Research on Soil Microbial Communities and Enzymatic Activity in Tropical Soils of Puerto Rico

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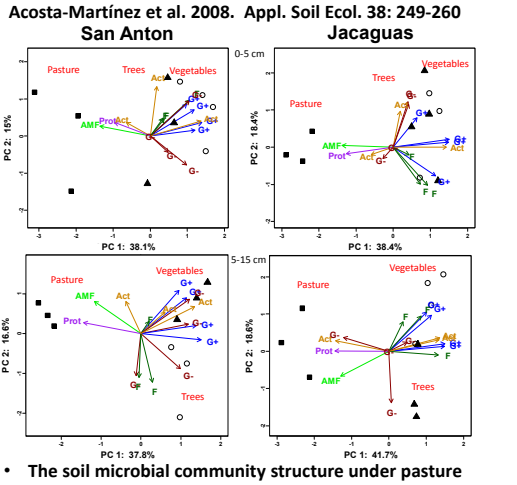
Celebrating 2015 International Year of Soils

International Year of Soils: Soil Biology and Biochemistry Research Across the Globe

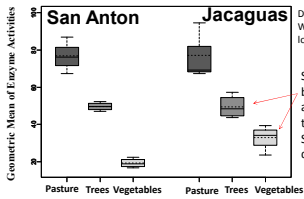
This poster highlights 4 major studies evaluating microbial communities and enzyme activities as influenced by land use and cropping management practices in tropical soils of Puerto Rico. Our results contribute towards understanding the extent that soil management influences soil biochemical functioning to identify sustainable soil management for the regions evaluated.

STUDY 1: Microbial communities and enzymatic activities under different management and land use in semiarid soils

Acosta-Martínez et al. 2008. Appl. Soil Ecol. 38: 249-260



- The soil microbial community structure under pasture differed from fruit trees and agriculture (vegetables) due to higher AMF markers (i.e., 16:1ω5c), protozoan (20:1ω6c), and actinomycetes (10Me 16:0).
- Bacterial and saprophytic fungal markers were higher under trees and vegetables.



Dotted line=mean; Solidline=median; Whiskers extend to highest and lowest sample value

Specifically in this soil, the biogeochemical potential is almost double under fruit trees than vegetable production while SOC was not significantly different (15.9 and 12.1 g kg^{-1})

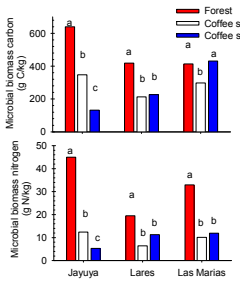
- The geometric mean of 4 enzyme activities (biogeochemical cycling potential) showed this trend for both soils: pasture> fruit trees > vegetable production.
- Both soils showed similar geometric mean under pasture as the same grass was used (*Sporobolus indicus*) and SOC was similar (30.5 in San Anton; 23.5 g kg^{-1} in Jacaguas).
- Lower above & below-ground biomass with vegetables production reduced the microbial community size of these soils and their biogeochemical potential (3-4 times).

STUDY 2: Soil biological diversity (microbes & earthworms) in coffee (*Coffea arabica* L.) agroecosystems

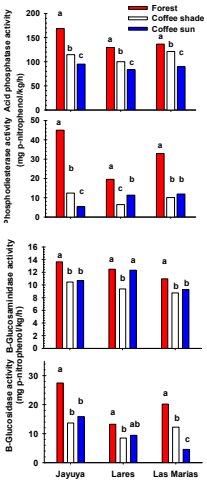
Amador et al. 2013. Trop. Ecol. 54: 365-374

Sotomayor-Ramírez et al. 2008. Proc. Carib. Food Crops Soc. 44: 333-345.

