Relationships between a mixture of trace elements and enzyme activities are better explained by potentially available fraction

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INTRODUCTION

The conventional management of agricultural soils can increase the (bio) availability of some contaminants. Trace Elements (TE), appearing as a mixture of trace elements (MTE), are deposited on these soils by the use of fertilizers, fungicides, leachates from landfills and/or by aerial deposition of particles from industrial or high traffic.

In this context, to carry out reliable environmental risk analysis with MTE it is necessary to quantify the effect in targeted and endogenous organisms presents in soil. Soil extracellular enzyme activities (EAs) are able to show harmful effects produce by MTE in soils.

The **aim of this study** was to evaluate the impact of a MTE on key EAs of agricultural soils of different uses under conventional management (olive grove, rainfed and forest).

METHODOLOGY

Study area		**Enzyme activities (EAs)**	**C-cycle**	**N-cycle**	**P-Cycle**	**S-Cycle**	**Living microorganisms**
SE of Madrid (Spain)	**20 Points** Olive grove Rainfed Forest		Alpha-glucosidase (AG) Beta-glucosidase (BG) Beta-galactosidase (BGA) Phenoloxidase (PHE)	Arylamidase (ARYLN) N-acetyl-glucosam. (NAG) Urease (URE)	Phosphatase (PHOS) Acid phosphatase (ACP) Phosphatase alkaline (PAK)	Arylsulfatase (ARYLS)	Dehydrogenase (DH)
		MTE	As, Sb, Ba, Be, Cd, Cr, Co, Cu, Hg, Pb, Mo, Ni, Se, Sn, V, Zn	Total fraction (*aqua regia*)			
				Potentially available fraction (DTPA)			
		Statistical analysis	Basic (mean, standard deviation)				
			Hibrid redundancy analysis (hRDA) Monte Carlo permutation test (n=499)				

