

Rocio Medina¹; Natalia Di Clemente¹; Verónica Mora¹; Janina Alejandra Rosso²; María Teresa Del Panno¹

1. Centro de Investigación y Desarrollo en Fermentaciones Industriales (CINDEFI). 2. Instituto de Investigaciones Físicoquímicas Teóricas y Aplicadas

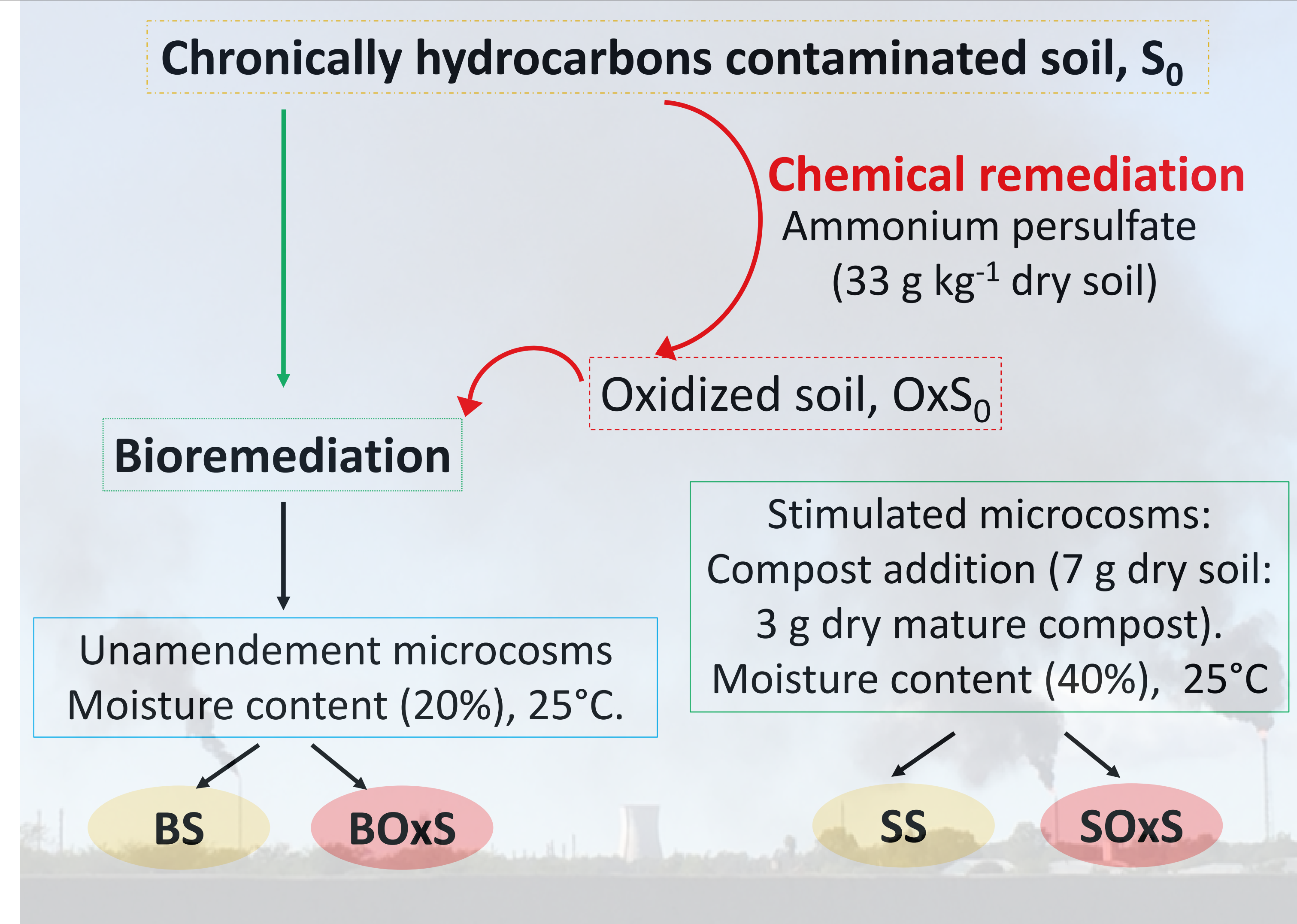
INTRODUCTION

Polycyclic aromatic hydrocarbons (PAHs) are hydrophobic organic pollutants persistent in soil^[1,2]. The remediation using chemical oxidants could overcome the limitations of bioremediation in the PAHs elimination^[3], although it could also damage the community and the soil structure^[4,5]. The aim of this work was to evaluate the early effect of a combined strategy applied to chronically PAHs-contaminated soil.

