

Effects of land use change on soil chemical and biological properties in Teapa, Tabasco (SE-Mexico)



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Introduction

Increasing populations in tropical countries lead to severe land use changes. Intensive agroindustrial activities as in banana plantations of Tabasco required the clearing of tropical forests and the intensive application of fertilizers to assure high yields. High market competition in the last years lead farmers to intercrop timber species within the plantations for additional income.

We studied the effect of land use change on soil chemical properties and biological characteristics in three typical ecosystems of Tabasco, SE Mexico.

Materials and Methods

Study area:

- Floodplain of the Teapa River in SE Mexico (Fig. 1)
- Climate: tropical warm and humid
- Mean annual rainfall and temperature: 3440mm, 26°C
- Soils: Fluvisols and Gleysols

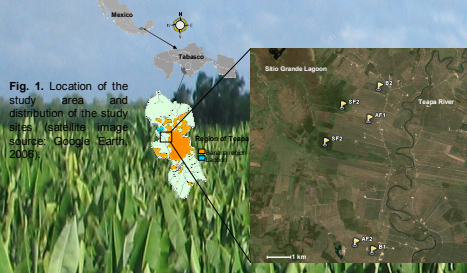


Fig. 1. Location of the study area and distribution of the study sites (satellite image source: Google Earth, 2006).

Sites (each with two repetitions):

- Banana plantations (B)
- Agroforestry systems (AF)
- Succession forests (SF)

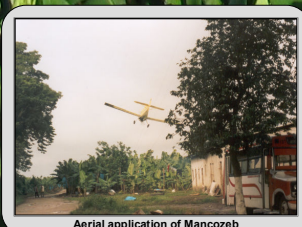


Open ditch draining system in a banana plantation

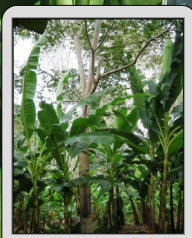
Management in B and AF: open ditch draining system, 200 kg ha⁻¹ y⁻¹ NPK, and fungicides (100 kg ha⁻¹ y⁻¹ Mancozeb)

Experimental design and Treatments:

- Study carried out from Nov. 2005-Feb. 2006
- Randomized experimental design, 10 replications per site
- **Soil properties** (0-30 cm): pH, soil organic matter (SOM), N_{tot}, C/N, P_{avai}, K_{exch}, CEC, Mn_{ext}, Zn_{ext}
- **Earthworms**: sampled based on TSBF Methodology
- **Litter decomposition**: litter bag technique, using banana (*Musa acuminata*) and *Bravaisia integerrima* (Acanthaceae) leaves, 5 replicates, 5 collection dates, duration: 8 weeks



Aerial application of Mancozeb



Agroforestry system

Acknowledgments

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Results

Soil chemical properties (Fig. 2)

- Three factors explained 72.6% of total variance
- Forests: significant higher SOM, N_{tot}, CEC
- Managed systems: significant higher P_{avai}, K_{exch}
- All sites: high contents of Mn (8.8±6.9 mg kg⁻¹)

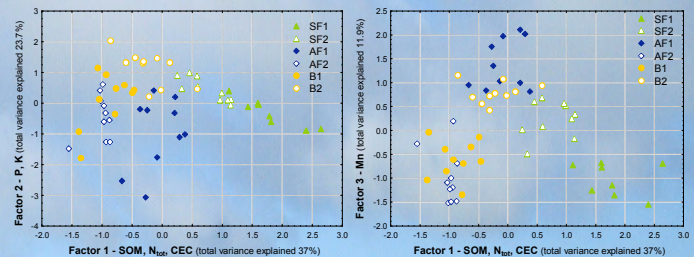


Fig. 2. Ordination diagram based on the Factor Analysis of the soil chemical properties in the study sites. Factor scores plotted for Factor 1 against Factor 2 (left) and Factor 1 against Factor 3 (right). Sites are symbol coded.

Biological properties

Earthworms (Fig. 3)

- Total 10 species: 4 native, 6 exotic
- Succession forests: >80% native
- Managed systems: 60-96% exotic
- Variation not statistically significant due to aggregative distribution of the earthworms

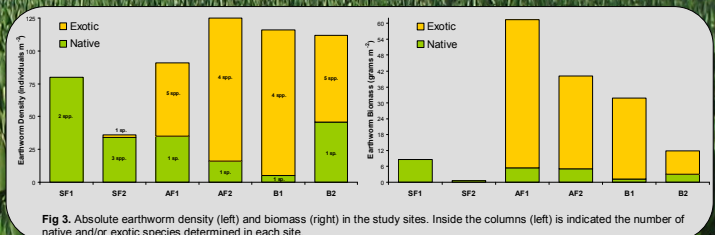


Fig. 3. Absolute earthworm density (left) and biomass (right) in the study sites. Inside the columns (left) is indicated the number of native and/or exotic species determined in each site.

Litter decomposition (Fig. 4)

- Remaining litter after 8 weeks: 8-20% *B. integerrima* and 24-40% *M. acuminata*
- Half-life time: *B. integerrima* 1.8-3.1, *M. acuminata* 4.1-5.8
- C/N ratio decline with exposition time
- No significant differences within the same litter in the study sites

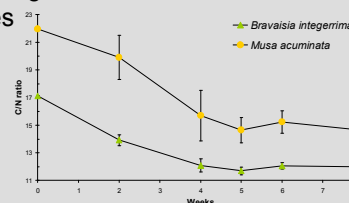
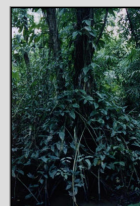


Fig. 4. C/N ratio of the leaf litters during the process of decomposition.



Succession forest (*B. integerrima*)

Conclusions

- Soil fertility was not affected negatively by the intensive management practices in the region.
- Native earthworm fauna was susceptible to land use changes and/or management practices.
- Decomposition was not directly affected by land use, but by the microclimate within the plots.