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Taxonomic and Functional Profiling of Soil Fungi and Bacterial Microbiomes in Colombian Coffee (*Coffea arabica* L.) Plantations: A Regional Metabarcoding Study

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Introduction

Microorganisms associated with coffee plants are vital for ecosystem functioning and possess significant biotechnological potential for promoting plant growth, biological control, and sustainable agriculture. This study aimed to investigate the taxonomic and functional diversity of soil fungi and bacteria across coffee farms in three traditional Colombian regions, comparing organic and conventional management systems.

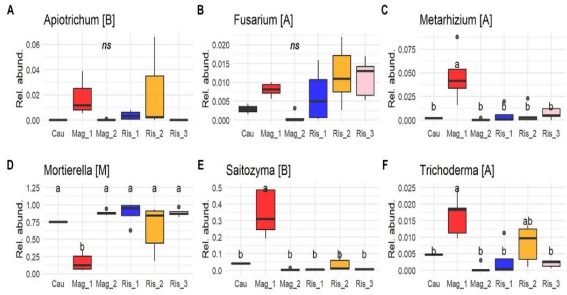

Figure 1: Abundant genus of soil fungi

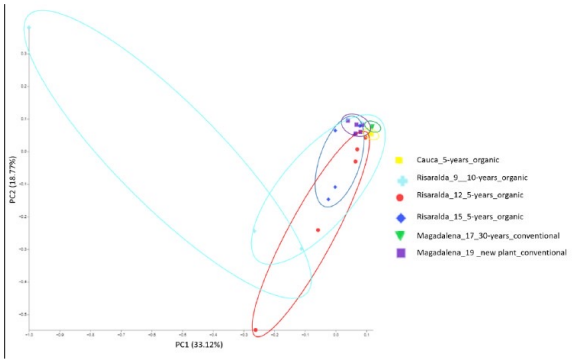

Figure 2: Beta diversity for bacterial communities

Materials/Methods

Soil fungal and bacterial communities were surveyed on six farms situated in the Cauca, Magdalena, and Risaralda regions of Colombia. Five farms operated under organic management and were recently established (1 to 15 years old) with low shade cover, while one farm employed long-term conventional management (30 years old) with higher shade coverage.
Fungal communities were assessed through amplicon sequencing and functional prediction using FUNGuild, whereas bacterial communities were analyzed via 16S rRNA metabarcoding.

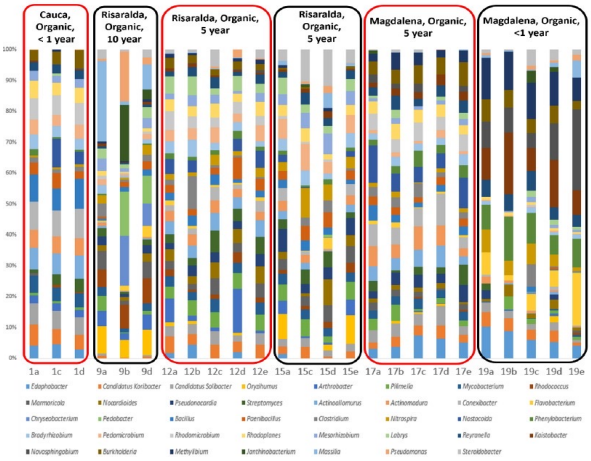

Figure 3: Bacterial communities associated with the samples

Results/Discussion

The analysis revealed a dominance of saprotroph-symbiotroph and pathotroph fungi, with *Mortierella* and *Saitozyma* as the prevalent genera. Notably, insect-pathogenic *Metarhizium* species served as indicators in long-term shaded conventional farms.
Beneficial bacterial genera such as *Janthinobacterium*, *Bacillus*, *Actinomadura*, and *Actinoallomurus* were also identified, associated with plant growth promotion, organic matter decomposition, and antibiotic production.

Conclusion/Perspectives

Although metabarcoding provided valuable insights into microbial composition, further metagenomic approaches could elucidate functional dynamics, albeit at higher costs. These findings highlight the diverse and beneficial microbial communities present in coffee plantations and emphasize the importance of targeted management practices to enhance beneficial species, suppress pathogens, and promote sustainability.

References:

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