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Effect of organic amendment on chronically hydrocarbon contaminated soil after chemical remediation

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Rocio Medina[1]; Natalia Di Clemente[1]; Verónica Mora[1]; Janina Alejandra Rosso[2]; María Teresa Del Panno[1]

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

INTRODUCTION

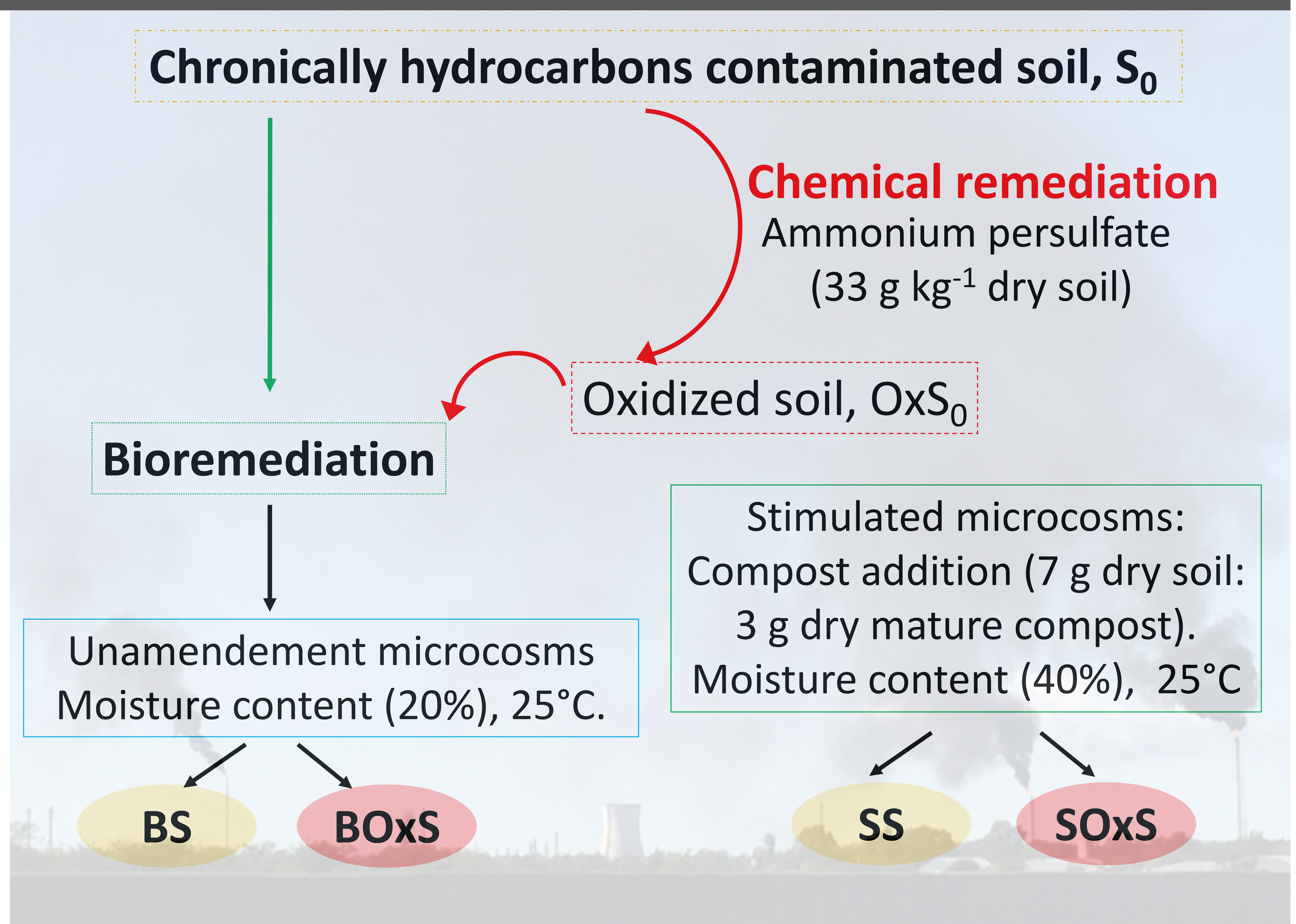
Polycyclic aromatic hydrocarbons (PAHs) are hydrophobic organic pollutants persistent in soil[1,2]. The remediation using chemical oxidants could overcome the limitations of bioremediation in the PAHs elimination[3], although it could also damage the community and the soil structure[4, 5].

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.

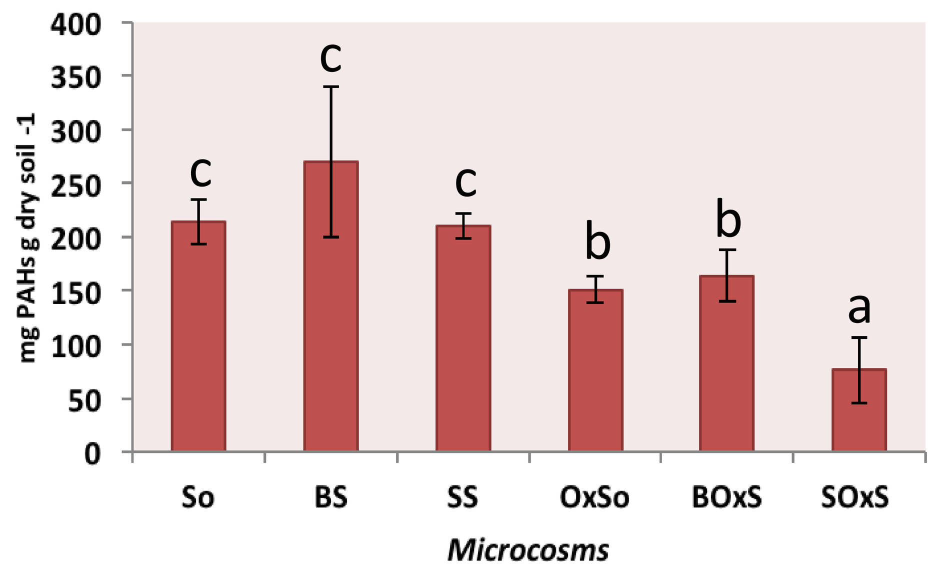
Microcosms were monitored once a week along 28 days, by count of heterotrophic on R2 agar; most probably number (MPN) of PAHs hydrocarbons degrading bacteria (DB) on liquid mineral medium supplemented with PAHs, phosphorous solubilizing bacterial (PSB) and fungi on rose bengal medium. Dehydrogenase activity 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