RESULTS

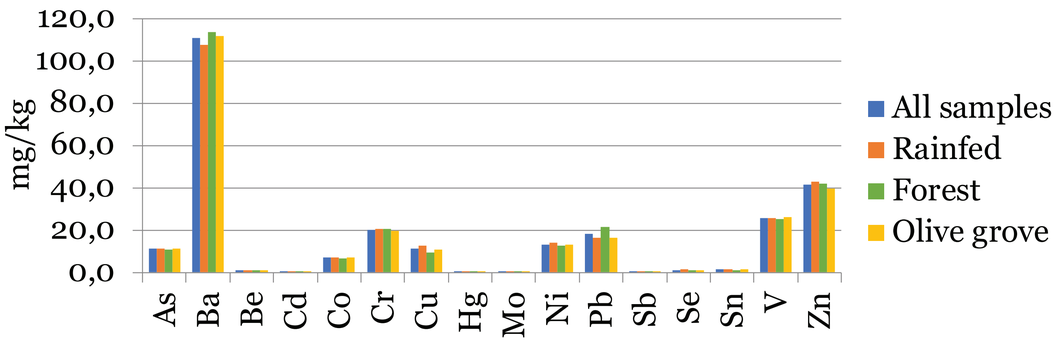

Fig. 1: Total concentrations of trace elements

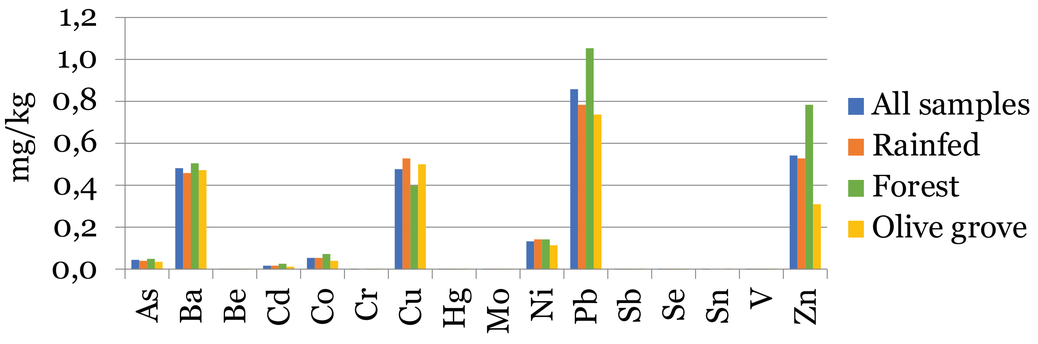

Fig. 2: Potentially available concentrations (DTPA) of trace elements

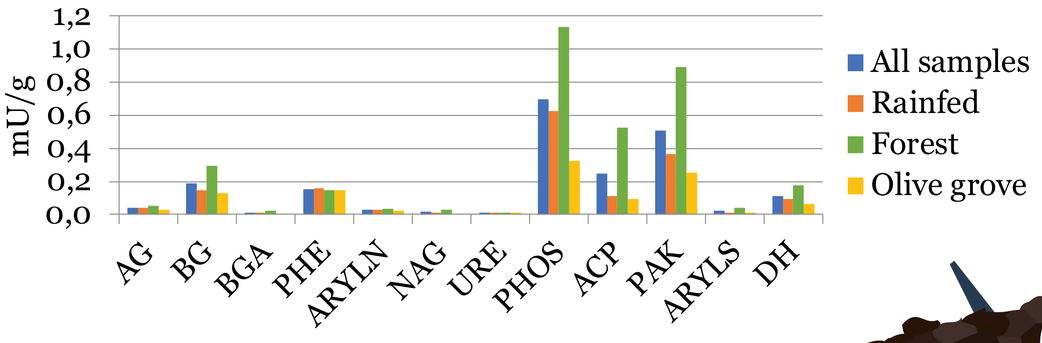

Fig. 3: Enzyme activities (PHE in U.g^{-1})

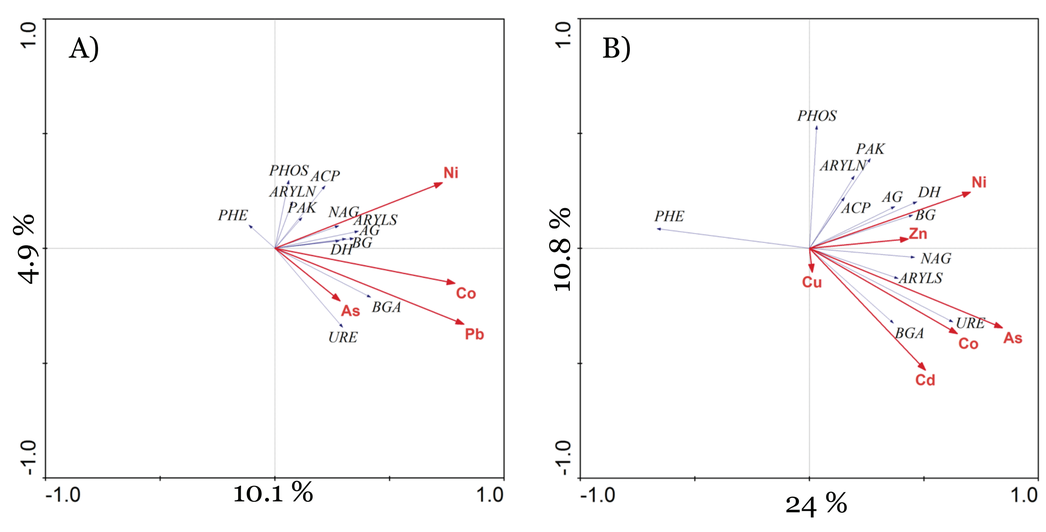

Fig. 4: hRDA relating total trace elements with EA (A) and DTPA trace elements with EA (B). Percentage of explained variance in each axis.

DISCUSSION AND CONCLUSION

- Different total concentrations of Cu, Se, Sn, Mo and Pb and potentially available concentrations of Co, Cu, Ni, Pb, Zn and Mo were found in soils with olive, rainfed and forest uses (Fig. 1 and 2).
- There are differences between the EAs of the different agricultural soils, the highest being PHOS and PAK (phosphatases) (Fig. 3).
- The total concentrations of TE in the MTE (Fig. 4) explain the fact that the variability in the EAs is worse than the potentially available, highlighting the need to consider potentially available fraction in risk analysis.

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