Do forests preserve soil biodiversity?

An inventory of five soil organisms in seven tropical countries

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Introduction

Bacterial nodules in a soybean plant

Soil biota constitutes an important living community in the soil system. They play a crucial role in the sustainability of the soil systems and provide essential services for the functioning of ecosystems to meet essential human needs. For example, the carbon tightly bound in lignin is broken down largely in the microbial soup of termite hindguts and half of the world's oxygen is produced by ocean microbes, and they fix an unknown, but presumably enormous, amount of atmospheric carbon and nitrogen.

Objective

- To evaluate and explore trends in diversity and abundance of soil biota functional groups; including: ants (Hymenoptera: Formicidae); beetles (Coleoptera); earthworm communities (Oligochaeta); termites communities (Isoptera); and arbuscular mycorrhizal fungi (AMF) in benchmark areas located in Brazil, Cote d'Ivoire, India, Indonesia, Kenya, Mexico and Uganda.

Glomus agregatum attached to the root of a plant

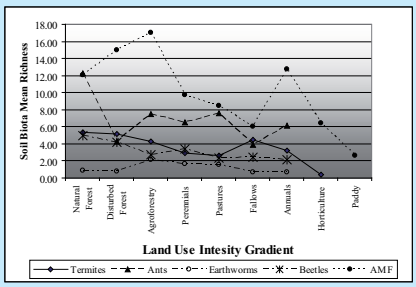
Methodology

- Ants, beetles and termites was extracted using monoliths (25 x 25 x 30 cm) and pitfalls on a 20m transect and hand sorted for identification. Beetles were extracted from litter using the Winkler.
- Earthworms were extracted using three large monoliths (50 x 20 cm) around the central sampling point and hand sorted for taxonomic identification.
- Soil core samples were used for AMF extraction in 2 rings of 3m and 6m radii around the centre point and dilution and microscopy techniques used for isolation and taxonomic identification.
- Species Richness and Species Biological diversity (Shannon Index) were determined by analysing data after taxonomic identification.
- The number of windows varied for each country from one to six and selection was based on the heterogeneity of the benchmark areas in the individual country.

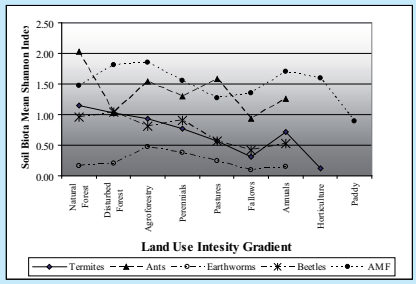
Disseminating the benefits soil organisms in crop management

Results

- The highest mean species richness observed was in agroforestry systems which had 17 species of AMF.
- Forests recorded the highest number of species of ants (12), termites (5) and beetles (5).
- Whereas AMF showed the highest richness in all the land use kinds, earthworms had the lowest richness, even in forests.
- Termites, ants and beetles showed highest biological diversity (Shannon Index) in the forests, than in the other land use kinds. The richness gradually reduced in disturbed forests, in agroforestry systems, with lowest diversity occurring in the fallows.
- Annual crops though intensely used showed surprisingly higher species diversity compared to agroforestry and perennial land use systems (i.e., coffee, tea, sugarcane, etc).



Distribution and trends of the mean species richness of termites, ants, earthworms' beetles and AMF in different land use kinds in the seven tropical countries.



Distribution and trends of the mean biological diversity of termites, ants, earthworms, beetles and AMF different land use kinds in the seven tropical countries.

Take Away Message

- Forests have high biological diversity compared to other land use systems for sampled soil organisms (i.e., ants, beetles, and termites).
- AMF populated degraded environments mostly probably to assist plants absorb nutrients through their mycelia.
- Species richness and diversity declined with increased land use intensification. Fallows had the lowest diversity.
- Earthworms were most diverse in agroforestry systems than in the natural forests.
- Fallows might not be sustainable in the long run.

CGIAR Science Council Priorities

System Priority 1: Sustaining Biodiversity for current and future generations

Acknowledgement

This poster presents the results of the inventory of below ground biodiversity as part of the international project "Conservation and Management of Below-Ground Biodiversity" implemented in seven tropical countries namely: Brazil, Cote d'Ivoire, India, Indonesia, Kenya, Mexico, and Uganda. This project is coordinated by the Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture (TSBF-CIAT) with co-financing from the Global Environmental Facility (GEF), and implementation support from the United Nations Environment Program (UNEP).

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