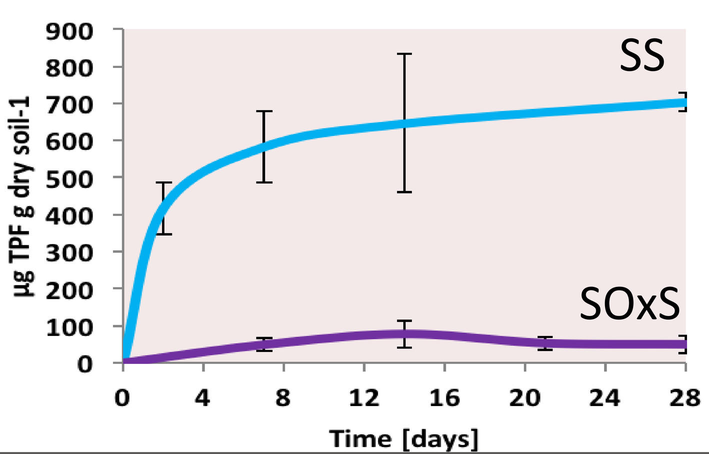
PAHs elimination

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



Dehydrogenase activity

S_0 and OxS_0: 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.

Cutivable community

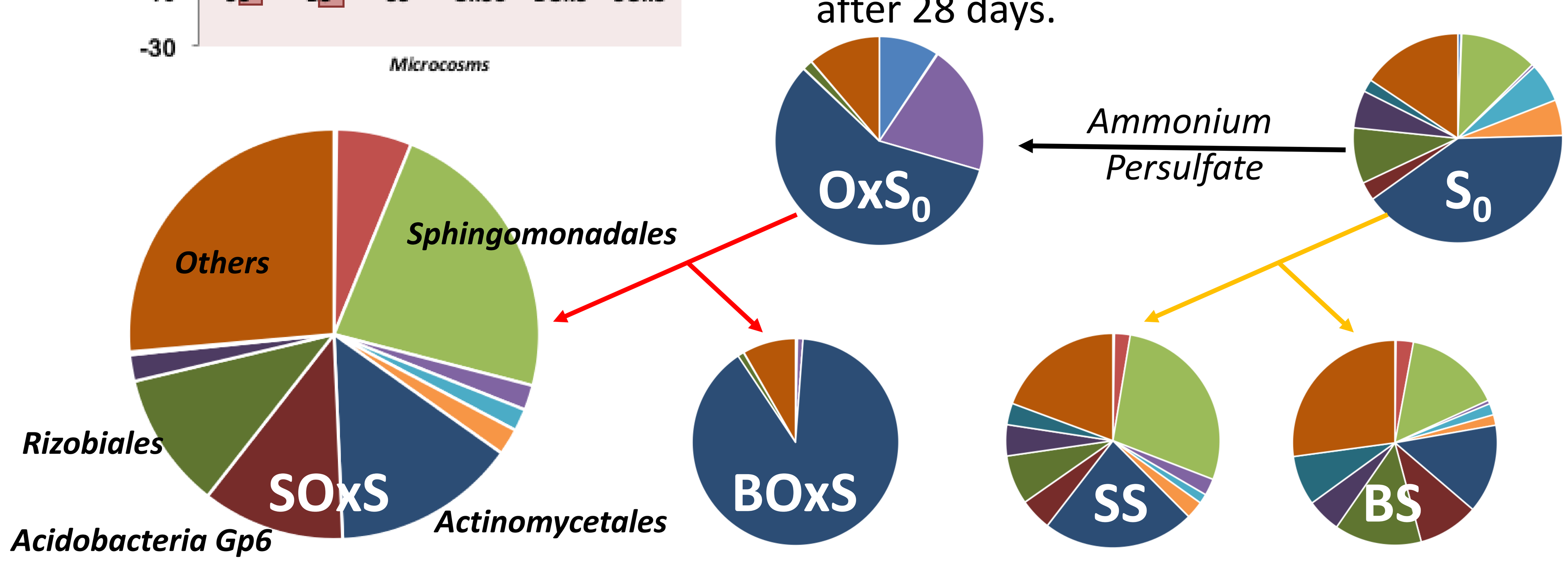
A dramatic decline of the cultivable populations was observed immediately after chemical remediation.

Stimulation with mature compost allowed the cultivable population recovery.

	Log CFU / g- ds	Log PSB / g-ds	Log CFU Fungi / g^{-1} ds	Log MPN-PAHs DB / g^{-1} 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 [%]	^0H	^1H	^2H
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.