MATERIALS AND METHODS

Chronically contaminated soil was sampled from a petrochemical industry near La Plata city^[6]. The original hydrocarbons content was 214 ppm of PAHs (1 % bioavailable) and 2400 ppm of aliphatic hydrocarbons.

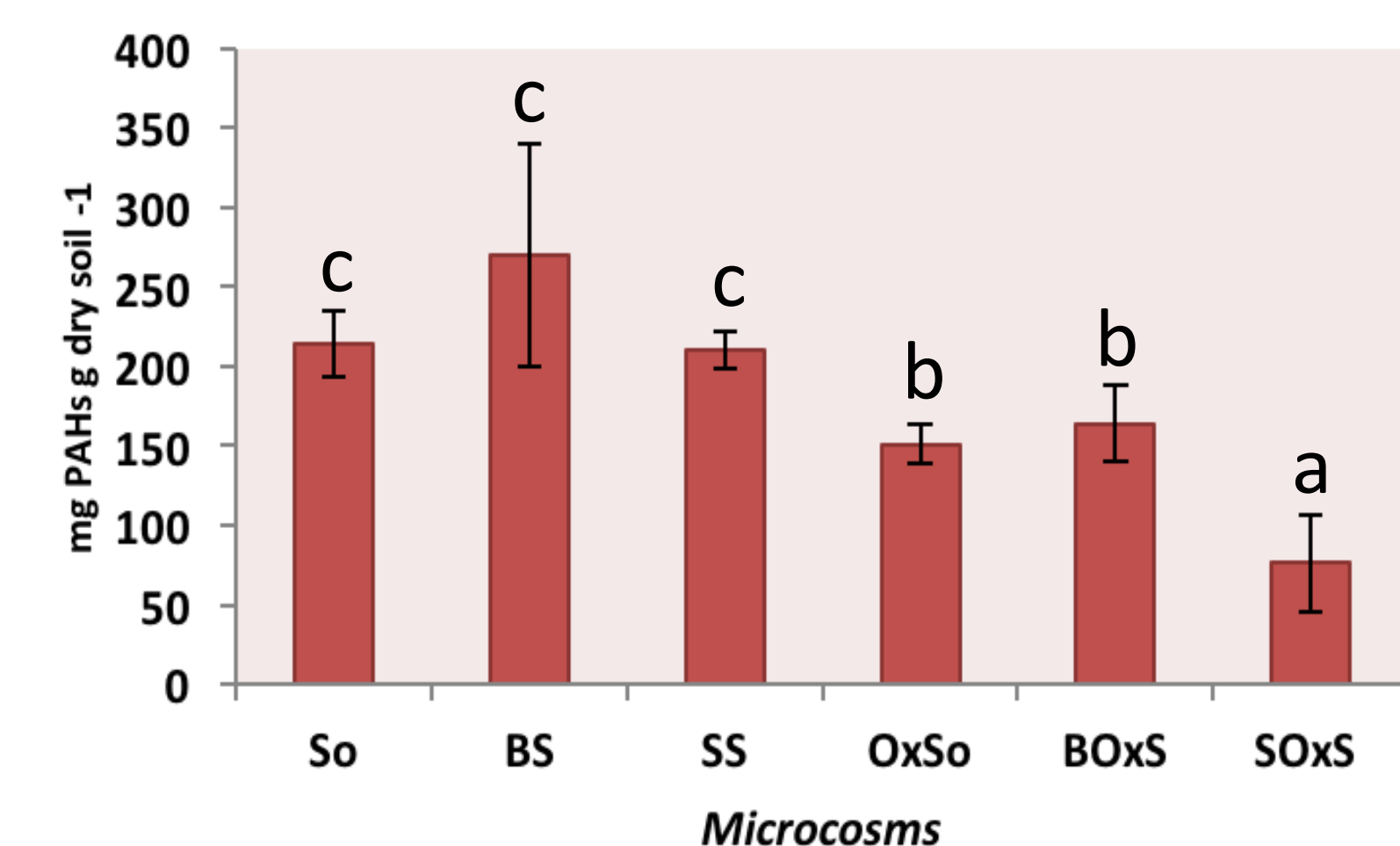
Microcosms were monitored once a week along 28 days, by count of heterotrophic on R2 agar; most probably number (MPN) of PAHs hydrocarbons degrading bacteria (DB) on liquid mineral medium supplemented with PAHs, phosphorous solubilizing bacterial (PSB) and fungi on rose bengal medium. Dehydrogenase activity was measurement during the same period of time^[7]. At the end of the treatments the hydrocarbons content and aqueous phytotoxic effect on *Lactuca sativa* were evaluated^[8]. Finally, structure of bacterial community was studied by pyrosequencing of V1-V3 regions of 16S rRNA^[6].