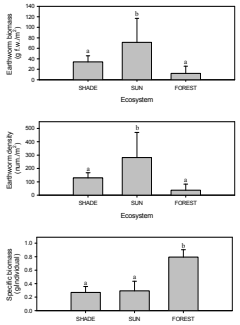
Site	Series	Taxonomic subgroup	Height above sea level (m)
Jayuya	Los Guineos	Humic Hapludox	789
Lares	Alonso	Oxic Dystrudepts	604
Las Marías	Humatas	Typic Haplohumults	286



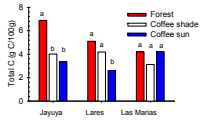
- For all soils, MB was highest under secondary forest (FOR), previously under coffee production.
- MB was greater in shaded coffee (SHD) than coffee under sun (SUN) in Jayuya soil, with the opposite observed in Las Marias soil.



- Only acid phosphatase activity differed among ecosystems for all soils: FOR > SHD > SUN



- Unlike MB, earthworm biomass and abundance were higher under SUN compared to SHD and FOR.
- The specific biomass of earthworms was highest under FOR and similar for the SUN and SHC coffee ecosystems.



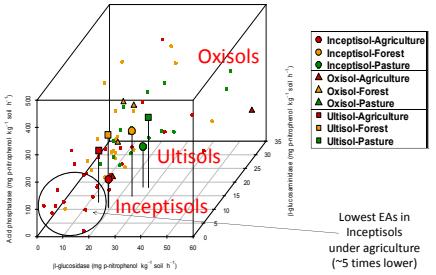
- The soil biological indicators showed more distinctions among the two coffee management strategies while total C was generally similar under SHD and SUN, except for the Lares soil.

STUDY 3: Enzyme activities in the Río Grande de Arecibo watershed (north-central, PR)

Acosta-Martínez et al. 2007. Appl. Soil Ecol. 35: 35-45

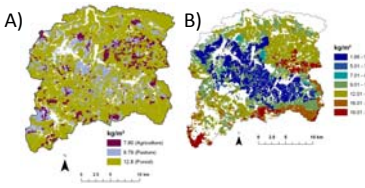
Sotomayor-Ramírez et al. 2020. J. Agric. Univ. P.R. 94: 1-23

Sampling points and sampling area (inset)



Lowest EAs in Inceptisols under agriculture (~5 times lower)

- Three enzyme activities together indicated that agricultural practices can significantly decrease (5 times lower) the biogeochemical cycling potential of Inceptisols; which tend have coarser texture in this region.
- When Inceptisols are placed under pasture or forest, their activities can be increased to the levels found for Oxisols and Ultisols.

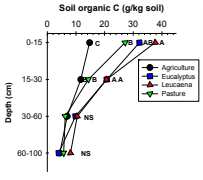


- Soil organic carbon content (kg C/m^2, 0 to 100 cm) by land use only (A) and by mapping unit*land use layering (B) in this watershed. Generally, soils under forest showed the greatest SOC content followed by pasture and the lowest under agriculture for all soil orders.

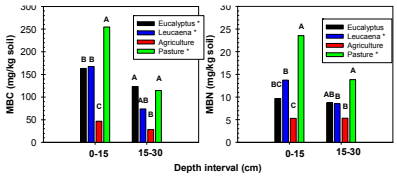
STUDY 4: Soil C, microbial biomass C &N, and enzyme activities of C & N cycling following 26-yr conversion from sugarcane (*Sacharum officinarum*) to forest (*Eucaliptus robusta* or *Leucaena leucocephala*) or pasture (mixture of tropical grasses) in Vertisols of south-west Puerto Rico

Sotomayor-Ramírez et al. 2009. Biol. Fertil. Soils. 45: 487-497

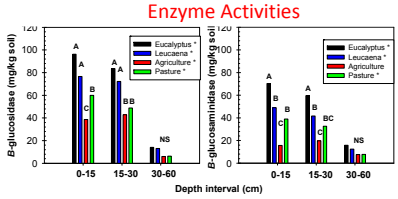
Organic C



Soil microbial biomass



Enzyme Activities



Letters within depths indicate differences between land use. For B and C, * denotes differences between depths.

- The Vertisol studied showed this trend in C accumulation, C mineralization, microbial biomass C and N, and β-glucosidase and β-glucosaminidase activities after 26 yrs: Eucalyptus forest> Leucaena forest> pasture > agriculture

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