CIFOR World Agroforestry	**SOP 004**	**Date: 11.09.2023** **Author:** Lukelysia Mwangi **Authorizer:** David Lelei

STANDARD OPERATING PROCEDURE

METHOD FOR SAMPLING AND ISOLATION OF SOIL MACROFAUNA

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G142	Living soils laboratory

Revise before:	[*date*]
Historical data	[*dates of previous issues*]
Date retrieval:	[*to be filled in once the document has become obsolete and is archived*]

Changes in this version compared to previous version:

1. Inclusion of workflow
2. Inclusion of quality control document

Contents

ABBREVIATIONS

- SOP – Standard operating procedure
- GPS - Global Positioning System
- CH_2O - Formaldehyde

1. INTRODUCTION

Soil macrofauna contributes to different soil functions and may be used as indicators of soil quality. They create macropores, transform and distribute organic matter and influence soil physical and chemical processes.

Soil macrofauna comprises those soil organisms that are > 1 cm long or have a width or diameter of >2 mm (Lavelle and Spain 2001). This includes a diverse array of organisms occupying various trophic levels such as:

- Major consumers of surface organic debris (e.g., millipedes, insect larvae)
- Consumers of buried and more decomposed organic matter (e.g., earthworms)
- Predators (e.g., burrowing or ground-dwelling spiders, beetles).

Earthworms and termites are the most important soil macrofauna in natural and managed ecosystems. They are referred to as ecosystem engineers due to their ability to modify the soil environment and avail resources to other organisms by such varied mechanisms.

Ants and other macrofauna which represent predators, herbivores and bioturbators, also influence important changes in the physical and chemical properties of soils, as well as dispersing plant propagules.

Soil macrofauna are often used as indicators of soil biological quality and therefore constitute important components of soil biota, indicative of overall soil biodiversity and effects of land use change and management practices.

2. SCOPE AND APPLICATION

Globally there is a long-known dependence on soils, until now soils have been considered to have a biological active component. Land degradation has been experienced in most areas and there is a critical and immediate need to apply knowledge about the role of below-ground biodiversity in sustaining soils. Most natural ecosystems have been rapidly altered by land use changes, for example a major change in tropical regions is land use change associated with agricultural intensification. Intensification occurs and is necessary to ensure global food supplies but as it occurs biological regulation of soil is altered and often substituted by fertilizers and mechanical tillage. Consequently, resulting in reduction of soil biodiversity hence presenting a challenge such as possibility of restoring soil biodiversity to increase agricultural productivity in degraded regions.

3. PRINCIPLE

The importance of soil biotic diversity includes Carbon sequestration in soils, reduction of greenhouse emissions, maintenance of soil physical structure and water retention capacity, nutrient provision to plants and control of plant pathogens as specific contributions of soil organisms to soil fertility. The relationship between species diversity and functional diversity of all soil biota is uncertain and pose an area of further research at the landscape level as well as in the laboratory.

4. PROCEDURES

4.1 MATERIALS, EQUIPMENT AND CHEMICALS

i. Materials

a) Hand hoes
b) Machetes
c) spades
d) Vials
e) Ruler
f) Buckets
g) Trays
h) GPS
i) 10mm sieve
j) Dissecting microscope
k) Scalpels
l) Pins

ii. Equipment

a) Disserting microscope
b) Fume chamber

iii. Reagents

a) Ethanol (75%)
b) CH_2O (4%)

4.2 SOIL MACROFAUNA SAMPLING

2.3.1 Sampling procedure

Sampling should be conducted at the end of rainy season when the soil macroinvertebrates are known to be active. The sampling points to be located 5 m apart along a transect with a random origin. Sampling involve excavation and hand-sorting of soil macrofauna from monoliths (25cm x 25 cm x 30 cm deep)

The soil macrofauna are enumerated based on the following taxonomic groups:

- Arachnida (spiders, ticks etc.)
- Coleoptera [beetles (adults, larvae)]
- Blattoidea (cockroaches)
- Hymenoptera (ants)
- Chilopoda (centipedes)
- Hemiptera (Cicadidae)
- Diplopoda (millipedes)
- Earthworms (pigmented, un-pigmented)
- Gastropods (slugs and snails)
- Orthoptera (Gryllidae- crickets)
- Isopoda (Woodlice)
- Isoptera (termites)

Other methods include:

Transect method for termites, ants, beetles and earthworms

Pitfall traps method do not sample all taxonomic groups but mainly for beetles, ants, juvenile orthopterans, myriapods, spiders

Note: For counts only, do steps 1 to 5 and 7. Once counted return organisms back to the soil.

2.3.2 Soil macrofauna abundance analysis

a) In the laboratory the soil macrofauna to be separated enumerated based on the following taxonomic groups:

- Arachnida (spiders, ticks etc)
- Coleoptera [beetles (adults, larvae)]
- Blattoidea (cockroaches)
- Hymenoptera (ants)
- Chilopoda (centipedes)

- Hemiptera (Cicadidae)
- Diplopoda (millipedes)
- Earthworms (pigmented, un-pigmented)
- Gastropods (slugs and snails)
- Orthoptera (Gryllidae- crickets)
- Isopoda (Woodlice)
- Isoptera (termites)

b) Abundance and biomass to be determined for each organism

c) The number and biomass of each category of soil macrofauna to be expressed on an area basis (m^{-2}).

d) Earthworms to be categorized into the three functional groups based on their habitat, food choice, feeding behaviour and ecophysiology and observations under dissecting microscope. Count and measure biomass of each of the functional group. These groups include:

- Epigeics
- Anecics
- Endogeics

5. OCCUPATIONAL HEALTH AND SAFETY

- All activities performed under this SOP comply with the recommendations of ICRAF Health and Safety policy
- Laboratory dress code: clean laboratory coats and low-heeled closed shoes worn always while performing the procedures.
- Laboratory working areas are cleaned daily and benches regularly disinfected and sterilized using 70% alcohol during various procedures.

6. REFERENCES

- Anderson, J. M. and Ingram J. S. I. 1993. Tropical Soil Biology and Fertility: A Handbook of Methods. CAB International.
- Lavelle P. and Spain A. S. 2001. Soil Ecology. Kluwer Academic Publishers.
- Moreira F.M., Huising J. and Bignell D.E. (Eds.). 2008. A Handbook of Tropical Soil Biology: Sampling and Characterization of Below-ground Biodiversity. Earthscan, London.

7. ANNEX

A HANDBOOK OF TROPICAL SOIL BIOLOGY: SAMPLING AND CHARACTERIZATION OF BELOW-GROUND BIODIVERSITY BY : E. J. Huising, Huang, S. P., Coe, R., Cares, J. E., Louzada, J. N., Zanetti, R., Moreira, F. M. S., Susilo, F. X., Konaté, S., and van Noordwijk, M., *A Handbook of Tropical Soil Biology: Sampling and Characterization of Below-Ground Biodiversity.* TSBF-CIAT, CTA, UNEP and GEF, 2008, p. 256.