RESULTS

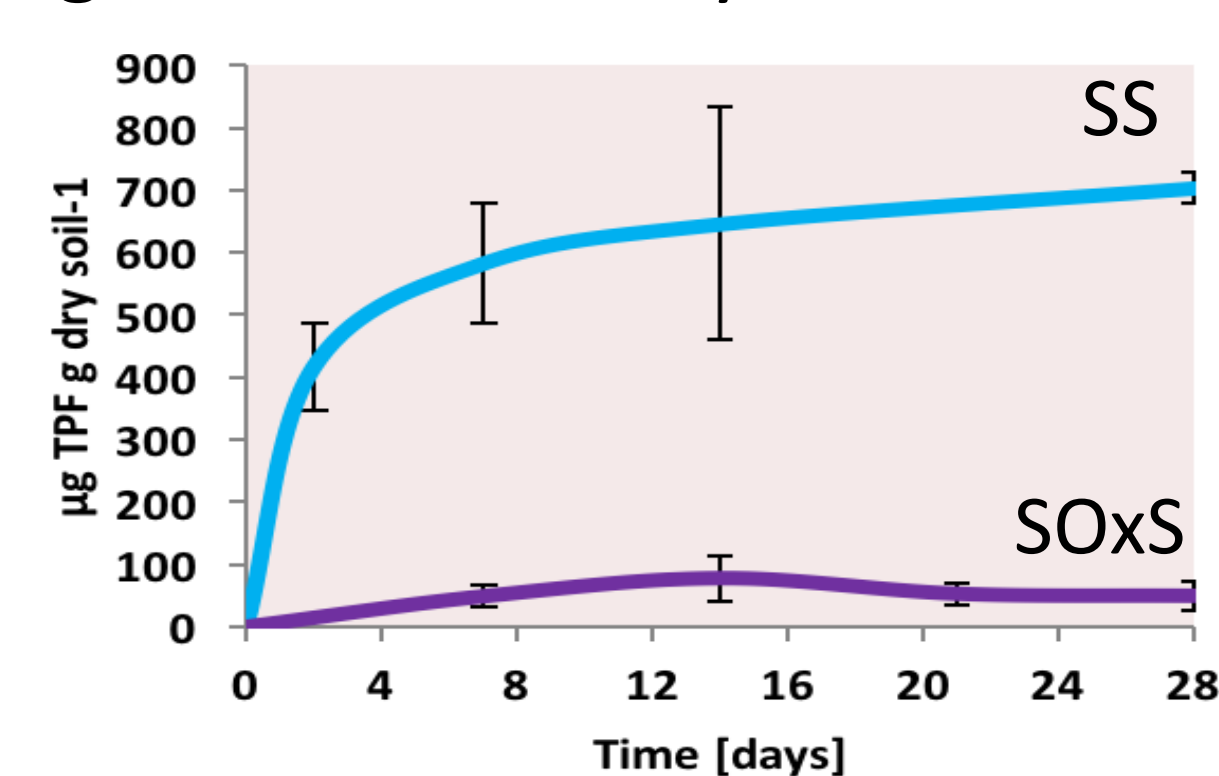
PAHs elimination

Oxidative treatment: Elimination of 29%.
Stimulation with compost: Additional elimination of 20%.



