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Soil Quality Management

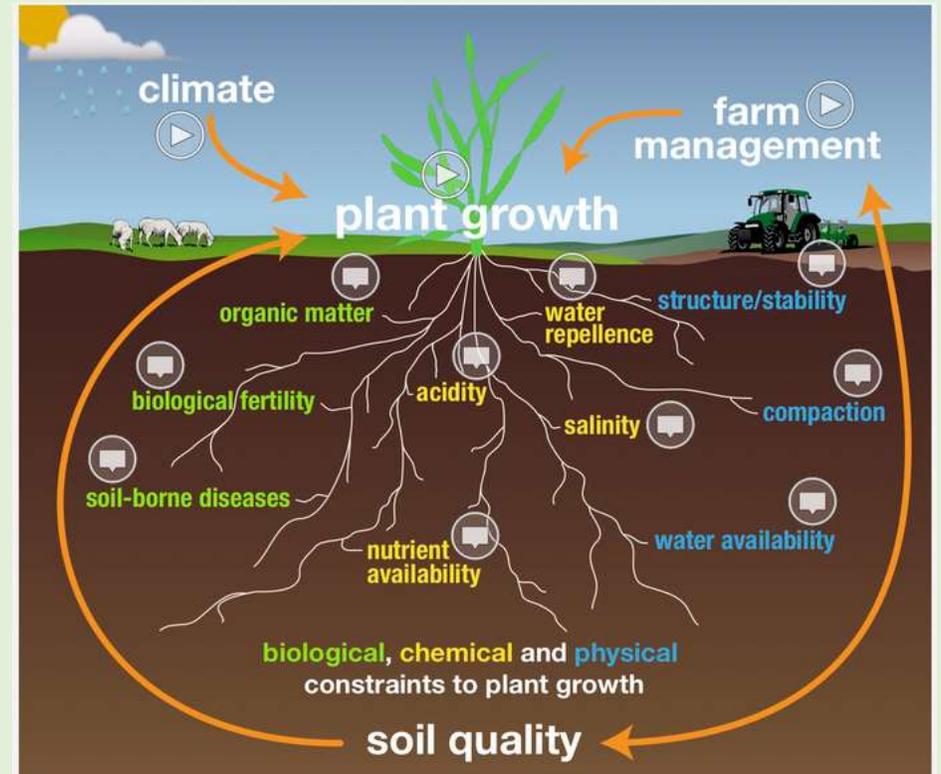
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Outline

- Course's requirements and description
- Course aims
- Course structure
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- Exam



Course requirement & description

Requirements

Fundamentals of Soil Science, Biochemistry, Microbiology

Description

Soil quality is a necessary indicator of sustainability land management.

The proper approach in defining soil quality indicators must be holistic not reductionistic, thus indicators should describe the major ecological processes in soil.

Soil quality depends on a large number of physical, chemical and biological soil properties, and its characterization requires the selection of indicators most sensitive to changes in management practices.

The aim of the course is to provide a clear definition of soil quality bioindicators to develop a rationale for their use.

Course aims

To present soil as a living, dynamic, vulnerable resource

To introduce the concept of soil quality, health and security

To explain the link between Soil Quality and Sustainability

To present a basic set of indicators to monitor soil quality

To suggest how to choose the right indicators in relation to specific case studies in forest and agricultural environment

Course structure for 4 ECTS

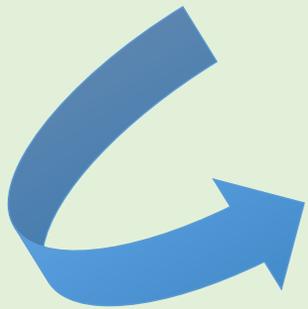
1. Lectures in class (n. 8 x 2 hours)
2. Integrative seminars (n. 2 x 2 hours)
3. Laboratory activity on soil quality assessment (n. 4 x 3 hours)

Determination and interpretation of some chemical indicators such as:

- soil pH
- capacity of exchangeable cations

Determination and interpretation of some biological indicators such as:

- soil respiration
- soil enzyme activity



Laboratory equipment

pH meter



Fluoroscan



Spectrophotometer



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Program

I. Introduction

- Soil and its different definitions
- Role and position of soils in terrestrial ecosystems
- Ecosystem services and soil functions
- Concepts of chemical and biological fertility



II. Indicators of soil quality and health

- Review of the concepts of soil quality, soil health and soil security. Rationale for the use of soil indicators and specific requisites. Physical, chemical and biological indicators. Static and dynamic descriptors.
- Pools and processes.
- Main bioindicators: definitions and functions.
- Soil health and resilience
- Soil quality indexes



III. Soil organic matter (SOM)

- Main features, composition, physical, chemical and biological properties.
- SOM as a complex indicator of soil quality. Quantity and quality of SOM
- Role of SOM to maintain soil fertility, to promote carbon storage and as the site of tight interactions with soil biota. Pools of ecological relevance.

