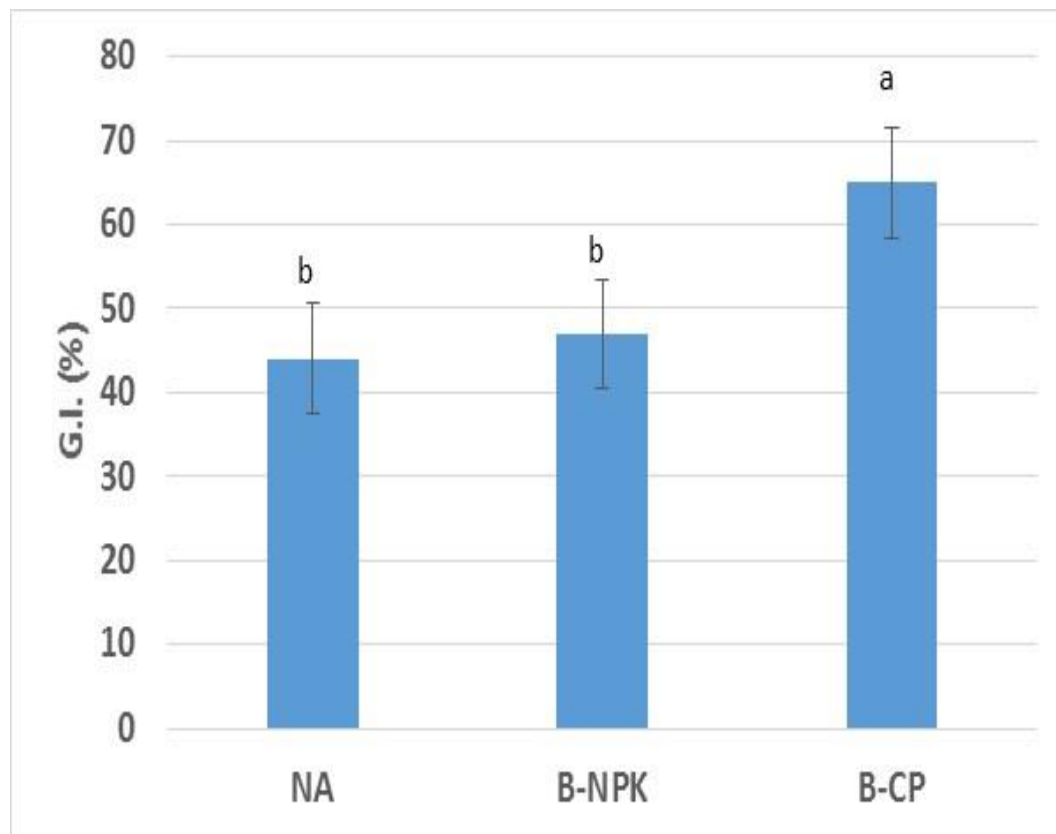
Enzymatic activities



- **B-CP: Significant increase in enzyme activities.**
 - CP promotes biostimulation of soil microbiota
 - Incorporation of exogenous microorganisms
 - Reduces pollutants availability due to organic matter input
- **B-NPK: No effect**

RESULTADOS Y DISCUSIÓN

Germination test:



Zucconi Test

IG < 50 : Toxicity

IG: 50-80: Moderate toxicity

IG > 80: No toxicity

- AN ≈ B-NPK: IG < 50%



High toxicity

- B-CP: IG = 67%

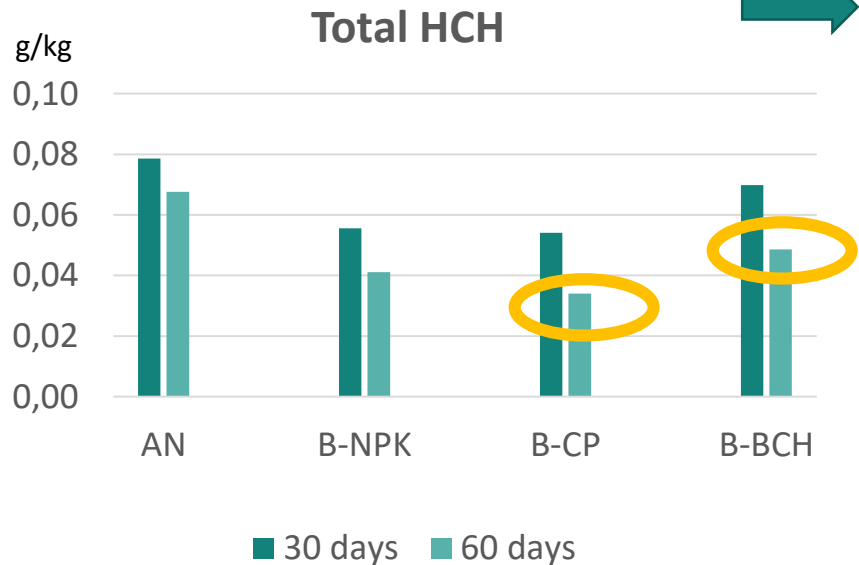


Moderate Toxicity

Assays in progress

Different organic matter sources

B-BCH: Treatment with **biochar** from olive tree residues



Degradation at 90 y 120 days

- HCH degradation increases with incubation time.
- Best results are observed in compost treatments.

Phytoremediation

Rosa canina L.
Salix alba L.
Populus x canadensis "clon I-214"

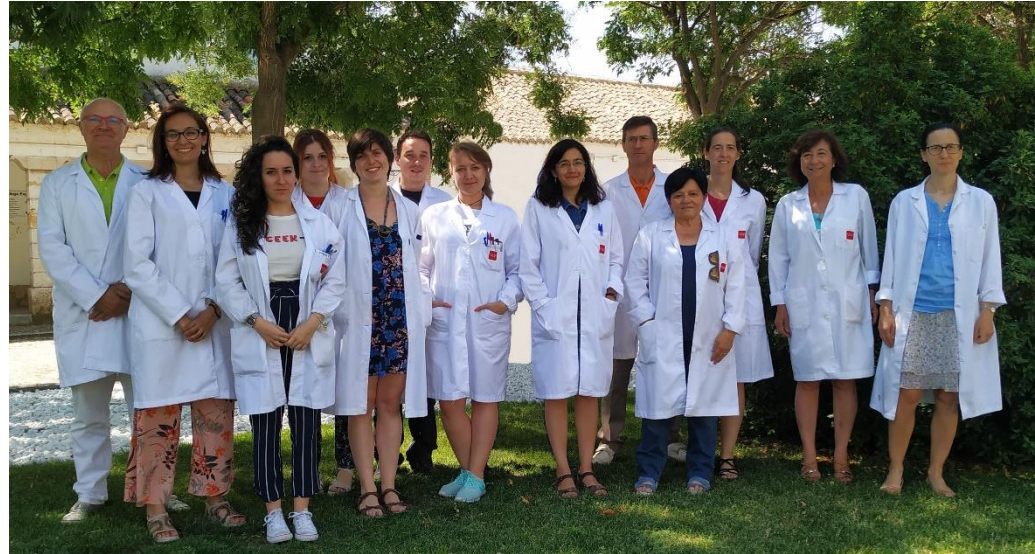


CONCLUSIONS

- ★ The **organochlorine compounds** detected in the soil undergo a degradation process under the evaluated conditions.
- ★ The natural attenuation (**NA**) achieves degradations of around **45%**, not observing a positive effect when providing soluble nutrients (**B-NPK**).
- ★ Application of compost (**B-CP**) induces an increase in degradation to values around **57%** in the **60 days** of incubation, probably due to the double effect of biostimulation due to the contribution of nutrients and organic matter and a **potential bioincrease** due to the incorporation of exogenous microorganisms.

The application of compost shows a positive effect in the recovery of the soil functionality, observing increases in the biological activity of the soil as well as the decrease in its phytotoxicity.





Thank you for your attention

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