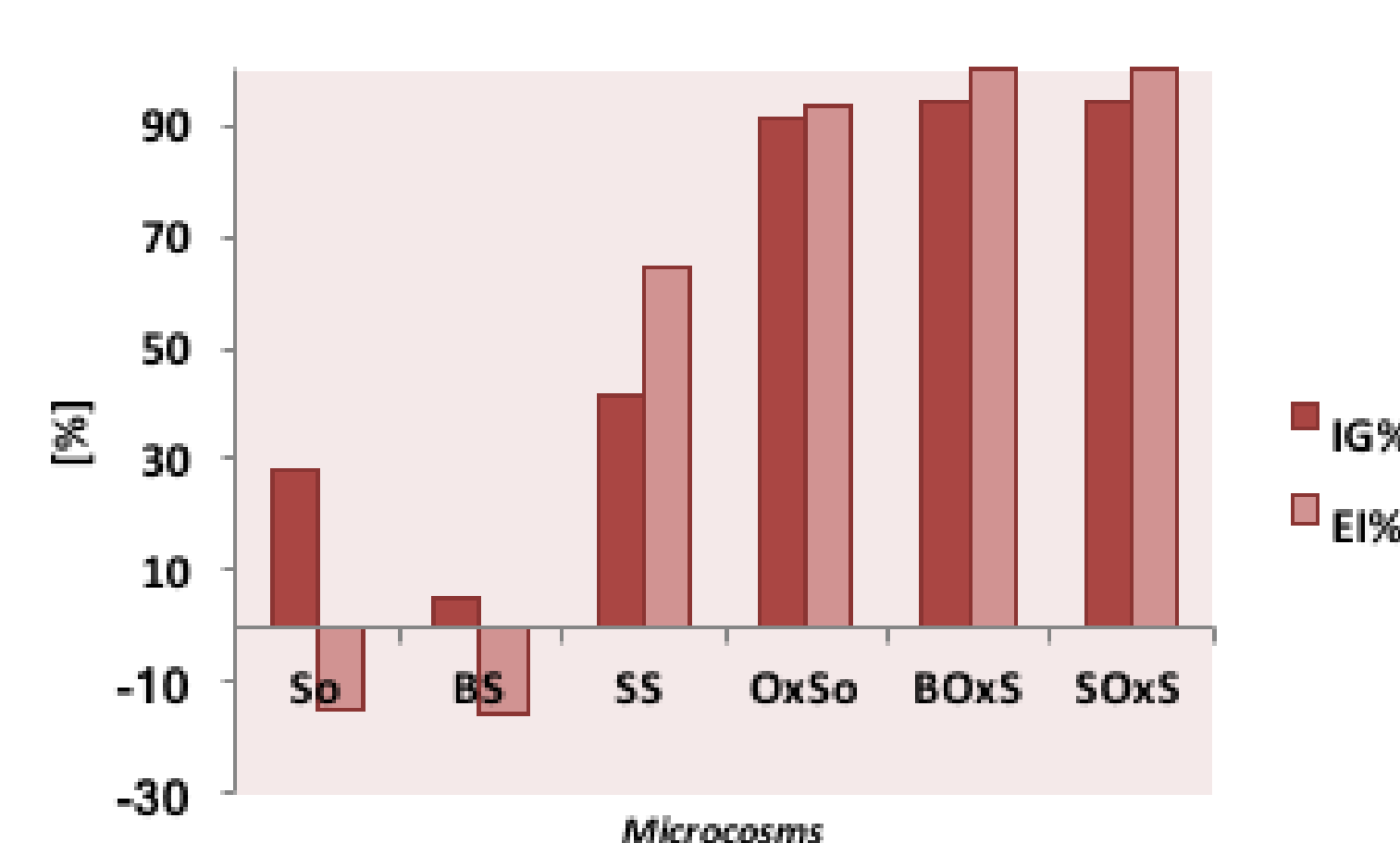
Dehydrogenase activity

S₀ and OxS₀: not detected.
Stimulation with compost: increases on global soil activity.



Aqueous extracts toxicity

PS addition and stimulation with mature compost increases inhibition germination index and elongation inhibition index.