IV. Soil microbial biomass

- Definition, composition and main characteristics
- Factors influencing microbial biomass development. Trophic conditions and adaptation strategies. Functions of soil microorganisms and their specific role within nutrient cycles.
- How to study microbial biomass. Quantitative and qualitative approaches. FE method, SIR, multi-SIR, CLPP techniques. Concepts of genetic and functional diversity.
- Microbial indexes: the microbial quotient, significance and measurement.



V. Mineralization processes (C & N mineralization)

- Significance of mineralization processes to guarantee soil fertility
- C mineralization. Soil respiration and its components: definition and measurement
- Microbial indexes: the metabolic and the mineralization quotients: significance and measurement
- N mineralization. Mineralization potential and *in situ* measurements

VI. Soil enzymes

- Definitions and main features. Notes on enzyme kinetics: general infos. Localization and origin of soil enzymes. Classes of soil enzymes. Functions and stability of enzymes in soil. Immobilized enzymes.
- Intra- and extracellular enzymes.
- Determination of enzyme activities by means of different methods : colorimetric and fluorimetric techniques. Specific activities. Real and potential activity.

VII. Drivers of global soils change:

- Natural and anthropogenic pressures (climate changes, land use changes, pollution)
- Threats to soil functions
- Soil degradation, soil loss

VIII. How to plan a monitoring activity

- WWWHWWW scheme.
- Experimental design, sampling schemes.
- How to choose the right indicators. New sets of indicators.
- Presentation of specific case studies in agricultural, forest and urban soils

texts

1) Brady NC, Weil RR, 2016

The nature and properties of soils, XV Ed. (Chapt. 1, 11, 12, 20), XIV Ed.(Chapt. 2, 12, 13, 21) or XIII Ed. (Chapt. 1-11-12-20)(University Library)

2) FAO and ITPS., 2015.

Status of the World's Soil Resources (SWSR) – Main Report. Food and Agriculture Organization of the United Nations and Intergovernmental Technical Panel on Soils, Rome, Italy (selected chapters) (**Dropbox folder**)

3) NERI Technical Report No. 388, 2002

Microorganisms as indicators of soil health,
(Dropbox folder)

4) European Commission - DG ENV, Report 2010

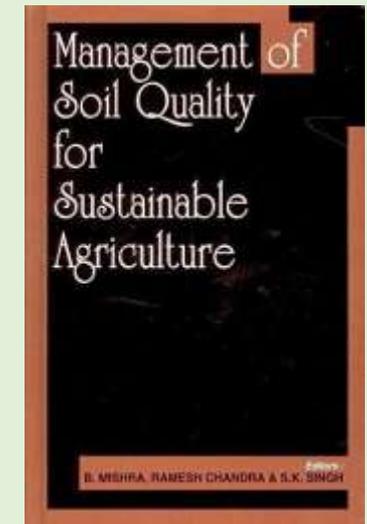
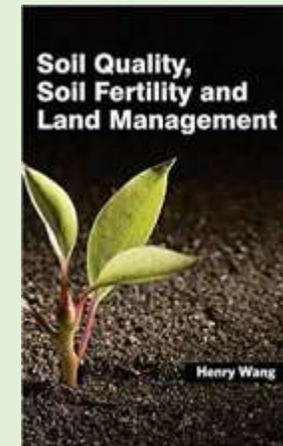
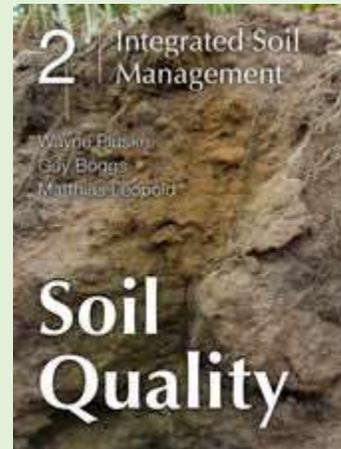
Soil biodiversity: functions, threats and tools for policy makers,
(Dropbox folder)

5) Gardi C., Jeffrey J. , 2009

Soil biodiversity, JRC Scientific and Technical Reports
(Dropbox folder)

5) Shukla G., Varma A., 2011,

Soil enzymology –Springer Verlag
(selected chapters) (Dropbox folder)



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Exam

- Mid term test
- Final oral or written exam

Evaluation criteria:

- 1) knowledge of course contents,
- 2) ability to integrate and critically discuss course contents,
- 3) skill in planning a monitoring activity starting from a case study,
- 4) level of clarity in exposition