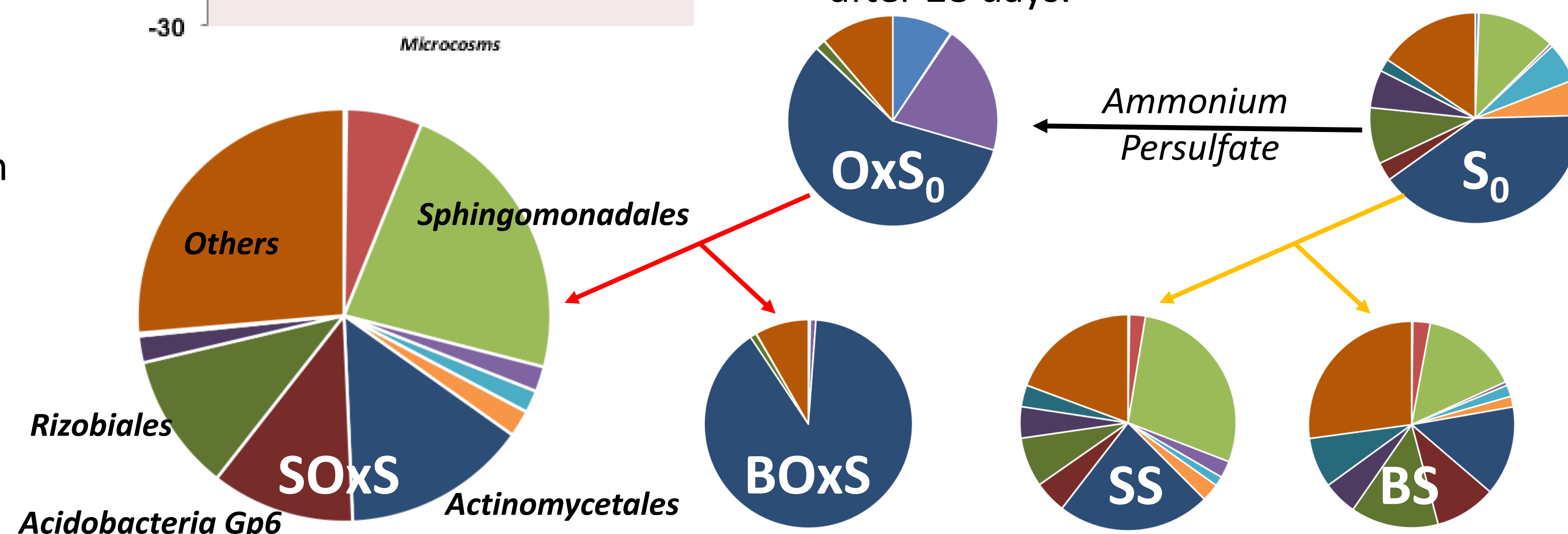
Cultivable community

A dramatic decline of the cultivable populations was observed immediately after chemical remediation. Stimulation with mature compost allowed the cultivable population recovery.

	Log CFU / g ds	Log PSB / g ds	Log CFU Fungi / g ds	Log MPN-PAHs DB / g ds
S ₀	7.6	3.7	5.7	3.4
BS	7.6	5.0	4.7	2.6
SS	7.5	6.2	5.6	3.9
OxS ₀	4.3	nd	4.0	1.9
BOxS	7.6	4.4	3.9	2.2
SOxS	7.8	6.4	5.2	3.4

Community structure

Structure and diversity indexes of the bacterial community was recovered after 28 days.



Alpha diversity

⁰H: species richness
¹H: Shannon diversity
²H: reciprocal of Simpson's

	Coverage [%]	⁰ H	¹ H	² H
S ₀	84	449	5	44
BS	70	1126	5	80
SS	71	929	67	38
OxS ₀	97	112	28	10
BOxS	97	65	6	3
SOxS	67	933	89	64

CONCLUSIONS

- The combined treatment allowed increases PAHs elimination, recovering cultivable bacterial and fungal populations and consequent dehydrogenase activity.
- Toxicity was not reverted after PS addition neither mature compost addition, probable due to high residual salinity.
- After 28 days of mature compost addition the diversity indices and bacterial community structure were recovery.
- Members of *Sphingomonadales*, *Actinomycetales*, *Acidobacteria Gp6* and *Rizobiales* orders were predominant, suggesting the active metabolism of organic matter, nutrients mobilization and hydrocarbons degradation.
- A longer term treatment could define the potentiality of the combined strategy for the elimination of PAH.

References: [1]. Yen et al. 2011. *Journal of Hazardous Materials* 186 (2): 2097–2102. [2]. Szczepaniak et al. 2016. *Environmental Science and Pollution Research* 23 (22): 23043–56. [3]. Lim et al. 2016. *Marine Pollution Bulletin* 109 (1). Elsevier Ltd: 14–45. [4]. Sutton et al. 2011. *Journal of Soils and Sediments* 11 (1): 129–40. [5]. Mora et al. 2014. *Environmental Science and Pollution Research* 21 (12): 7548–56. [6]. Medina et al. 2018. *Science of The Total Environment* 618, 518-530. [7]. Del Panno et al. 2005. *FEMS Microbiology Ecology* 53 (2): 305–16. [8]. Sobrero et al. 2004. In *Ensayos Toxicológicos Y Métodos de Evaluación de Calidad de Aguas.*, 55–68.